# PROJECT MANUAL
# Volume II of II

Divisions 02 – 33

# Carmel Fire Department Inc.
# Addition/Renovation
# 94 Gleneida Ave.
# Carmel, NY 10512

**March 23, 2021**


H2M architects + engineers

*3 LEAR JET LANE, SUITE 205*
*LATHAM, NY 12110*

*PHONE# 518-765-5105*
*FAX# 518-765-5107*


SET NO. _____

# TABLE OF CONTENTS

## DIVISION 00 – BIDDING AND CONTRACT REQUIREMENTS


| Section | Title | Pages |
|---|---|---|
| 001000 | Project Manual Preface | 1 – 2 |
| 001116 | Invitation to Bid | 1 – 1 |
| 002100 | Notice to Bidders | 1 – 3 |
| 004100 | Bid Form | 1 – 5 |
| 005000 | Standard Form of Agreement Between Owner and Contractor AIA – A132-2019 | 1 – 9 |
| | Preferred Contractor List | 1 – 1 |
| | Attachment “A” – Project Manual Enumeration | 1 – 5 |
| | Attachment “B” – Drawing Set Enumeration | 1 – 1 |
| | Attachment “C” – Insurance Requirements | 1 – 3 |
| | Attachment “D” – Milestone Schedule | 1 – 1 |
| 007000 | General Conditions of the Contract for Construction, AIA – A232-2019 | 1 – 37 |


## DIVISION 01 – GENERAL REQUIREMENTS


| Section | Title | Pages |
|---|---|---|
| 010400 | Coordination | 1 – 6 |
| 010600 | Regulatory Requirements and Safety | 1 – 4 |
| 012200 | Unit Prices | 1 – 2 |
| 012300 | Alternate | 1 – 1 |
| 012600 | Contract Modification Procedures | 1 – 4 |
| 012900 | Payment Procedures-Partial Release & Waiver of Lien (AIA G702, G703) | 1 – 9 |
| 013100 | Project Management & Coordination | 1 – 4 |
| 013200 | Construction Progress Documentation | 1 – 5 |
| 013300 | Submittal Procedures | 1 – 8 |
| | Submittal Cover Sheet | 1 - 1 |
| 014000 | Quality Requirements | 1 – 5 |
| 014216 | Definitions | 1 – 3 |
| 014523 | Testing and Inspection Services | 1 – 4 |
| 014523.13 | Special Inspections and Structural Testing | 1 – 9 |
| 015000 | Temporary Facilities and Controls | 1- 12 |
| 015800 | Project Identification | 1 – 2 |
| 016000 | Product Requirements | 1 – 7 |
| 016116 | VOC Content Restrictions – Non LEED | 1 – 1 |
| 017123 | Field Engineering | 1 – 2 |
| 017329 | Cutting and Patching | 1 – 4 |
| 017419 | Construction Waste Management | 1 – 3 |
| 017423 | Cleaning | 1 – 3 |
| 017700 | Closeout Procedures, AIA G706, G706A and Final Waiver of Lien | 1 – 13 |
| 017900 | Demonstration and Training | 1 – 4 |

## DIVISION 02 – EXISTING CONDITIONS


| Section | Title | Pages |
|---|---|---|
| 023200 | Geotechnical Investigations | 1 – 2 |
| | Geotechnical Investigation Report | 1 – 36 |
| 024116 | Selective Demolition | 1 – 8 |


## DIVISION 03 – CONCRETE


| Section | Title | Pages |
|---|---|---|
| 031000 | Concrete Forming and Accessories | 1 – 6 |
| 033000 | Cast-In-Place Concrete | 1 – 13 |
| 033500 | Concrete Finishing | 1 – 4 |
| 034500 | Precast Architectural Concrete | 1 – 6 |
| 034813 | Precast Concrete Bollards | 1 – 3 |
| 036000 | Grouting | 1 – 3 |


## DIVISION 04 – MASONRY


| Section | Title | Pages |
|---|---|---|
| 040513 | Mortar | 1 - 4 |
| 040523 | Masonry Accessories | 1 – 8 |
| 042113 | Brick Masonry | 1 - 12 |
| 042200 | Concrete Unit Masonry | 1 – 9 |
| 042200.11 | Reinforced Unit Masonry | 1 – 4 |
| 042300 | Glass Unit Masonry | 1 – 5 |
| 044300 | Stone Masonry | 1 – 5 |


## DIVISION 05 – METALS


| Section | Title | Pages |
|---|---|---|
| 051200 | Structural Steel Framing | 1 – 12 |
| 052100 | Steel Joist Framing | 1 – 7 |
| 053100 | Steel Decking | 1 – 8 |
| 054000 | Cold-Formed Metal Framing | 1 – 8 |
| 054400 | Cold-Formed Metal Trusses | 1 – 4 |
| 055000 | Metal Fabrications | 1 – 10 |
| 055100 | Metal Stairs, Handrails and Railings | 1 – 8 |
| 055133 | Metal Ladders | 1 – 3 |
| 055516 | Stair Treads and Nosings | 1 – 3 |


## DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES


| Section | Title | Pages |
|---|---|---|
| 061000 | Rough Carpentry | 1 – 8 |
| 061643 | Gypsum Sheathing | 1 – 4 |
| 066000 | Plastic Fabrications | 1 – 4 |


## DIVISION 07 – THERMAL AND MOISTURE PROTECTION


| Section | Title | Pages |
|---|---|---|
| 071116 | Cementitious Waterproofing | 1 – 2 |
| 072113 | Board Insulation | 1 – 4 |

| | | |
|---|---|---|
| 072116 | Blanket Insulation | 1 – 5 |
| 072129 | Spray Foam Insulation | 1 – 5 |
| 072713 | Air Barrier/Vapor Retarder | 1 – 5 |
| 072726 | Fluid-Applied Air and Vapor Barriers | 1 – 6 |
| 073113.11 | Composite Shingles | 1 – 6 |
| 074646 | Fiber Cement Siding | 1 – 5 |
| 075323.11 | Self-Adhering EPDM Roofing System | 1 – 13 |
| 076113 | Standing Seam Sheet Metal Roofing | 1 – 8 |
| 076200 | Sheet Metal Flashing & Trim | 1 – 7 |
| 077123 | Manufactured Gutters & Downspouts | 1 – 4 |
| 077253 | Snow Guards | 1 – 4 |
| 078400 | Firestopping | 1 – 8 |
| 079200 | Sealants | 1 – 9 |

**DIVISION 08 – OPENINGS**

| Section | Title | Pages |
|---|---|---|
| 080671 | Door Hardware Schedule | 1 – 7 |
| 081113 | Hollow Metal Doors & Frames | 1 – 7 |
| 083113 | Access Doors and Frames | 1 – 3 |
| 083613 | Sectional Overhead Doors | 1 – 5 |
| 084113 | Aluminum Framed Entrances and Storefronts | 1 – 7 |
| 085213 | Aluminum Clad Wood Windows | 1 – 7 |
| 087100 | Door Hardware | 1 – 14 |
| 088000 | Glazing | 1 – 10 |
| 088300 | Mirrors | 1 – 4 |
| 089100 | Louvers | 1 – 3 |

**DIVISION 09 – FINISHES**

| Section | Title | Pages |
|---|---|---|
| 090561.13 | Moisture Vapor Emission Control | 1 – 5 |
| 092116 | Gypsum Board Assemblies | 1 – 13 |
| 093013 | Ceramic Tiling | 1 – 7 |
| 095100 | Acoustical Lay-In Ceilings | 1 – 6 |
| 095423 | Linear Metal Ceilings | 1 – 3 |
| 096513 | Resilient Base and Accessories | 1 – 3 |
| 096513.23 | Resilient Stair Treads | 1 – 4 |
| 096519 | Resilient Tile Flooring | 1 – 5 |
| 099100 | Painting | 1 – 11 |

**DIVISION 10 – SPECIALTIES**

| Section | Title | Pages |
|---|---|---|
| 101400 | Signage | 1 – 5 |
| 102813 | Toilet & Miscellaneous Accessories | 1 – 3 |
| 104319 | Emergency Eyewash Station | 1 – 2 |
| 104400 | Fire Protection Specialties | 1 – 2 |
| 105153 | Locker Room Benches | 1 – 2 |
| 107316.13 | Canopies | 1 – 3 |

**DIVISION 11 - EQUIPMENT**

| Section | Title | Pages |
|---|---|---|
| 115223 | TV Mounting Brackets | 1 – 2 |

| | | |
|---|---|---|
| 119600 | Firematic Equipment | 1 – 2 |

**DIVISION 12 – FURNISHINGS**

| Section | Title | Pages |
|---|---|---|
| 123216 | Plastic Laminate Countertops, Shelving and Casework | 1 – 4 |
| 123661 | Quartz Surfacing Countertops and Windowsills | 1 – 5 |
| 124813 | Floor Grates and Frames | 1 – 3 |

**DIVISION 14 – CONVEYING EQUIPMENT**

| Section | Title | Pages |
|---|---|---|
| 142410.13 | Hydraulic Elevators | 1 – 8 |

**DIVISION 21 – FIRE SUPPRESSION**

| Section | Title | Pages |
|---|---|---|
| 210300 | Fire Protection General Conditions | 1 – 13 |
| 210500 | Fire Protection Basic Materials and Methods | 1 – 4 |
| 211300 | Fire Suppression Sprinklers | 1 – 5 |

**DIVISION 22 - PLUMBING**

| Section | Title | Pages |
|---|---|---|
| 220510 | Plumbing General Conditions | 1 – 14 |
| 220511 | Plumbing Demolition | 1 – 2 |
| 220519 | Meters and Gauges for Plumbing Piping | 1 – 2 |
| 220553 | Identification for Plumbing Piping and Equipment | 1 – 2 |
| 220719 | Plumbing Piping Insulation | 1 – 3 |
| 221005 | Plumbing Piping | 1 – 7 |
| 221250 | Natural Gas Piping | 1 – 4 |
| 224000 | Plumbing Fixtures | 1 – 3 |

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

| Section | Title | Pages |
|---|---|---|
| 230500 | Mechanical General Conditions | 1 – 13 |
| 230519 | Meters and Gauges for HVAC Piping | 1 – 1 |
| 230553 | Identification for HVAC Piping and Equipment | 1 – 2 |
| 230593 | Testing, Adjusting, and Balancing for HVAC | 1 – 7 |
| 230713 | Duct Insulation | 1 – 3 |
| 230719 | HVAC Piping Insulation | 1 – 3 |
| 230993 | Sequence of Operations for HVAC Controls | 1 – 2 |
| 232112 | Radiant Heating Hydronic Piping | 1 – 6 |
| 232113 | Hydronic Piping | 1 – 5 |
| 232300 | Refrigerant Piping | 1 – 3 |
| 233100 | HVAC Ducts and Casings | 1 – 3 |
| 233300 | Air Duct Accessories | 1 – 2 |
| 233700 | Air Outlets and Inlets | 1 – 2 |
| 235240 | Condensing Hot Water Boilers | 1 – 4 |
| 238126.13 | Small-Capacity Split-System Air Conditioners | 1 – 3 |

## DIVISION 26 - ELECTRICAL


| Section | Title | Page |
|---|---|---|
| 260502 | Electrical General Conditions | 1 – 8 |
| 260505 | Selective Demolition for Electrical | 1 – 2 |
| 260519 | Low-Voltage Power Conductors & Cables (600 V & Less) | 1 – 9 |
| 260526 | Grounding and Bonding for Electrical Systems | 1 – 6 |
| 260529 | Hangers and Supports for Electrical Systems | 1 – 4 |
| 260533.13 | Conduit for Electrical Systems | 1 – 9 |
| 260533.16 | Boxes for Electrical Systems | 1 – 8 |
| 260553 | Identification for Electrical Systems | 1 – 8 |
| 260573 | Overcurrent Protective Device Coordination and ARC Flash Hazard Analysis | 1 – 4 |
| 260583 | Wiring Connections | 1 – 2 |
| 260923 | Lighting Control Devices | 1 – 8 |
| 262100 | Low-Voltage Electrical Service Entrance | 1 – 4 |
| 262416 | Panelboards | 1 – 9 |
| 262726 | Wiring Devices | 1 – 6 |
| 262813 | Fuses | 1 – 3 |
| 262816.16 | Enclosed Switches | 1 – 4 |
| 262913 | Enclosed Controllers | 1 – 2 |
| 263213 | Engine Generators | 1 – 13 |
| 263600 | Transfer Switches | 1 – 7 |
| 264300 | Surge Protective Devices | 1 – 5 |
| 265100 | Interior Lighting | 1 – 7 |
| 265600 | Exterior Lighting | 1 – 5 |


## DIVISION 28 – ELECTRONIC SAFETY AND SECURITY


| Section | Title | Pages |
|---|---|---|
| 283100 | Fire Detection and Alarm | 1 – 14 |


## DIVISION 31 - EARTHWORK


| Section | Title | Pages |
|---|---|---|
| 311000 | Site Clearing | 1 – 5 |
| 312000 | Earth Moving | 1 – 11 |
| 312333 | Trenching and Backfilling | 1 – 3 |
| 312500 | Erosion and Sediment Control | 1 – 2 |


## DIVISION 32 – EXTERIOR IMPROVEMENTS


| Section | Title | Pages |
|---|---|---|
| 321216 | Asphalt Paving | 1 – 7 |
| 321313 | Cement Concrete Paving | 1 – 13 |
| 323113 | Chain Link Fence | 1 – 6 |
| 329200 | Turfs and Grasses | 1 – 7 |


## DIVISION 33 - UTILITIES


| Section | Title | Pages |
|---|---|---|
| 333000 | Sanitary Sewerage | 1 – 9 |
| 334100 | Storm Utility Drain Piping | 1 – 5 |

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 SUMMARY

A. This section describes a limited soils investigation at the site. The Geotechnical Report is an integral part of the Contract Document.

1.02 SOILS INVESTIGATION REPORT

A. General:
1. A Geotechnical Report attached to this section has been prepared for the site of this Work.

B. Use of Data:
1. This report is available for bidder's information but is not warranty of subsurface conditions.
2. Owner, CM, Civil Engineer and Architect will not be responsible for interpretations or conclusions drawn from the Geotechnical Report by the Contractor.
3. Owner, CM, Civil Engineer and Architect are not responsible for the accuracy and/or completeness of the information given in the Geotechnical Report.
4. Bidders should visit the site and acquaint themselves with existing conditions.
5. Bidders may make their own subsurface investigations at their own cost to satisfy themselves as to site and subsurface conditions. Such investigations may be performed only under time schedules and arrangements approved in advance by the CM, Architect and Owner.

1.03 TERMINOLOGY

A. General:
1. All terms referring to excavation and/or fill should be the same as the terms in Section 31 and the Civil and Structural Documents.
2. Any variation, the terms in Section 31 and Civil Documents shall take precedent.

**END OF SECTION**

**PAGE INTENTIONALLY BLANK**

Tectonic

PRACTICAL SOLUTIONS. EXCEPTIONAL SERVICE.

# GEOTECHNICAL EVALUATION
# PROPOSED TWO STORY APPARATUS BAY EXTENSION
# 94 GLENEIDA AVENUE
# TOWN OF CARMEL, PUTNAM COUNTY, NEW YORK

**Submitted To:**

**Carmel Fire Department**

94 Gleneida Avenue
Carmel, NY 10512

W.O. 9978.01

July 22, 2019

**Submitted By:**

**Tectonic Engineering & Surveying Consultants P.C.**

1279 Route 300, 2nd Floor
Newburgh, NY 12550

(P) 845.567.6656
(F) 845.567.6248

Tectonic
PRACTICAL SOLUTIONS. EXCEPTIONAL SERVICE.

Carmel Fire Department
94 Gleneida Avenue
Carmel, NY 10512

Attention: Mr. Michael Hengel
(Via Email: MHCFD@bestweb.com)

July 22, 2019

**RE: W.O. 9978.01**
**GEOTECHNICAL EVALUATION**
**PROPOSED TWO STORY APPARATUS BAY EXTENSION**
**94 GLENEIDA AVENUE**
**TOWN OF CARMEL, PUTNAM COUNTY, NEW YORK**

Dear Mr. Hengel;

Tectonic Engineering & Surveying Consultants P.C. is pleased to submit this subsurface investigation and geotechnical engineering evaluation for the proposed two-story apparatus bay addition to be constructed at the Carmel Fire Department, located at 94 Gleneida Avenue, in the Town of Carmel, Putnam County, New York. The purpose of this investigation was to evaluate the subsurface conditions at the proposed building site and to develop recommendations for the geotechnical aspects of building foundation design and construction. This report presents our findings and recommendations.

We appreciate this opportunity to assist you with this project. If you have any questions, please do not hesitate to contact the undersigned.

Sincerely,

TECTONIC ENGINEERING & SURVEYING CONSULTANTS P.C.

STATE OF NEW YORK
MARK ANDREW STIER
076154
LICENSED PROFESSIONAL ENGINEER

Mark A. Stier, P.E., PG
Executive Vice President

"G:\Newburgh\Geotechnical\9900\9978.01 Carmel Fire Department\Report\TEC_2018 Cover Letter.docx"

**Newburgh Office**

1279 Route 300 | Newburgh, NY 12550
845.567.6656 Tel | 845.567.8703 Fax

tectonicengineering.com
Equal Opportunity Employer

**GEOTECHNICAL EVALUATION**
**PROPOSED TWO STORY APPARATUS BAY EXTENSION**
**94 GLENEIDA AVENUE**
**TOWN OF CARMEL, PUTNAM COUNTY, NEW YORK**

## TABLE OF CONTENTS


| SECTION | ITEM | PAGE |
|---|---|---|
| 1.0 | INTRODUCTION | 1 |
| 2.0 | SCOPE OF SERVICES | 1 |
| 3.0 | SITE AND PROJECT DESCRIPTIONS | 1 |
| 4.0 | SUBSURFACE INVESTIGATION | 2 |
| 5.0 | LABORATORY TESTING | 3 |
| 6.0 | SUBSURFACE CONDITIONS | 3 |
| | 6.1 Native Soils | 3 |
| | 6.2 Bedrock | 4 |
| | 6.3 Groundwater | 4 |
| 7.0 | SEISMIC SITE COEFFICIENTS AND LIQUEFACTION POTENTIAL | 5 |
| 8.0 | DISCUSSION AND CONCLUSIONS | 5 |
| 9.0 | RECOMMENDATIONS | 6 |
| | 9.1 Shallow Foundations | 6 |
| | 9.2 Mat Foundation | 7 |
| | 9.3 Design for Lateral Loading | 7 |
| | 9.4 Groundwater and Foundation Drainage | 8 |
| | 9.5 Slab-On-Grade Floors | 9 |
| | 9.6 Parking Lot Pavement | 9 |
| 10.0 | EARTHWORK CONSTRUCTION CRITERIA | 10 |
| | 10.1 General Site and Subgrade Preparation | 10 |
| | 10.2 Fill and Backfill Materials | 11 |
| | 10.3 Protection of Subgrades | 12 |
| | 10.4 Excavations and Shoring | 13 |
| 11.0 | CONSTRUCTION MONITORING | 13 |
| 12.0 | LIMITATIONS | 14 |

| | |
|---|---|
| FIGURE I | BORING LOCATION PLAN |
| APPENDIX I | BORING LOGS |
| APPENDIX II | LABORATORY TEST RESULTS |

## 1.0 INTRODUCTION

Tectonic Engineering & Surveying Consultants, P.C. (Tectonic) has completed a subsurface investigation and geotechnical engineering evaluation for the proposed two-story apparatus bay addition to be constructed at the Carmel Fire Department, located at 94 Gleneida Avenue, in the Town of Carmel, Putnam County, New York. The purpose of this investigation was to evaluate the subsurface conditions at the proposed building site and to develop recommendations for the geotechnical aspects of building foundation design and construction. This report presents our findings and recommendations.

## 2.0 SCOPE OF SERVICES

The following services were performed for the Carmel Fire Department, hereafter referred to as the Client.

- Review of preliminary building sketches and site surveys, provided by the Client.
- Drilling, sampling, and logging of seven (7) borings to depths of up to 28 feet below existing grade.
- Field inspection by an engineering geologist working under the purview of a New York State licensed Professional Engineer, to locate the borings; log and classify all soil samples; and record groundwater levels.
- Performance of laboratory testing of soil samples to help in the field classifications and evaluate the engineering characteristics of the soils.
- Geotechnical engineering evaluation of the subsurface conditions and laboratory test results, as they relate to the design and construction of the proposed building addition.
- Preparation of this geotechnical report presenting the results of the performed investigation, laboratory testing, engineering analyses, and our geotechnical recommendations for building foundation design and construction.

## 3.0 SITE AND PROJECT DESCRIPTIONS

The project site is located at 94 Gleneida Avenue (Block 1, Lot 24), in the Town of Carmel, Putnam County, New York. The site currently consists of an existing single-story concrete and block firehouse, with no below grade basement, at the approximate center of the lot. The site is situated on the east side of Gleneida Avenue (Route 52), between Vink and East Drives. The site is bound on the north by a one-story brick structure, on the west by Route 52, on the south by Vink Drive, and by a grass-covered landscaped area, used as a sewer easement, to the east. Based on the topographic survey provided by Joel Greenberg, Architect, dated February 21, 1996, the project site generally slopes downward from the west towards the east, with site elevations ranging from approximately +554 to +534 feet. The survey does not indicate any finished floor elevation for the existing building. The datum referenced by the survey was not specified.

Based upon project documents provided by the Client, it is our understanding that a new two-story apparatus bay and support space addition, with no below grade basement, will be constructed east of the existing firehouse. It is also our understanding that the footprint of the addition will be approximately 80 feet wide, by 89 feet long, with an approximate footprint of 7,100 square feet (sf). Site elevations within the footprint of the apparatus bay addition range from approximately +542 feet on the western end, to +537 feet on the eastern end. The design team provided no finished floor elevation, but did indicate that the new floor will be 1 foot, 9 inches higher than the existing finished floor. Structural loading values were not available at the writing of this report.

## 4.0 SUBSURFACE INVESTIGATION

The subsurface investigation consisted of the drilling, sampling, and logging of seven (7) test borings, designated as B-1 through B-6, and B-6A. Borings B-1 through B-5 were drilled within the footprint of the proposed addition, and borings B-6 and B-6A were drilled in the vicinity of the proposed loading dock. Boring B-6A was offset approximately 3 feet south of boring B-6, after boring B-6 encountered an obstruction at a depth of 10 feet below ground surface (bgs). Boring B-6A was terminated at a depth of 4 feet bgs, as utilities were encountered. The boring locations are shown on the attached Boring Location Plan, Figure 1.

The borings were performed by General Borings, Inc. between June 25 and June 27, 2019, using an truck-mounted, Mobile B-53 drill rig. The borings were advanced to depths of up to 28 feet bgs using 4-inch inside diameter hollow stem augers. Standard Penetration Testing (SPT) and split-spoon sampling was generally performed continuously to a depth of 10 feet and at 5-foot intervals, thereafter, using a safety hammer. SPT sampling was performed in accordance with the requirements of ASTM Standard D1586 *"Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils".* The field SPT N-values were recorded for each penetration test and samples of the soils obtained during the investigation were collected and retained in glass jars. These samples are currently stored at our material testing laboratory. Rock cores were taken in boring B-1, using a 2-inch diameter, double tube, NX-size, diamond core barrels.

An engineering geologist observed the subsurface investigation and prepared logs of the subsurface conditions under the direction of a Professional Engineer licensed in New York State. The materials encountered were classified in accordance with the current New York State Building Code (Code), the Burmister Soil Classification System, and the Unified Soil Classification System (ASTM D2488). Copies of the boring logs are included in Appendix I.

## 5.0 LABORATORY TESTING

Laboratory testing was conducted on samples selected to assist in identifying the soils' engineering properties. The laboratory testing included three (3) soil gradations, performed in general accordance with ASTM D6913, and three (3) Atterberg limits determinations, performed in general accordance with ASTM D4318. The results of the laboratory testing are provided in Appendix II and are included in the soil descriptions presented below.

## 6.0 SUBSURFACE CONDITIONS

The conditions encountered during the subsurface investigation consist primarily of native soils overlying bedrock. The following subsections provide generalized descriptions of the encountered soil and groundwater conditions. Details descriptions of the subsurface conditions are provided in the boring logs included in Appendix I. Based on the sampling method utilized, an energy correction is typically applied to convert the field N-values measured to those of a safety hammer. A safety hammer was used to perform the SPT, so the field N-values are equivalent to the $N_{60}$-values – the standard used for most geotechnical engineering analyses.

### 6.1 Native Soils

The native soils encountered underlying approximately 2 inches of asphalt and 2 inches of gravel subbase in borings B-1, B-3 through B-5, or between 4 and 8 inches of topsoil-like material in borings B-2, B-6 and B-6A consisted predominately of clayey silt, with up to 27 percent coarse-to-fine sand, and up to 15 percent coarse-to-fine gravel. Laboratory testing on the clayey silt show relatively low levels of plasticity, with liquid limits ranging from between 14 and 17, and plasticity indices ranging from between 0 and 3. SPT $N_{60}$-values in the clayey silt ranged from 7 to over 116 bpf, indicating a stiff to hard consistency. It is likely that at least some of the upper soils consist of fill in the form of re-worked native soils; however, due to the composition and density, it is difficult to discern the exact limits. The clayey silt was generally encountered in a stiff to very stiff consistency. The clayey silt has USCS classifications of ML.

A thin layer of coarse-to-fine sand, with up to 35 percent clayey silt and up to 20 percent coarse-to-fine gravel was encountered between approximate elevations of +538.5 and +536.5 feet in boring B-5. The SPT $N_{60}$-value in the sand layer was 49 bpf, indicating a dense condition. The sand has a USCS classification of SM.

It should be noted that the highest N60-values generally occurred at the bottom of the native soil layer, where split spoon refusal occurred on partially weathered rock. Split spoon refusal is generally defined as less than 6 inches of split spoon penetration after 50 blows with the hammer.

### 6.2 Bedrock

Bedrock was cored in boring B-1 from approximately 23 to 28 feet bgs, corresponding to elevations of approximately +516 to +511 feet. Gray, slightly weathered, slightly to moderately fractured, medium grained, hard gneiss was encountered. Recovery (REC) was 50 percent, and the rock quality designation (RQD) was approximately 40 percent, which indicates the quality of the rock mass was in a poor condition. Borings B-2 through B-6 were terminated at auger refusal at elevations ranging from between approximately +521 to +515 feet. Based on the elevations of auger refusal, bedrock likely slopes downwards from the west to the east.

### 6.3 Groundwater

The depth of groundwater was measured inside the hollow-stem augers after the completion of each boring. Based on field measurements, groundwater was generally encountered between 5 to 7 feet bgs. A summary of the groundwater elevations is provided in Table 6.3.1. It is noted that groundwater levels fluctuate seasonally and with changing weather conditions, so groundwater should be anticipated to be encountered at depths other than those observed at other times.

**Table 6.3.1 – Groundwater Summary**

| Boring Location | Surface Elevation (ft) | Groundwater Elevation (ft) |
|---|---|---|
| B-1 | +539.0 | +534.0 |
| B-2 | +540.0 | +535.0 |
| B-3 | +537.0 | +532.0 |
| B-4 | +538.5 | +533.5 |
| B-5 | +541.5 | +534.4 |
| B-6 | +534.0 | +528.0 |
| B-6A | +536.0 | +533.5 |

## 7.0 SEISMIC SITE COEFFICIENTS AND LIQUEFACTION POTENTIAL

As part of our investigation, we have evaluated an appropriate site coefficient for use in seismic design. Based on the results of the subsurface investigation and the criteria outlined in the current edition of the Code, the subsurface conditions underlying the site should be considered Class D, with maximum spectral response accelerations at short periods ($S_{MS}$) equal to 0.357g and at a 1-second period ($S_{M1}$) equal to 0.163g. Based on the procedures outlined in the Code, the corresponding five-percent damped design spectral response acceleration at short periods, $S_{DS}$, is equal to 0.238g, and at a 1-second period, $S_{D1}$, is equal to 0.109g.

Liquefaction of soils can be caused by strong vibratory motion due to earthquakes. Both research and historical data indicate that loose, granular soils saturated by a shallow groundwater table are most susceptible to liquefaction. Liquefaction occurs when an earthquake and associated ground shaking of sufficient duration results in the loss of grain-to-grain contact due to a rapid increase in pore-water pressure, causing the soil to behave as a fluid for short periods. An analysis was performed to evaluate the liquefaction potential in accordance with the Code. A procedure recommended by Youd et. al. (2001) was used in evaluating the liquefaction potential at the site. This method estimates the stresses likely to be induced by an earthquake and the stresses likely to initiate liquefaction using the SPT N-values, the effective overburden pressure, and the peak horizontal ground acceleration caused by the design seismic event. The factors of safety against liquefaction were computed by the ratio of cyclic shear strength of the soil to the cyclic shear stress induced by the seismic event. The liquefaction analysis indicates that the subsurface soils have a factor of safety against liquefaction greater than the generally accepted minimum of 1.1, based on the anticipated earthquake magnitude of 5.51 and the peak horizontal ground acceleration of 0.140g as provided by the United States Geological Survey.

## 8.0 DISCUSSION AND CONCLUSIONS

The proposed construction will consist of a new two-story apparatus bay extension, with no below-grade basement. The site can be generally categorized as being underlain by stiff to very stiff clayey silt soils, with a relatively shallow groundwater table. At the writing of this report, structural loading was not available; however, the apparatus bay will reportedly be used to house vehicles weighing as much as 80,000 pounds. Based on the results of the subsurface investigation and analyses, construction of the proposed addition is feasible from a geotechnical standpoint, provided the recommendations presented in the following sections of this report are incorporate into its design and construction.

The native soils encountered at a depth of approximately 4 feet bgs are considered suitable for supporting conventional shallow foundations. The proposed building can be supported on conventional shallow foundations or a concrete mat foundation. The foundations or mat should be founded on an approved subgrade consisting of the stiff clayey silt soils, or controlled fill.

The following general conclusions can also be made:

- The soils at the site are not expected to be susceptible to liquefaction.
- Groundwater was measured at depths of between 5 and 7 feet bgs. Construction phase dewatering may be required.
- Excavation for the foundations should be feasible with conventional heavy-duty construction equipment.
- Due to their high fines content, the native soils are not suitable for use as controlled fill or as backfill behind walls. All soils proposed for use as controlled fill should be tested and accepted to meet conformance with the Code, and by the geotechnical engineer, prior to use.

## 9.0 RECOMMENDATIONS

The following sub-sections provide our geotechnical recommendations for design and construction of the proposed building foundations. The recommendations are based on our understanding of the proposed construction, the results of the subsurface investigations, and our experience in the general vicinity of the project site.

### 9.1 Shallow Foundations

The proposed apparatus bay addition can be supported on traditional shallow spread footings and/or continuous wall footings that bear on the stiff clayey silt soils, or a granular controlled fill. The foundations can be designed for a maximum net allowable soil bearing pressure of 2 tons per square foot (tsf). Section 10 of this report provides the subgrade preparation procedures necessary to achieve the recommended bearing capacity.

Using the above design criteria, total settlement is estimated to be less than 1-inch and differential settlements are estimated to be less than 0.5-inch. The differential settlement is estimated between columns and over a distance of about 30 feet along continuous footings. Continuous wall footings should have a minimum width of 2 feet and isolated column footings should have a minimal width of 3 feet. Interior foundations should bear at least 2 feet below the finished floor slab elevation within heated

sections of the building. Exterior footings should bear at a depth of at least 4 feet below finished exterior grade, for frost protection.

### 9.2 Mat Foundation

Based on the results of our subsurface investigation and the anticipated loading conditions, the proposed two-story apparatus bay addition can alternatively be supported on a concrete mat foundation. The mat should bear at a minimum depth of 4 feet below grade on the stiff clayey silt soils, or granular controlled fill. The mat should be designed using a maximum net allowable bearing capacity of 2 tons per square foot (tsf). A Winkler spring coefficient of 25 pounds per cubic inch (pci) is recommended for design purposes. A mat foundation constructed to the approximate dimensions of the proposed building is anticipated to settle up to 1 inch. The possible induced settlements of the adjoining buildings should be evaluated based on this anticipated settlement. A value of base sliding coefficient of 0.35 is recommended for the coefficient of sliding resistance. A maximum seasonal high groundwater level of an approximate depth of 5 feet should be used for the purposes of design, based on the results of groundwater observations.

### 9.3 Design for Lateral Loading

Below-grade walls should be designed in accordance with the following criteria:

| Soil Parameter | Controlled Fill | Native Soils |
|---|---|---|
| Angle of Internal Friction | 34° | 30° |
| Active Earth Pressure Coefficient (Ka) [1,2] | 0.28 | 0.33 |
| Passive Earth Pressure Coefficient (Kp) [2,3] | 3.54 | 3.00 |
| At-Rest Earth Pressure Coefficient (Ko) [2,4] | 0.44 | 0.50 |
| Coefficient of Base Friction [5] | 0.50 | 0.35 |
| Unit Weight of Soil (pounds per cubic foot) | 125 | 120 |

1) Use only for freestanding walls, where movement of up to 0.0025 X height of wall is both possible and tolerable. Otherwise, use at-rest coefficient.

2) The coefficients provided assume a level backfill and vertical foundation walls. The coefficients should be re-evaluated for other conditions.

3) Ignore the passive pressure above a depth of 4 feet below exterior grade to account for frost disturbance.

4) Use for walls restrained against lateral movement.

5) Coefficient of base friction applies to mass concrete placed directly against material indicated.

Additional loading due to temporary and permanent surcharges should be added to the lateral loading exerted by the retained soil. Loads due to supported structures should be applied in appropriate combinations with the lateral loads.

Walls should be backfilled in accordance with Section 10.2 of this report. Placement and compaction of backfill should be observed and tested by a geotechnical engineer to monitor that proper compaction is being achieved.

### 9.4 Groundwater and Foundation Drainage

Based on the results of our subsurface investigation, it is not anticipated that groundwater will be encountered during construction of the footings and foundation walls. However, due to the proximity of the groundwater table to the assumed bearing elevation, construction phase dewatering may be required. Damproofing, geocomposite drainage board, and foundations drains should be provided for all foundation walls where the outside grade is higher than the slab elevation. The foundation drains should be connected directly to the storm sewer via a gravity connection, a collector pit and ejector pump, or as otherwise required by the Code. Drains may be installed on the outside of foundation walls, where they are not immediately adjacent to other structures. The pipes should be surrounded by a minimum of one cubic foot of crushed stone per linear foot of pipe and a minimum of 6 inches of crushed stone should extend beneath the interior floor slabs. See Section 10 for recommendations for the crushed stone. Foundation drainage materials should be approved by the geotechnical engineer prior to their inclusion in the project specifications. Moisture barriers should also be installed below the mat foundation, if used. All roof drains should be directed away from the building.

A design groundwater depth of 5 feet should be used for all design and construction of the proposed building. Subsequently, the need for construction dewatering is not anticipated. However, rainwater and surface water may become trapped in excavations. If necessary, dewatering can be performed with sump pumps and should be performed to allow work to be performed in the dry. Any dewatering should prevent loosening or migration of the subgrade soils. The dewatering system, if necessary, should be designed by a New York State licensed Professional Engineer.

### 9.5 Slab-On-Grade Floors

If a mat is not selected, slab-on-grade floors should be supported on a minimum 6-inch thick layer of free draining ½- to ¾-inch crushed stone placed over a proof-rolled and approved subgrade, consisting of native sands or controlled fill placed over a proof-rolled and approved subgrade. Subgrade preparation, controlled fill material and placement recommendations are provided in Section 10 of this report.

A vapor barrier, consisting of a polyethylene membrane at least 20 mils thick, should be placed beneath all moisture sensitive floor slabs. A coefficient of friction of 0.3 should be used between the slab and the vapor barrier. If concrete is cast directly against compacted crushed gravel, a coefficient of friction of 0.45 can be used.

For design of slab-on-grade floors with a 6-inch crushed stone base, a modulus of subgrade reaction of 150 pounds per cubic inch (pci) is recommended. The modulus of subgrade reaction is suitable for estimating distributions of bearing pressure beneath the slab and for estimating bending moments and shears within the slab. It is not intended to be used for calculating total or differential settlements.

### 9.6 Parking Lot Pavement

It is our understanding that the current plan is to construct new asphalt paving sections for the apparatus bay. Tectonic recommends that the existing paved surface be removed, and the site then be graded to the design subgrade elevations. Subgrades consisting of existing soil should be proofrolled under the observation of the project geotechnical engineer, and observed to be firm, stable and unyielding. Subgrade preparation and proofrolling should be performed in accordance with the recommendations provided in Section 10.2 of this report. For this report, the pavement design parameters were estimated by Tectonic for heavy duty traffic. An assumed twenty (25) year design life was used for each pavement section.

A design California Bearing Ratio (CBR) value of 5 was selected for the design of the asphalt pavement section. This CBR was selected based on the soils encountered on the site, and the compacted native soils that will underlie the pavement.

We recommend that the pavement sections consist of the following:

| Table 9.6.1: Asphalt Concrete Pavements | |
|---|---|
| **Pavement Section Type** | **Recommended Section** |
| Heavy Duty | 1.5 inches Top Course HMA (Items 402.095102 or 402.125102)<br>3.5 inches Binder Course HMA (Item 402.195102 or 402.255902)<br>12 inches Type 2 Aggregate Subbase (Item 304.12) |
| Rigid Pavement | 5 inches 4,000 psi Concrete in accordance with Section 500 of NYSDOT Standard Specifications<br>6 inches Type 2 Aggregate Subbase (Item 304.12) |

Note:

1) All Item Numbers are indicated in New York State Department of Transportation Standard Specifications.

Based on the elevations where groundwater was encountered in the borings, it is not anticipated that pavement drains will be required. If, during construction, poor drainage conditions are encountered and pavement drains are deemed necessary, the underdrains should have a positive outlet to the storm drainage system and should be designed and constructed in accordance with Section 605 of the NYSDOT Standard Specifications.

The native glacial till (either undisturbed or reworked) is expected to comprise a significant fraction of the pavement subgrade. These materials are frost heave susceptible due to their high silt content and the relatively shallow groundwater conditions at the site. Subsequently, construction of the pavement section directly onto these soils may shorten the effective life of the pavement and, if it is desired to reduce the impact of frost action, then at least 12 inches of granular structural fill should be placed between the native soils and the aggregate subbase.

## 10.0 EARTHWORK CONSTRUCTION CRITERIA

The following sections present our recommendations regarding earthwork and construction monitoring.

### 10.1 General Site and Subgrade Preparation

Initially, the site should be stripped of all existing plants, topsoil, and debris. Debris from the clearing operations should be removed from the site and disposed of at a legal disposal facility.

All foundation subgrades should be inspected by the geotechnical engineer prior to placement of fill or concrete. Inspection should include observation of proofrolling of the mat foundation subgrade. If soils other than the recommended bearing materials (stiff clayey silt) are encountered or if loose (or otherwise disturbed) soils are identified during proofrolling, they should be removed from the zone of influence of the footing. The zone of influence is defined as 1:1 (horizontal to vertical) planes sloping downward and outward from the bottom edges of the footing. Proofrolling should be performed in open areas using a minimum of 4 passes with a 5-ton sheepsfoot roller. Within areas of limited access, proofrolling should be performed with a double-drum vibratory trench roller with a minimum static weight of 1.5 tons. Excavations to remove unsuitable subgrade materials should be backfilled with compacted controlled fill, as recommended in the following sub-section.

### 10.2 Fill and Backfill Materials

Controlled fill used to raise grade or placed as backfill around the isolated spread footings or the mat foundation and behind foundation walls, should be a well-graded durable granular material. Based on the results of the subsurface investigation, we anticipate that the on-site soils are not expected to be acceptable for use as controlled fill, due to their high fines contents and the presence of debris. A geotechnical engineer should review and approve the use of soils in the field prior to placement.

Controlled fill should consist of clean sand, gravel, crushed stone, crushed gravel, or a mixture of these. In addition, controlled fill should be free of trash, debris, roots, vegetation, organic matter, or other deleterious materials. The fill materials should contain no particles exceeding 4 inches in largest dimension. No more than 30 percent of the material should be retained on the $^{3}/_{4}$-inch sieve. The material passing the $^{3}/_{4}$-inch sieve should contain, by weight, no more than 40 percent passing the No. 100 sieve and no more than 12 percent passing the No. 200 sieve. Fill and backfill material, both on-site and soils imported to the site, should be free of trash, debris, roots, vegetation or other deleterious materials. Recycled concrete aggregate, provided that it is free from organic and other deleterious materials, may be used as controlled fill.

Controlled fill and backfill should be compacted to at least 95 percent of the maximum dry density, at a near optimum moisture content (±2 percent), as determined by ASTM D1557. The lift thickness for the soils will vary depending on the type of compaction equipment used. Fills should generally be placed in uniform horizontal lifts not exceeding 8 inches in loose thickness when compacted with heavy

compaction equipment. In confined areas, the loose lift thickness should be reduced to 4 inches, or less, and each lift should be compacted with sufficient passes of hand operated vibratory or impact compaction equipment. Compaction within 5 feet of foundation walls should only be done with hand-operated equipment. A geotechnical engineer with appropriate field and laboratory support should inspect all subgrades, approve materials for use as controlled fill, and test backfill materials for compliance with the recommended compaction.

Free draining crushed stone, placed as drainage materials around mat foundation drains should be Underdrain Filter Type I material, as specified in the New York State Department of Transportation Standard Specifications, and as follows:

| Sieve Size | Percent Finer by Weight |
|---|---|
| 1 inch | 100 |
| 1/2 inch | 30 - 100 |
| 1/4 inch | 0 - 30 |
| No. 4 | 0 - 10 |
| No. 8 | 0 – 5 |

### 10.3 Protection of Subgrades

Subgrades should be protected from the effects of frost, construction traffic, perched groundwater, surface water and precipitation. The necessary protection should be provided as soon after approval by the geotechnical engineer as is practicable and should be maintained until coverage with compacted fill or concrete. It is recommended that temporary surface drainage measures be installed to divert runoff away from the proposed construction limits.

Based on the depths of groundwater encountered during the subsurface investigation, it is anticipated that construction phase dewatering may be required. Dewatering should be performed in a manner that will prevent loosening or migration of the subgrade soils. Given the presence of native sands with a relatively high content of fines, and clayey silt at the anticipated bearing elevation, it is anticipated that it may be difficult to adequately dewater the native soils using standard sump pumps and pits. It may be necessary to use other means of dewatering that will be suitable for dewatering the fine soils at subgrade depths, such as jet injections, or well points. The operation of sumps directly in the footing excavations should not be allowed. Sump pits, if installed, should be placed at least 1-foot outside of foundation excavations for every foot below the foundation subgrade elevation that they are excavated. The dewatering system should be

designed by a New York State Licensed Professional Engineer, and it should be designed to ensure that dewatering does not results in any loss of soil.

If maintaining subgrade stabilization during periods of wet weather is a concern, crushed stone may be placed on footing and/or floor subgrades after excavation and proofrolling. The crushed stone should be clean ½ to ¾ inch gravel, stone, or recycled concrete, and should not exceed 6 inches in thickness.

### 10.4 Excavations and Shoring

Temporary excavation slopes should conform to the latest OSHA standards, including slopes permitted for specified heights and soil conditions encountered. Based on the boring and test pit data, the existing on-site soils should be considered Type C soils, per the OSHA standards. The presence of perched water, or other deleterious materials could require flatter slopes or temporary excavation support (e.g., shoring and bracing). Excavation support may also be necessary in areas where sufficient distance to provide adequate benching of slopes is not available.

Excavations into the native soils should be feasible using heavy-duty construction equipment (i.e. hydraulic excavators). Design of all excavation slopes greater than a 4-foot depth and design of sheeting, shoring, and bracing should be performed by a New York State licensed Professional Engineer. Adequate surface-water runoff control should be provided to avoid instability and caving of soils.

## 11.0 CONSTRUCTION MONITORING

A geotechnical engineer familiar with the existing subsurface conditions and having the appropriate laboratory and field testing support should be engaged by the owner to observe that all earthwork is performed in accordance with the specifications, the Code, and the criteria provided in this report. As a minimum the following work should be performed under the observation of the geotechnical engineer:

- Subgrade preparation
- Proofrolling
- Remedial removals of unsuitable soils
- Placement and compaction of backfill materials
- Dewatering, if required.

All materials proposed for use as soil fill should be tested and approved prior to delivery to the site. Additionally, all fill materials should be tested as they are being placed to verify that the required compaction is achieved. We further recommend that the project plans and specifications be reviewed by the geotechnical consultant prior to completion of the bid documents. It should be noted that upon review of those documents, some recommendations presented herein may be revised or modified.

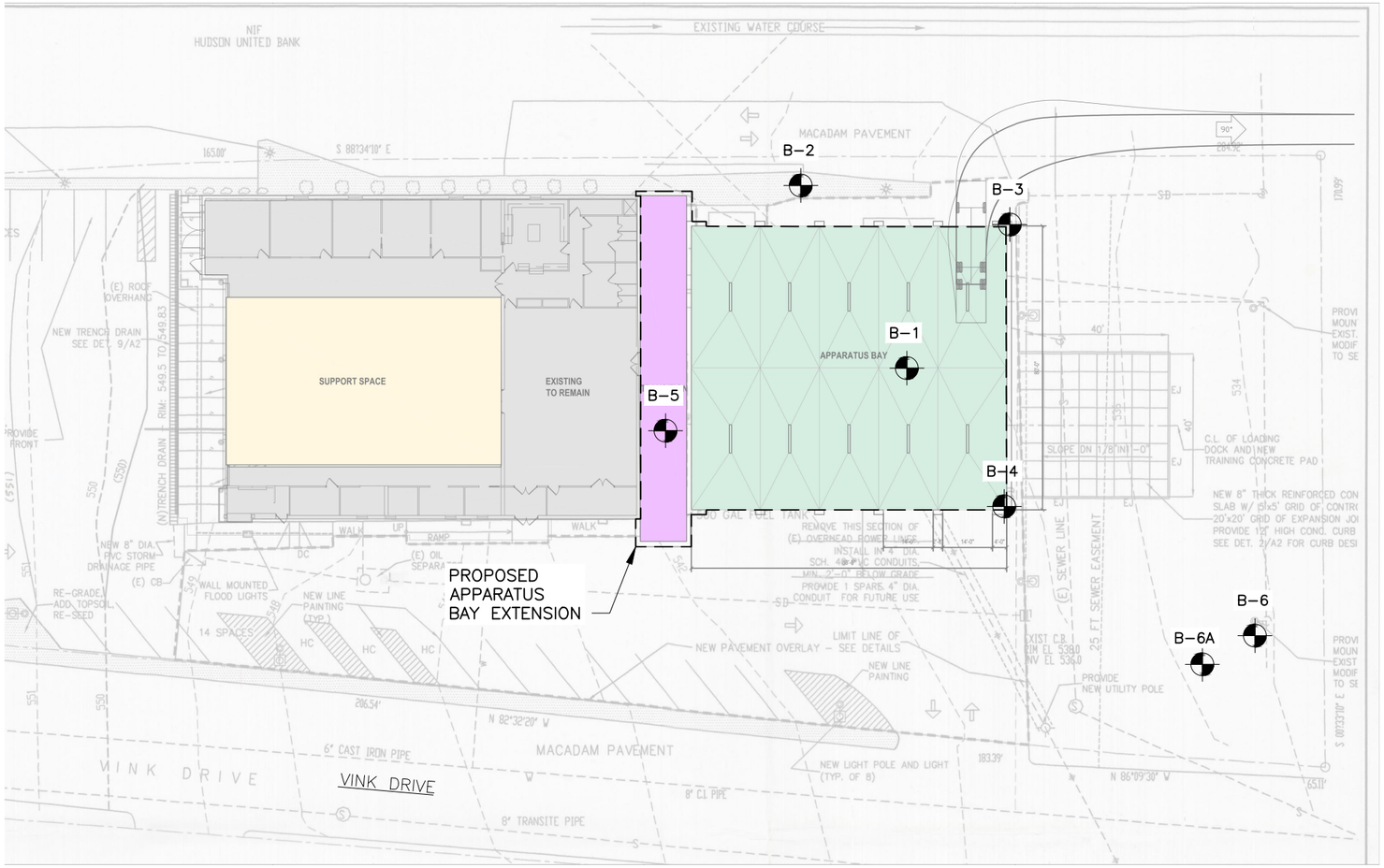
## 12.0 LIMITATIONS

Our professional services have been performed using that degree of care and skill ordinarily exercised under similar circumstances by reputable geotechnical engineers and geologists practicing in this or similar situations. The interpretation of the field data is based on good judgment and experience. However, no matter how qualified the geotechnical engineer or detailed the investigation, subsurface conditions cannot always be predicted beyond the points of actual sampling and testing. No other warranty, expressed or implied, is made as to the professional advice included in this report.

The recommendations contained in this report are intended for design purposes only. This report only addresses the design and construction of the proposed new two-story apparatus bay extension to be constructed at 94 Gleneida Avenue, in the Town of Carmel, Putnam County, New York. Contractors and others involved in the construction of this project are advised to make an independent assessment of the soil, bedrock and groundwater conditions for the purpose of establishing quantities, schedules and construction techniques.

This report has been prepared for the exclusive use of the Carmel Fire Department for the specific application to the proposed building construction noted above. We recommend that prior to construction, Tectonic Engineering & Surveying Consultants P.C. (Tectonic) review the project plans and specifications. It should be noted that upon review of those documents, some recommendations presented herein might be revised or modified. In the event that any changes in the design or location of the proposed structures are planned, Tectonic shall not consider the conclusions and recommendations contained in this report valid unless reviewed and verified in writing. It is further recommended that Tectonic be retained to provide construction monitoring and inspection services to ensure proper implementation of the recommendations contained herein, which would otherwise limit our professional liability.

FIGURE I



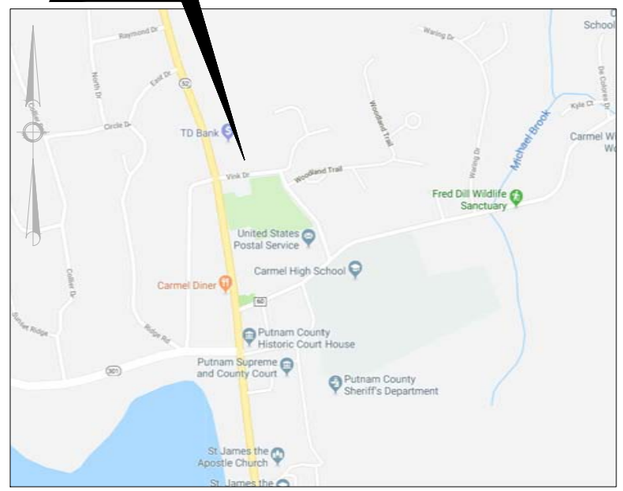

# LEGEND

B-1 APPROXIMATE BORING LOCATION

# NOTES

1. PLAN BASED ON A DRAWING BY H2M ARCHITECTS + ENGINEERS, DATED APRIL 2019.
2. BORING LOCATIONS WERE FIELD LOCATED BY TECTONIC AND SHOULD BE CONSIDERED APPROXIMATE.

*SITE*




0 1 2 3

ORIGINAL SIZE IN INCHES


Tectonic
PRACTICAL SOLUTIONS. EXCEPTIONAL SERVICE.
Tectonic Engineering & Surveying Consultants P.C.
70 Pleasant Hill Road
P.O. Box 37
Mountainville, NY 10953
Phone: (845) 534-5959
(800) 829-6531
www.tectonicengineering.com
*Project Contact Info*
1279 Route 300
Newburgh, NY 12550
Phone: (845) 567-6656


BORING LOCATION PLAN

CARMEL FIRE DEPARTMENT EXTENSION
94 GLENEIDA AVENUE, TOWN OF CARMEL
PUTNAM COUNTY, NEW YORK

| Date | Work Order | Drawing No. | Rev |
|---|---|---|---|
| 7/3/19 | 9978.01 | FIGURE 1 | 0 |
| Scale 1" = 40' | | | |

# APPENDIX I

Tectonic

PROJECT No. **9978.01**
PROJECT: **Carmel Fire Department**
LOCATION: **Carmel, NY**

# BORING No. B-1

SHEET No. 1 of 2

CLIENT: **Carmel Fire Department**
CONTRACTOR: **General Borings, Inc.**
METHOD OF ADVANCING BORING | DIA. | DEPTH
POWER AUGER: | **4"** | **0** TO **23'**
ROT. DRILL: | | TO
CASING: | | TO
DIAMOND CORE: | **2"** | **23** TO **28'**
Mobile B-53 Truck Mounted Drill Rig with Safety Hammer

GROUND WATER | DATE | TIME | DEPTH
**6/25/19** | **9:00 am** | **5'**

MON. WELL ☐ YES ☒ NO
SCREEN DEPTH: **---** TO **---**
WEATHER: **Clear** TEMP: **90° F**
DEPTH TO ROCK: **23'**
*CHANGES IN STRATA ARE INFERRED

INSPECTOR: **Michael Bastien**
DRILLER: **Tom McGovern**
SURFACE ELEVATION: **539.0**
DATUM: **See Remarks**
DATE START: **6/25/19**
DATE FINISH: **6/26/19**

UNCONFINED COMPRESS. STRENGTH (TONS/FT) ● 1 2 3 4 5
PLASTIC LIMIT % | WATER CONTENT % | LIQUID LIMIT % ✕ ⊗ △ 10 20 30 40 50
STANDARD PENETRATION (BLOWS/FT.) ● 10 20 30 40 50

| DEPTH (FT.) | N OR MIN./FT. | PENETRATION RESISTANCE (BL/6 IN.) | SAMPLES: SAMPLE NUMBER | RECOV. LENGTH (IN.) | RECOV. RQD (%) | MOISTURE | UNIFIED SOIL CLASS. | DESCRIPTION OF MATERIAL | LITHOLOGY* | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 24 | 7, 13, 11, 10 | S-1 | 18 | | M | ML | 2" Asphalt, 2" gravel subbase<br>Tn-bwn SILT, some c-f Sand, little f Gravel | | |
| 3 | 28 | 11, 12, 16, 22 | S-2 | 20 | | M | ML | Tn-bwn CLAYEY SILT, some c-f Sand, little c-f Gravel | | |
| 5 | 21 | 5, 9, 12, 5 | S-3 | 18 | | W | ML | Tn-bwn CLAYEY SILT, some c-f Sand, little c-f Gravel | | 534.0 |
| 7 | 17 | 7, 7, 10, 8 | S-4 | 6 | | W | ML | Tn-bwn SILTY CLAY, some c-f Sand, little c-f Gravel | | |
| 9 | 15 | 3, 6, 9, 9 | S-5 | 16 | | W | ML | Same | | 529.0 |
| 16 | 55 | 15, 21, 34, 34 | S-6 | 6 | | W | ML | Tn-bwn CLAYEY SILT, some c-f Sand, little c-f Gravel | | 524.0 |
| 20 | 60+ | 60/5 | S-7 | 2 | | M | ML | Gy CLAYEY SILT, some c-f Sand, little c-f Gravel | | 519.0 |
| | | | | | | | | | | 514.0 |

REMARKS: Surface elevations estimated based on topographic survey provided by Joel Greenburg, Architect, dated 2/21/1996.

BORING LOG 9978.01.GPJ TECTONIC ENG.GDT 7/17/19

Tectonic

PROJECT No. **9978.01**

PROJECT: **Carmel Fire Department**

LOCATION: **Carmel, NY**

# BORING No. B-1

SHEET No. 2 of 2

CLIENT: **Carmel Fire Department**

CONTRACTOR: **General Borings, Inc.**

| DEPTH (FT.) | N OR MIN./FT. | PENETRATION RESISTANCE (BL/6 IN.) | SAMPLES: SAMPLE NUMBER | SAMPLES: RECOV. LENGTH (IN.) | SAMPLES: RECOV. RQD (%) | SAMPLES: MOISTURE | UNIFIED SOIL CLASS. | DESCRIPTION OF MATERIAL | LITHOLOGY* | UNCONFINED COMPRESS. STRENGTH (TONS/FT) 1 2 3 4 5 / PLASTIC LIMIT % / WATER CONTENT % / LIQUID LIMIT % 10 20 30 40 50 / STANDARD PENETRATION (BLOWS/FT.) 10 20 30 40 50 | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 26 | | | C-1 | 30 | 40 | | | Gy, slightly weathered, slightly to moderately fractured, medium grained, hard GNEISS | | | |
| 27 | | | | | | | | | | | |
| 28 | | | | | | | | | | | |
| 29 | | | | | | | | End of Boring at 28' | | | |
| 30 | | | | | | | | | | | 509.0 |
| 31 | | | | | | | | | | | |
| 32 | | | | | | | | | | | |
| 33 | | | | | | | | | | | |
| 34 | | | | | | | | | | | |
| 35 | | | | | | | | | | | 504.0 |
| 36 | | | | | | | | | | | |
| 37 | | | | | | | | | | | |
| 38 | | | | | | | | | | | |
| 39 | | | | | | | | | | | |
| 40 | | | | | | | | | | | 499.0 |
| 41 | | | | | | | | | | | |
| 42 | | | | | | | | | | | |
| 43 | | | | | | | | | | | |
| 44 | | | | | | | | | | | |
| 45 | | | | | | | | | | | 494.0 |
| 46 | | | | | | | | | | | |
| 47 | | | | | | | | | | | |
| 48 | | | | | | | | | | | |
| 49 | | | | | | | | | | | |
| 50 | | | | | | | | | | | 489.0 |
| 51 | | | | | | | | | | | |
| 52 | | | | | | | | | | | |
| 53 | | | | | | | | | | | |
| 54 | | | | | | | | | | | |
| 55 | | | | | | | | | | | 484.0 |

REMARKS: Surface elevations estimated based on topographic survey provided by Joel Greenburg, Architect, dated 2/21/1996.

BORING LOG 9978.01.GPJ TECTONIC ENG.GDT 7/17/19

Tectonic

PROJECT No. **9978.01**
PROJECT: **Carmel Fire Department**
LOCATION: **Carmel, NY**

# BORING No. B-2

SHEET No. 1 of 2

CLIENT: **Carmel Fire Department**
CONTRACTOR: **General Borings, Inc.**
METHOD OF ADVANCING BORING | DIA. | DEPTH
POWER AUGER: | **4"** | **0** TO **25'**
ROT. DRILL: | | TO
CASING: | | TO
DIAMOND CORE: | | TO
Mobile B-53 Truck Mounted Drill Rig with Safety Hammer

GROUND WATER

| DATE | TIME | DEPTH |
|---|---|---|
| **6/26/19** | **12:00 pm** | **5'** |

MON. WELL ☐ YES ☒ NO
SCREEN DEPTH: **---** TO **---**
WEATHER: **Clear** TEMP: **90° F**
DEPTH TO ROCK: **Not Encountered'**
*CHANGES IN STRATA ARE INFERRED

INSPECTOR: **Michael Bastien**
DRILLER: **Tom McGovern**
SURFACE ELEVATION: **540.0**
DATUM: **See Remarks**
DATE START: **6/26/19**
DATE FINISH: **6/26/19**

UNCONFINED COMPRESS. STRENGTH (TONS/FT) ● 1 2 3 4 5
PLASTIC LIMIT % | WATER CONTENT % | LIQUID LIMIT % 10 20 30 40 50
STANDARD PENETRATION (BLOWS/FT.) ● 10 20 30 40 50

| DEPTH (FT.) | N OR MIN./FT. | PENETRATION RESISTANCE (BL/6 IN.) | SAMPLES: SAMPLE NUMBER | RECOV. LENGTH (IN.) | RECOV. RQD (%) | MOISTURE | UNIFIED SOIL CLASS. | DESCRIPTION OF MATERIAL | LITHOLOGY* | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 7 | 1 2 5 8 | S-1 | 16 | | M | ML | 4" Topsoil like material<br>Bwn CLAYEY SILT, some c-f Sand, little c-f Gravel | | |
| 3 | 25 | 8 12 13 13 | S-2 | 18 | | M | ML | Tn-bwn SILT, some c-f Sand, little c-f Gravel | | |
| 5 | 17 | 4 7 10 6 | S-3 | 14 | | W | ML | Same ▼ | | 535.0 |
| 7 | 13 | 9 7 6 18 | S-4 | 14 | | W | ML | Tn-bwn CLAYEY SILT, some c-f Sand, little c-f Gravel | | |
| 9 | 13 | 2 7 6 7 | S-5 | 14 | | W | ML | Same | | |
| 10 | | | | | | | | | | 530.0 |
| 15 | | | | | | | | | | 525.0 |
| 16 | 79.4 | 21 63 16.4 | S-6 | 2 | | W | ML | Bwn-gy CLAYEY SILT, some c-f Sand, some c-f Gravel | | 79.4 |
| 20 | | | | | | | | | | 520.0 |
| 21 | 85+ | 42 85/5 | S-7 | 12 | | W | ML | Gy CLAYEY SILT, some c-f Sand, trace f Gravel | | 85 |
| 25 | | | | | | | | | | 515.0 |

REMARKS: Surface elevations estimated based on topographic survey provided by Joel Greenburg, Architect, dated 2/21/1996.

BORING LOG 9978.01.GPJ TECTONIC ENG.GDT 7/17/19

Tectonic

PROJECT No. **9978.01**

PROJECT: **Carmel Fire Department**

LOCATION: **Carmel, NY**

# BORING No. B-2

SHEET No. 2 of 2

CLIENT: **Carmel Fire Department**

CONTRACTOR: **General Borings, Inc.**

| DEPTH (FT.) | N OR MIN./FT. | PENETRATION RESISTANCE (BL/6 IN.) | SAMPLES: SAMPLE NUMBER | SAMPLES: RECOV. LENGTH (IN.) | SAMPLES: RECOV. RQD (%) | SAMPLES: MOISTURE | UNIFIED SOIL CLASS. | DESCRIPTION OF MATERIAL | LITHOLOGY* | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|
| 26 | 75+ | 71<br>75 | S-8 | 12 | | M | ML | Gy CLAYEY SILT, some c-f Sand, little c-f Gravel | | |
| 27 | | | | | | | | End of Boring at 26' | | |
| 30 | | | | | | | | | | 510.0 |
| 35 | | | | | | | | | | 505.0 |
| 40 | | | | | | | | | | 500.0 |
| 45 | | | | | | | | | | 495.0 |
| 50 | | | | | | | | | | 490.0 |
| 55 | | | | | | | | | | 485.0 |

UNCONFINED COMPRESS. STRENGTH (TONS/FT)
1 2 3 4 5

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT %
10 20 30 40 50

STANDARD PENETRATION (BLOWS/FT.)
10 20 30 40 50

REMARKS: Surface elevations estimated based on topographic survey provided by Joel Greenburg, Architect, dated 2/21/1996.

BORING LOG 9978.01.GPJ TECTONIC ENG.GDT 7/17/19

# BORING No. B-3

Tectonic

| | |
|---|---|
| PROJECT No. | **9978.01** |
| PROJECT: | **Carmel Fire Department** |
| LOCATION: | **Carmel, NY** |

SHEET No. 1 of 1

| | | | | | |
|---|---|---|---|---|---|
| CLIENT: **Carmel Fire Department** | GROUND WATER | DATE | TIME | DEPTH | INSPECTOR: **Michael Bastien** |
| CONTRACTOR: **General Borings, Inc.** | | **6/26/19** | **2:30 pm** | **5'** | DRILLER: **Tom McGovern** |
| METHOD OF ADVANCING BORING / DIA. / DEPTH | | | | | SURFACE ELEVATION: **537.0** |
| POWER AUGER: **4"** **0** TO **15'** | MON. WELL ☐ YES ☒ NO | | | | DATUM: **See Remarks** |
| ROT. DRILL: **2 5/8"** **0** TO **20'** | SCREEN DEPTH: **---** TO **---** | | | | DATE START: **6/26/19** |
| CASING: TO | WEATHER: **Clear** TEMP: **90° F** | | | | DATE FINISH: **6/26/19** |
| DIAMOND CORE: TO | DEPTH TO ROCK: **---** | | | | |
| Mobile B-53 Truck Mounted Drill Rig with Safety Hammer | *CHANGES IN STRATA ARE INFERRED | | | | |

UNCONFINED COMPRESS. STRENGTH (TONS/FT) ● 1 2 3 4 5

PLASTIC LIMIT % ✕ WATER CONTENT % ⊗ LIQUID LIMIT % △ 10 20 30 40 50

STANDARD PENETRATION (BLOWS/FT.) ● 10 20 30 40 50

| DEPTH (FT.) | N OR MIN./FT. | PENETRATION RESISTANCE (BL/6 IN.) | SAMPLE NUMBER | RECOV. LENGTH (IN.) | RECOV. RQD (%) | MOISTURE | UNIFIED SOIL CLASS. | DESCRIPTION OF MATERIAL | LITHOLOGY* | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15 | 5 9 6 9 | S-1 | 20 | | M | ML | 2" Asphalt, 2" gravel subbase<br>Bwn CLAYEY SILT, little c-f Sand, little c-f Gravel | | |
| 3 | 16 | 9 7 9 9 | S-2 | 16 | | M | ML | Bwn-tn SILT, and c-f Sand, little c-f Gravel | | |
| 5 | 32 | 4 8 24 11 | S-3 | 12 | | W | ML | Same | | 532.0 |
| 7 | 20 | 13 8 12 20 | S-4 | 18 | | W | ML | Bwn CLAYEY SILT, some c-f Sand, little c-f Gravel | | |
| 9 | 25 | 6 7 18 57 | S-5 | 14 | | W | ML | Bwn CLAYEY SILT, some c-f Sand, little c-f Gravel | | 527.0 |
| 15 | | | | | | | | | | 522.0 |
| 16 | 49 | 18 20 29 57 | S-6 | 16 | | W | ML | Bwn CLAYEY SILT, some c-f Sand, little c-f Gravel | | |
| 20 | | | | | | | | | | 517.0 |
| 21 | 82.3 | 57 61 21.3 | S-7 | 8 | | W | ML | Same | | 82.3 |
| 22 | | | | | | | | End of Boring at 21.3' | | |
| 25 | | | | | | | | | | 512.0 |

REMARKS: Surface elevations estimated based on topographic survey provided by Joel Greenburg, Architect, dated 2/21/1996.

BORING LOG 9978.01.GPJ TECTONIC ENG.GDT 7/17/19

# Tectonic

# BORING No. B-4

PROJECT No. **9978.01**
PROJECT: **Carmel Fire Department**
LOCATION: **Carmel, NY**
SHEET No. 1 of 1

CLIENT: **Carmel Fire Department**
CONTRACTOR: **General Borings, Inc.**
METHOD OF ADVANCING BORING | DIA. | DEPTH
POWER AUGER: | **4"** | **0** TO **2'**
ROT. DRILL: | | TO
CASING: | | TO
DIAMOND CORE: | | TO
Mobile B-53 Truck Mounted Drill Rig with Safety Hammer

GROUND WATER | DATE | TIME | DEPTH
**6/27/19** | **8:00 am** | **5'**

MON. WELL ☐ YES ☒ NO
SCREEN DEPTH: **---** TO **---**
WEATHER: **Clear** TEMP: **90° F**
DEPTH TO ROCK: **---**
*CHANGES IN STRATA ARE INFERRED

INSPECTOR: **Michael Bastien**
DRILLER: **Tom McGovern**
SURFACE ELEVATION: **538.5**
DATUM: **See Remarks**
DATE START: **6/27/19**
DATE FINISH: **6/27/19**

UNCONFINED COMPRESS. STRENGTH (TONS/FT) ● 1 2 3 4 5
PLASTIC LIMIT % | WATER CONTENT % | LIQUID LIMIT % ✕ ⊗ △ 10 20 30 40 50
STANDARD PENETRATION (BLOWS/FT.) ● 10 20 30 40 50

| DEPTH (FT.) | N OR MIN./FT. | PENETRATION RESISTANCE (BL/6 IN.) | SAMPLE NUMBER | RECOV. LENGTH (IN.) | RECOV. RQD (%) | MOISTURE | UNIFIED SOIL CLASS. | DESCRIPTION OF MATERIAL | LITHOLOGY* | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 18 | 9 9 9 16 | S-1 | 14 | | M | ML | 2" Asphalt, 2" gravel subbase<br>Bwn CLAYEY SILT, some c-f Sand, little c-f Gravel | | |
| 3 | 22 | 14 12 10 13 | S-2 | 14 | | M | ML | Same | | |
| 5 | 14 | 5 7 7 4 | S-3 | 16 | | W | ML | Bwn SILT, some c-f Sand, little c-f Gravel ▼ | | 533.5 |
| 7 | 10 | 3 5 5 5 | S-4 | 14 | | W | ML | Same | | |
| 9 | 42 | 4 18 24 33 | S-5 | 16 | | W | ML | Bwn CLAYEY SILT, some c-f Sand, little c-f Gravel | | 528.5 |
| 16 | 71 | 15 16 55 56 | S-6 | 16 | | W | ML | Bwn CLAYEY SILT, little c-f Sand, little c-f Gravel | | 523.5 |
| 21 | 99 | 19 39 60 69 | S-7 | 16 | | W | ML | Bwn CLAYEY SILT, little c-f Sand, little c-f Gravel | | 518.5 |
| 25 | | | | | | | | End of Boring at 22' | | 513.5 |

REMARKS: Surface elevations estimated based on topographic survey provided by Joel Greenburg, Architect, dated 2/21/1996.

BORING LOG 9978.01.GPJ TECTONIC ENG.GDT 7/17/19

Tectonic

PROJECT No. **9978.01**
PROJECT: **Carmel Fire Department**
LOCATION: **Carmel, NY**

# BORING No. B-5

SHEET No. 1 of 1

CLIENT: **Carmel Fire Department**
CONTRACTOR: **General Borings, Inc.**
METHOD OF ADVANCING BORING | DIA. | DEPTH
POWER AUGER: | **4"** | **0** TO **20'**
ROT. DRILL: | | TO
CASING: | | TO
DIAMOND CORE: | | TO
Mobile B-53 Truck Mounted Drill Rig with Safety Hammer

GROUND WATER | DATE | TIME | DEPTH
**6/27/19** | **10:00 am** | **7'**

MON. WELL ☐ YES ☒ NO
SCREEN DEPTH: **---** TO **---**
WEATHER: **Clear** TEMP: **90° F**
DEPTH TO ROCK: **20'**
*CHANGES IN STRATA ARE INFERRED

INSPECTOR: **Michael Bastien**
DRILLER: **Tom McGovern**
SURFACE ELEVATION: **541.5**
DATUM: **See Remarks**
DATE START: **6/27/19**
DATE FINISH: **6/27/19**

UNCONFINED COMPRESS. STRENGTH (TONS/FT) ● 1 2 3 4 5
PLASTIC LIMIT % × — WATER CONTENT % ⊗ — LIQUID LIMIT % △ 10 20 30 40 50
STANDARD PENETRATION (BLOWS/FT.) ● 10 20 30 40 50

| DEPTH (FT.) | N OR MIN./FT. | PENETRATION RESISTANCE (BL/6 IN.) | SAMPLES: SAMPLE NUMBER | RECOV. LENGTH (IN.) | RECOV. RQD (%) | MOISTURE | UNIFIED SOIL CLASS. | DESCRIPTION OF MATERIAL | LITHOLOGY* | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | 2" Asphalt, 2" gravel subbase<br>Drilled to 1' | | |
| 2 | 22 | 4<br>7<br>15<br>14 | S-1 | 12 | | M | ML | Bwn SILT, some c-f Sand, little c-f Gravel | | |
| 3 | | | | | | | | | | |
| 4 | 49 | 16<br>12<br>37<br>29 | S-2 | 8 | | M | SM | Blk-bwn-tn c-f SAND, some Clayey Silt, little c-f Gravel | | |
| 5 | | | | | | | | | | 536.5 |
| 6 | 11 | 6<br>5<br>6<br>7 | S-3 | 2 | | M | ML | Bwn-blk CLAYEY SILT, little c-f Sand, trace f Gravel | | |
| 7 | | | | | | | | | ▼ | |
| 8 | 15 | 5<br>6<br>9<br>21 | S-4 | 5 | | W | ML | Bwn CLAYEY SILT, little c-f Sand, trace m-f Gravel | | |
| 9 | | | | | | | | | | |
| 10 | 20 | 5<br>11<br>9<br>15 | S-5 | 16 | | W | ML | Bwn CLAYEY SILT, some c-f Sand, little c-f Gravel | | 531.5 |
| 11 | | | | | | | | | | |
| 12 | | | | | | | | | | |
| 13 | | | | | | | | | | |
| 14 | | | | | | | | | | |
| 15 | | | | | | | | | | 526.5 |
| 16 | 72 | 14<br>20<br>52<br>88 | S-6 | 20 | | W | ML | Bwn CLAYEY SILT, some c-f Sand, little c-f Gravel | | 72 |
| 17 | | | | | | | | | | |
| 18 | | | | | | | | | | |
| 19 | | | | | | | | | | |
| 20 | 100+ | 100/2 | S-7 | 1 | | W | GW | Gy c-f GRAVEL, some c-f Sand, likely rock debris | | 521.5<br>100 |
| 21 | | | | | | | | | | |
| 22 | | | | | | | | End of Boring at 20.2' | | |
| 23 | | | | | | | | | | |
| 24 | | | | | | | | | | |
| 25 | | | | | | | | | | 516.5 |

REMARKS: Surface elevations estimated based on topographic survey provided by Joel Greenburg, Architect, dated 2/21/1996.

BORING LOG 9978.01.GPJ TECTONIC ENG.GDT 7/17/19

Tectonic

PROJECT No. **9978.01**
PROJECT: **Carmel Fire Department**
LOCATION: **Carmel, NY**

# BORING No. B-6

SHEET No. 1 of 1

CLIENT: **Carmel Fire Department**
CONTRACTOR: **General Borings, Inc.**
METHOD OF ADVANCING BORING | DIA. | DEPTH
POWER AUGER: | **4"** | **0** TO **10.8'**
ROT. DRILL: | | TO
CASING: | | TO
DIAMOND CORE: | | TO
Mobile B-53 Truck Mounted Drill Rig with Safety Hammer

GROUND WATER

| DATE | TIME | DEPTH |
|---|---|---|
| **6/27/19** | **11:00 am** | **NE** |

MON. WELL ☐ YES ☒ NO
SCREEN DEPTH: **---** TO **---**
WEATHER: **Clear** TEMP: **90° F**
DEPTH TO ROCK: **---**
*CHANGES IN STRATA ARE INFERRED

INSPECTOR: **Michael Bastien**
DRILLER: **Tom McGovern**
SURFACE ELEVATION: **534.0**
DATUM: **See Remarks**
DATE START: **6/27/19**
DATE FINISH: **6/27/19**

UNCONFINED COMPRESS. STRENGTH (TONS/FT) ● 1 2 3 4 5
PLASTIC LIMIT % | WATER CONTENT % | LIQUID LIMIT % ✕ ⊗ △ 10 20 30 40 50
STANDARD PENETRATION (BLOWS/FT.) ● 10 20 30 40 50

| DEPTH (FT.) | N OR MIN./FT. | PENETRATION RESISTANCE (BL/6 IN.) | SAMPLE NUMBER | RECOV. LENGTH (IN.) | RECOV. RQD (%) | MOISTURE | UNIFIED SOIL CLASS. | DESCRIPTION OF MATERIAL | LITHOLOGY* | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 9 | 2 3 6 5 | S-1 | 12 | | M | ML | 8" Topsoil like material<br>Bwn CLAYEY SILT, some c-f Sand, little c-f Gravel | | |
| 3 | 16 | 6 6 10 6 | S-2 | 18 | | M | ML | Same | | |
| 5 | 16 | 7 8 8 7 | S-3 | 14 | | M | ML | Bwn CLAYEY SILT, little c-f Sand, little c-f Gravel | | 529.0 |
| 7 | 31 | 22 14 17 16 | S-4 | 16 | | M | ML | Same | | |
| 9 | 55+ | 8 55/2 | S-5 | 6 | | W | ML | Same | | |
| 10 | | | | | | | | Auger refusal at 10' | | 524.0 |
| | | | | | | | | End of Boring at 10' | | |
| 15 | | | | | | | | | | 519.0 |
| 20 | | | | | | | | | | 514.0 |
| 25 | | | | | | | | | | 509.0 |

REMARKS: Surface elevations estimated based on topographic survey provided by Joel Greenburg, Architect, dated 2/21/1996.

BORING LOG 9978.01.GPJ TECTONIC ENG.GDT 7/17/19

Tectonic

PROJECT No. **9978.01**
PROJECT: **Carmel Fire Department**
LOCATION: **Carmel, NY**

# BORING No. B-6A

SHEET No. 1 of 1

CLIENT: **Carmel Fire Department**
CONTRACTOR: **General Borings, Inc.**
METHOD OF ADVANCING BORING | DIA. | DEPTH
POWER AUGER: | **4"** | **0** TO **4'**
ROT. DRILL: | | TO
CASING: | | TO
DIAMOND CORE: | | TO
Mobile B-53 Truck Mounted Drill Rig with Safety Hammer

GROUND WATER

| DATE | TIME | DEPTH |
|---|---|---|
| **6/27/19** | **12:00 pm** | **2.5'** |
| | | |

MON. WELL ☐ YES ☒ NO
SCREEN DEPTH: **---** TO **---**
WEATHER: **Clear** TEMP: **90° F**
DEPTH TO ROCK: **---**
*CHANGES IN STRATA ARE INFERRED

INSPECTOR: **Michael Bastien**
DRILLER: **Tom McGovern**
SURFACE ELEVATION: **536.0**
DATUM: **See Remarks**
DATE START: **6/27/19**
DATE FINISH: **6/27/19**

UNCONFINED COMPRESS. STRENGTH (TONS/FT) ◓ — 1 2 3 4 5
PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % — 10 20 30 40 50
● STANDARD PENETRATION (BLOWS/FT.) 10 20 30 40 50

| DEPTH (FT.) | N OR MIN./FT. | PENETRATION RESISTANCE (BL/6 IN.) | SAMPLES: SAMPLE NUMBER | RECOV.: LENGTH (IN.) | RECOV.: RQD (%) | MOISTURE | UNIFIED SOIL CLASS. | DESCRIPTION OF MATERIAL | LITHOLOGY* | ELEVATION (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | Drilled 4' with Auger and encountered utilities<br>No samples taken ▼ | | |
| 2 | | | | | | | | | | |
| 3 | | | | | | | | | | |
| 4 | | | | | | | | | | |
| 5 | | | | | | | | End of Boring at 4' | | 531.0 |
| 6 | | | | | | | | | | |
| 7 | | | | | | | | | | |
| 8 | | | | | | | | | | |
| 9 | | | | | | | | | | |
| 10 | | | | | | | | | | 526.0 |
| 11 | | | | | | | | | | |
| 12 | | | | | | | | | | |
| 13 | | | | | | | | | | |
| 14 | | | | | | | | | | |
| 15 | | | | | | | | | | 521.0 |
| 16 | | | | | | | | | | |
| 17 | | | | | | | | | | |
| 18 | | | | | | | | | | |
| 19 | | | | | | | | | | |
| 20 | | | | | | | | | | 516.0 |
| 21 | | | | | | | | | | |
| 22 | | | | | | | | | | |
| 23 | | | | | | | | | | |
| 24 | | | | | | | | | | |
| 25 | | | | | | | | | | 511.0 |

REMARKS: Surface elevations estimated based on topographic survey provided by Joel Greenburg, Architect, dated 2/21/1996.

BORING LOG 9978.01.GPJ TECTONIC ENG.GDT 7/17/19

Tectonic
PRACTICAL SOLUTIONS. EXCEPTIONAL SERVICE.

# LEGEND FOR SOIL DESCRIPTION

## COARSE GRAINED SOIL (Coarser then No. 200 Sieve)

DESCRIPTIVE TERM & GRAIN SIZE

| TERM | SAND | | | | | GRAVEL |
|---|---|---|---|---|---|---|
| coarse - c | No. | 4 | Sieve to No. | 10 | Sieve | 3" to 3/4" |
| medium - m | No. | 10 | Sieve to No. | 40 | Sieve | 3/4" to 3/16" |
| fine - f | No, | 40 | Sieve to No. | 200 | Sieve | |

COBBLES 3" to 10"

BOULDERS 10" +

| GRADATION DESIGNATIONS | PROPORTIONS OF COMPONENT |
|---|---|
| fine, f | Less than 10% coarse to medium |
| medium to fine, m-f | Less than 10% coarse |
| medium, m | Less than 10% coarse and fine |
| coarse to medium, c-m | Less than 10% fine |
| coarse, c | Less than 10% medium and fine |
| coarse to fine, c-f | All greater than 10% |

## FINE GRAINED SOIL (Finer than No. 200 Sieve)

| DESCRIPTION | PLASTICITY INDEX | PLASTICITY |
|---|---|---|
| Silt | 0 - 1 | none |
| Clayey Silt | 2 - 5 | slight |
| Silt & Clay | 6 - 10 | low |
| Clay & Silt | 11 - 20 | medium |
| Silty Clay | 21 - 40 | high |
| Clay | greater than 40 | very high |

## PROPORTION

| DESCRIPTIVE TERM | PERCENT OF SAMPLE WEIGHT |
|---|---|
| trace | 1 - 10 |
| little | 10 - 20 |
| some | 20 - 35 |
| and | 35 - 50 |

The primary component is fully capitalized

## COLOR

| | | |
|---|---|---|
| Blue - blue | Gy - gray | Wh - white |
| Blk - black | Or - orange | Yl - yellow |
| Bwn - brown | Rd - red | Lgt - light |
| Gn - green | Tn - tan | Dk - dark |

## SAMPLE NOTATION

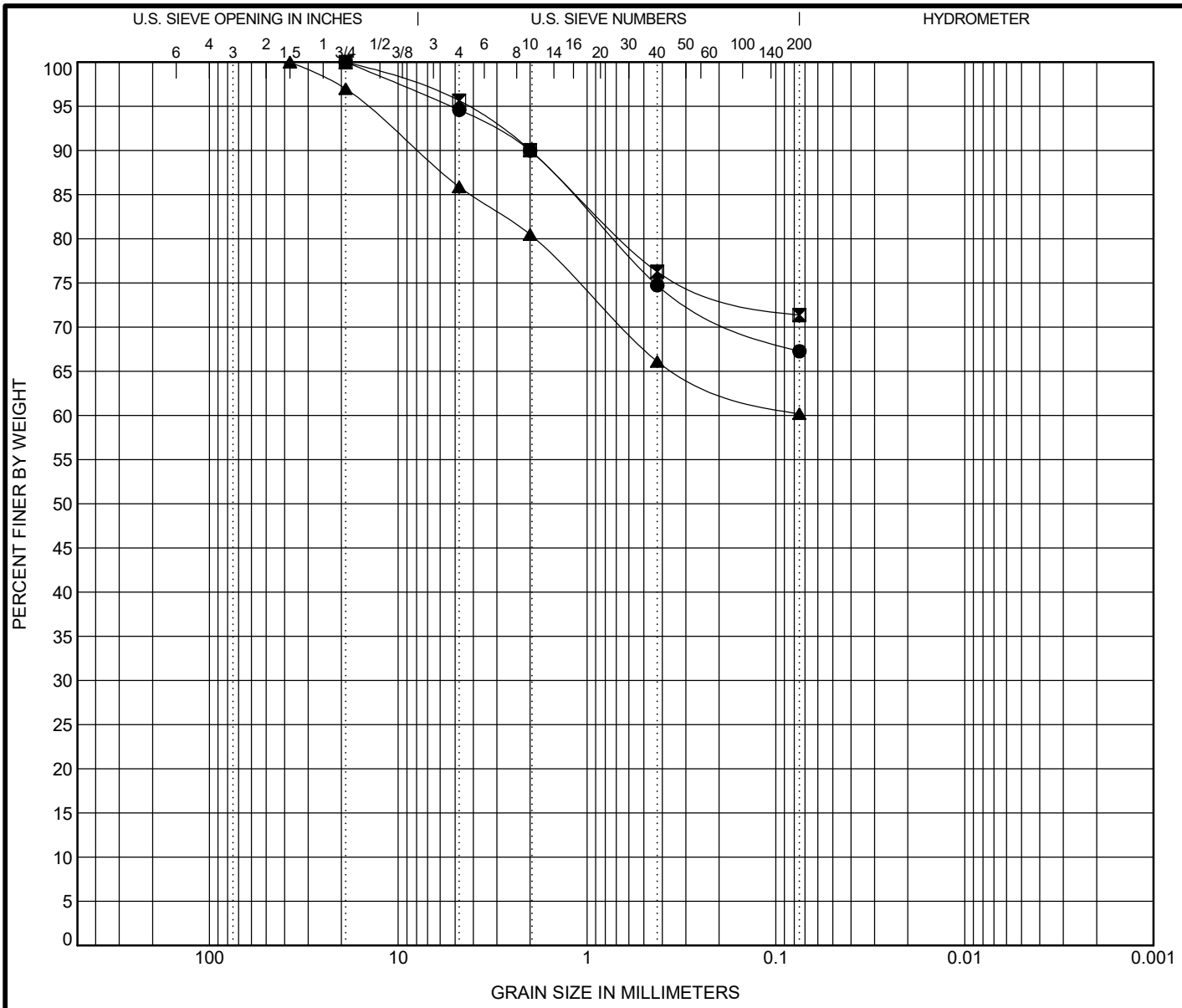
S - Split Spoon Soil Sample
U - Undisturbed Tube Sample
C - Core Sample
B - Bulk Soil Sample
NR - No Recovery of Sample

WOC - Weight of Casing
WOR - Weight of Rods
WOH - Weight of Hammer
PPR - Compressive Strength based on Pocket Penetrometer
TV - Shear Strength (tsf) based on Torvane

## ADDITIONAL CLASSIFICATIONS

New York City Building Code soil classifications are given in parentheses at the end of each description of material, if applicable. See sections 1804.2 of the 2008 Building Code for further details.

# APPENDIX II




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Sample Identification | | | Classification | WC% | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|---|---|
| ● | B-1 | 0.0 | S-1 | Tn-Bwn SILT, some c-f Sand, trace f Gravel | 12.4 | | | | | |
| ⊠ | B-2 | 2.0 | S-2 | Tn-Bwn SILT, some c-f Sand, trace f Gravel | 12.6 | | | | | |
| ▲ | B-5 | 1.0 | S-1 | Bwn SILT, some c-f Sand, little c-f Gravel | 9.8 | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

| | Sample Identification | | | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay | Source of Material |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ● | B-1 | 0.0 | S-1 | 19 | | | | 5.4 | 27.3 | 67.3 | | Boring |
| ⊠ | B-2 | 2.0 | S-2 | 19 | | | | 4.4 | 24.3 | 71.4 | | Boring |
| ▲ | B-5 | 1.0 | S-1 | 37.5 | | | | 14.1 | 25.7 | 60.2 | | Boring |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

Tectonic
280 Little Britain Road, Bldg #2
Newburgh, NY 12550
Telephone: (845) 563-9081 Fax: (845) 563-9085

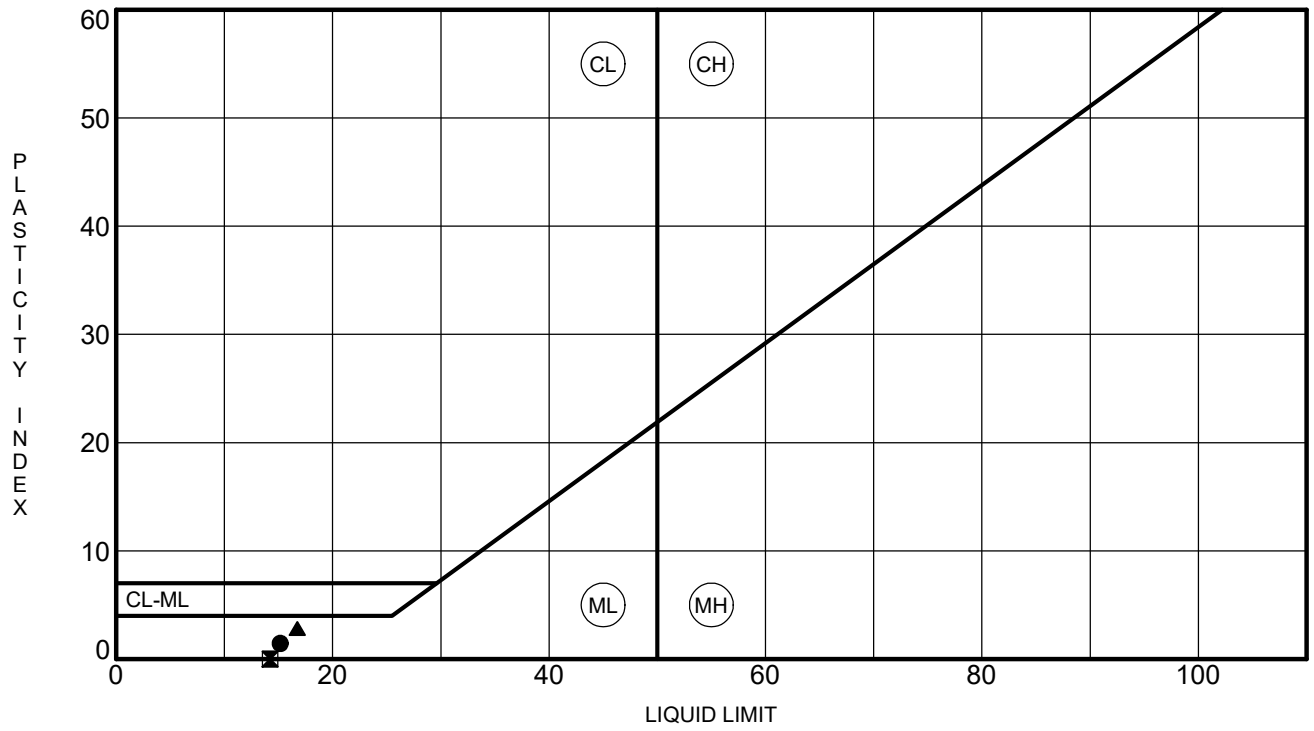
# GRAIN SIZE DISTRIBUTION

Project No: **9978.01** Date: **7/10/19**

Project: **Carmel Fire Department**

Location: **Carmel, NY**

GRAIN SIZE DISTRIBUTION 9978.01.GPJ TECTONIC ENG.GDT 7/10/19




| | Sample Identification | | | LL | PL | PI | Fines % | WC % | Classification |
|---|---|---|---|---|---|---|---|---|---|
| ● | **B-3** | **2.0** | **S-2** | **15** | **14** | **1** | **NA** | **12.8** | **Bwn-Tn Silt, and c-f Sand, little c-f Gravel** |
| ⊠ | **B-4** | **4.0** | **S-3** | **14** | **15** | **NP** | **NA** | **12.3** | **Bwn Silt, some c-f Sand, little c-f Gravel** |
| ▲ | **B-6** | **2.0** | **S-2** | **17** | **14** | **3** | **NA** | **12.4** | **Bwn Clayey Silt, some c-f Sand, little c-f Gravel** |

Tectonic
280 Little Britain Road, Bldg #2
Newburgh, NY 12550
Telephone: (845) 563-9081 Fax: (845) 563-9085

## ATTERBERG LIMITS' RESULTS

Project No: **9978.01** Date: **7/17/19**

Project: **Carmel Fire Department**

Location: **Carmel, NY**

| Boring # | Depth (Ft.) | Sample # | Specimen Description | % Gravel | % Sand | % Fines | USCS | Water Content | Liquid Limit | Plastic Limit | Plasticity Index | Penetro-meter (tsf) | Torvane (tsf) | Dry Density (pcf) | Organic Content ( % ) | pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B-1 | 0.0 | S-1 | Tn-Bwn SILT, some c-f Sand, trace f Gravel | 5.4 | 27.3 | 67.3 | | 12 | | | | | | | | |
| B-2 | 2.0 | S-2 | Tn-Bwn SILT, some c-f Sand, trace f Gravel | 4.4 | 24.3 | 71.4 | | 13 | | | | | | | | |
| B-3 | 2.0 | S-2 | Bwn-Tn Silt, and c-f Sand, little c-f Gravel | | | | | 13 | 15 | 14 | 1 | | | | | |
| B-4 | 4.0 | S-3 | Bwn Silt, some c-f Sand, little c-f Gravel | | | | | 12 | 14 | 15 | NP | | | | | |
| B-5 | 1.0 | S-1 | Bwn SILT, some c-f Sand, little c-f Gravel | 14.1 | 25.7 | 60.2 | | 10 | | | | | | | | |
| B-6 | 2.0 | S-2 | Bwn Clayey Silt, some c-f Sand, little c-f Gravel | | | | | 12 | 17 | 14 | 3 | | | | | |

SUMMARY OF LAB BORINGS 9978.01.GPJ TECTONIC ENG.GDT 7/11/19

Tectonic

280 Little Britain Road, Bldg #2
Newburgh, NY 12550
Telephone: (845) 563-9081 Fax: (845) 563-9085

## Summary of Laboratory Results

Project No: **9978.01** Date: **7/11/19**

Project: **Carmel Fire Department**

Location: **Carmel, NY**

# Our Story

For the past 30 years, Tectonic has delivered quality professional services in a timely and cost effective manner by pooling its talented staff into project teams that think, act, and perform as one integral unit.  By carefully listening and collaborating with its clients, the firm is able to identify the key issues and assure stakeholder objectives are met in the final deliverables. Through innovating and adopting technological advances, the firm is able to generate unique solutions to improve our nation's deteriorating infrastructure and build safe sustainable communities.

As the world evolves, and its challenges grow more complex, Tectonic continues to innovate and provide the practical solutions and exceptional customer service its clients have trusted since its founding.

www.TectonicEngineering.com

Tectonic

**MOUNTAINVILLE, NY (CORPORATE OFFICE)**
70 Pleasant Hill Road, PO Box 37
Mountainville, NY, 10953
Phone: 845-534-5959
Fax: 845-534-59993

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED SECTIONS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to Work of this Section.

B. Section 002100 - Notice to Bidders

C. Section 017700 - Closeout Procedures

D. Section 220511 - Plumbing Demolition

E. Section 260505 - Selective Demolition for Electrical

1.02 SUMMARY

A. This Section includes the following:
   1. Demolition and removal of portions of existing fire station, site improvements and other designated materials.
   2. Removing below-grade construction.
   3. Disconnecting, capping or sealing, and abandoning in-place or removing site utilities.
   4. Salvaging items for reuse.
   5. Items indicated on the plans to be abandoned in place may be filled with flowable fill or other approved materials.
   6. Temporary barriers to restrict access, control dust, keep existing areas weather tight.
   7. Protection of remaining building components until replacement construction is completed.

B. Furnish labor and materials necessary to install a complete system.

C. Identification of utilities.

1.03 DEFINITIONS

A. Demolish: Completely remove and legally dispose of off-site.

B. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

C. LEAD-SAFE working practices - an EPA term defining Contractor required procedures for containing work areas, minimizing dust and cleaning up when working with possible lead paint during construction projects.

D. Recycle: Recovery of demolition waste for subsequent processing in preparation for reuse.

E. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

F. Remove and Reinstall: Detach items from existing construction, store, prepare them for reuse, and reinstall them where indicated.

G. Remove and Salvage: Detach items for existing construction and store for Owner.

H. Salvage: Carefully detach from existing construction, in a manner to prevent damage, and store for Owner ready for reuse. Include fasteners or brackets needed for reattachment elsewhere.

1.04 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of the General Construction Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
   1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.05 SUBMITTALS

A. Pursuant to Section 013300 - Submittal Procedures.

B. Submit to the Architect proposed abandonment and removal schedule and procedures. Include proposed methods for control of dust and noise.

C. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by the Work.

1.06 QUALITY ASSURANCE

A. Conduct demolition operations in a manner that will minimize interference with structure to remain and with public or private property in the vicinity of said operations.

B. Pre-demolition Conference: Conduct conference at Project site with Architect. Review methods and procedures related to building demolition including, but not limited to, the following:
   1. Inspect and discuss condition of construction to be demolished.
   2. Review structural load limitations of existing structures.
   3. Review and finalize building demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
   4. Review and finalize protection requirements.
   5. Review procedures for protection of structure to remain, existing utilities, and existing exposed surfaces to remain.

C. Review items to be salvaged and returned to Owner and/or reused in the construction process.

1.07 REGULATORY REQUIREMENTS

A. Conform to applicable state and local codes for demolition of structures, safety of adjacent structures, dust control, runoff control, disposal and utility removal and cap offs.

B. Obtain required permits from Regulatory and Governing Authorities.

C. Notify affected utility companies before starting Work and comply with their requirements.

D. Do not close or obstruct roadways, sidewalks or adjacent utilities without approval by authorities having jurisdiction and Architect.

E. Conform to applicable regulatory procedures when discovering hazardous or contaminated materials. Hazardous and/or contaminated material removal are not the responsibility of this Contractor except where noted. Removal of all refrigerant from air conditioning and other cooling equipment is part of this contract for such equipment scheduled to be removed. Removal and disposal of existing light fixtures, lamps (bulbs), and ballasts are part of this contract for those light fixtures indicated to be removed and not re-used.

1.08 PROJECT CONDITIONS

A. The Fire Station will remain in full operation during this construction project. Access for Responders, access for responding apparatus and Fire Fighters and access for returning apparatus shall be maintained at all times.

B. Maintain access to the cell tower at all times.

C. Assume all existing paint is lead base paint. Employ lead safe working practices when cutting, removing, and/or disturbing existing painted materials. EPA LEAD-SAFE working practices: http://www.epa.gov/lead/pubs/renovation.htm. See also OSHA 29 CFR Section 1926.62(a).

D. Owner assumes no responsibility for buildings and structures to be selectively demolished.
   1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

E. Except where indicated to be salvaged as part of this Contract, on-site storage of removed items or materials is not permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

G. Promptly repair any damages caused by selective demolition work, at no extra cost to the Owner.

1.09 LEAD PAINT WARNING:

A. All contractors shall comply with the requirements of the OSHA construction standard for lead (29 CFR 1926.62) when disturbing painted surfaces at this facility.

B. OSHA does not recognize any method of paint film evaluation as an acceptable means of determining the applicability of these regulations. It is the responsibility of contractors on this project to determine which of their activities are subject to the OSHA construction standard for lead and to implement any and all controls required by that standard at no additional cost to the Owner.

C. All paint on existing structural steel, miscellaneous steel, any surface or other equipment at this facility shall the handled as “lead-based paint” unless proven otherwise. Any testing conducted to prove otherwise shall be at the expense of the party requiring such proof.

PART 2 PRODUCTS

2.01 NOT APPLICABLE

PART 3 EXECUTION

3.01 EXAMINATION

A. Provide, erect, and maintain temporary barriers and security devices as required.

B. Protect existing materials, structure, driveways and walls which are not to be demolished.

C. Prevent movement or settlement of remaining structure. Provide bracing and shoring, as required.

D. Mark location of utilities.

E. Verify that utilities have been relocated or disconnected and capped before starting selective demolition.

F. Review Project Record Documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

G. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required. Record existing conditions by use of pre-construction photographs.

H. Inventory and record the conditions of items to be removed and reinstalled and items to be removed and salvaged.

3.02 PREPARATION

A. Existing Utilities: Locate, identify, disconnect, and seal or cap off indicated utilities serving buildings and structures to be demolished.
   1. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.
   2. Arrange to shut off indicated utilities with the applicable local utility provider.
   3. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
   4. Cut off pipe or conduit a minimum of 24 inches below grade and well outside areas to be excavated. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction. Record location of any stubs still connected to active systems.

B. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.
   1. Strengthen or add new supports when required during progress of demolition.
   2. Brace and stabilize any structure removed and stored for reinstallation to preserve stability and alignment of structure during it removal from its existing location, during transport of the structure from its existing location, and to and from all storage locations, both during storage and during transport to the structure's final location on the Work site.
   3. Engineer, design and install bracing, shoring and stabilization to comply with the following:
      a. Loads imposed by movement.
      b. Environmental loads as defined in Chapter 16 of the International Building Code of New York State.
      c. Additional load and environmental effects of vibration.
      d. All other loads identified by an independent engineer.

3.03 DEMOLITION REQUIREMENTS

A. Conduct demolition to minimize interference with structure to remain.

B. Provide temporary enclosures and protection to maintain a weathertight building at all times.

C. Cease operations immediately if adjacent structure appears to be in danger. Notify authority having jurisdiction and Architect immediately. Do not resume operations until directed.

3.04 PROTECTION

A. Existing Facilities:
   1. Protect adjacent walkways, roofs, building entries, and other building facilities during demolition operations.
   2. Maintain required exits from existing buildings.
   3. Erect temporary barricades to prevent access from the occupied portions of the existing station to the construction work area. Maintain required means of egress. Adjust location and extent of temporary barricades as construction progress dictates.
   4. Erect temporary insulated enclosures to seal off dirt, dust, fumes, etc. and reduce noise from traveling into the occupied portions of the existing station. Modify temporary enclosures as construction progress dictates. If travel between the construction area and occupied portions of the existing station is required, provide temporary insulated, self closing doors with walk-off mats to control dirt and dust.
   5. Erect temporary weather tight enclosures to prevent existing station from inclement weather of all types. Provide insulated enclosures when temperatures dictate.
   6. Remove temporary barricades and enclosures when no longer required. Restore any damage to existing surfaces caused by the installation and/or use of temporary barricades and enclosures. Leave area clean and neat.

B. Existing Utilities: Maintain utility services to remain and protect from damage during demolition operations.
   1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.
   2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and authorities having jurisdiction.
      a. Provide at least 72 hours' notice to occupants of affected buildings if shutdown of service is required during changeover.

C. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction, and as indicated. .
   1. Protect adjacent buildings and facilities from damage due to demolition activities.
   2. Protect existing site improvements, appurtenances, and landscaping to remain.
   3. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
   4. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
   5. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.

D. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.05 SELECTIVE DEMOLITION

A. General: Demolish and remove existing construction only to the extent required. Use methods required to complete the Work within limitations of governing regulations and as follows:
   1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.

2. Provide 72 hours' notice of any operations likely to mar, stain, discolor, singe, or otherwise disturb adjoining exposed surfaces. Consult with Owner and Architect for best method of preservation of existing building surface to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
5. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
6. Dispose of demolished items off-site at an approved facility.
   a. Dispose of existing light fixture lamps and ballasts in accordance with the Toxic Substances and Control Act (TSCA), New York State Department of Environmental Conservation (NYSDEC) and local authorities having jurisdiction.
7. Temporarily remove existing conduits, wiring, piping and other surface mounted items from existing station veneer and/or siding to allow for installation of new masonry veneer. Re-install all removed conduits and other items that are required to stay in service. Extend conduits, wiring and other utilities as necessary.

B. Existing roof removal to allow for new addition tie-in, new veneer construction on existing station and new roof top equipment installation.

3.06 DEMOLITION, GENERAL

A. General: Demolish indicated existing buildings and site improvements completely. Use methods required to complete the Work within limitations of governing regulations and as follows:
   1. Demolition under this Project <u>does not include</u> any removal or relocation of asbestos containing materials or removal of any buried tanks. Identification and demolition of such materials/items will be completed prior to commencement of work under this Project.
      a. Hazardous Materials: If materials suspected of containing hazardous materials other than those identified to be removed are encountered, do not disturb; immediately notify Owner.
   2. Disconnect, remove, and/or end cap and identify designated utilities within demolition areas as indicated on the drawings.
   3. Remove materials to be re-installed or retained in manner to prevent damage. Store and protect in accordance with requirements of this Section.
   4. Remove demolished materials from site and dispose of legally.
   5. Do not burn or bury materials on site. Remove demolished materials as Work progresses. Leave building and site in clean condition.
   6. Demolish in an orderly and careful manner. Protect existing supporting structural members.
   7. At or adjacent to existing construction to remain, neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small poser tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
   8. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
   9. Maintain fire watch during and for at least 48 hours after flame cutting operations as required by applicable local and state regulations.
   10. Maintain adequate ventilation when using cutting torches.
   11. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

12. Remove air-conditioning equipment without releasing refrigerants. Dispose of any refrigerant materials in accordance with authorities having jurisdiction. Refrigerant materials to be handled by a qualified and trained refrigerant technician.
    a. 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 and other authorities having jurisdiction regulations. Include name and address of technician and date(s) refrigerant was recovered.
13. Dispose of demolished items and materials promptly.

B. Site Access and Temporary Controls: Conduct demolition and debris-removal operations to ensure no interference with fire department response to station, responding to calls from station, and minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

## 3.07 DEMOLITION BY MECHANICAL MEANS

A. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete demolition operations above each floor or tier before disturbing supporting members on the next lower level.

B. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled decent.
1. Remove structural framing members and lower to ground by method suitable to minimize ground impact and dust generation.
2. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

C. Below-Grade Construction: Demolish foundation walls and other below-grade construction where such construction is two or more feet below finished grade.
1. Demolish all such below-grade construction that lies within the footprint indicated for new construction or that extends up to 5 feet outside the footprint indicated for new construction.
2. Abandon all such below-grade construction lying over 5 feet outside the footprint indicated for new construction.
3. Remove below-grade construction, including basements, foundation walls, and footings, to depths indicated.
4. Septic and/or holding tanks shall be pumped out by a licensed professional septic system contractor. Metal tanks shall be removed and disposed of in accordance with authorities having jurisdiction. Backfill tank excavations with select granular fill. Concrete tanks, distribution boxes and drywells if outside the new structure footprint and pavement areas may be crushed (after pumping) and compacted in place or filled with lean concrete unless prohibited by local codes. Concrete septic tanks, drywells and distribution boxes within the new structure footprint and/or pavement areas shall be removed, backfilled in lifts and compacted with select granular fill.

3.08 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to condition existing before demolition operations began.

B. Promptly repair damage to adjacent structure caused by demolition operations.

3.09 SITE RESTORATION

A. Below-Grade Areas: Rough grade below-grade areas ready for further excavation or new construction.

B. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grade.

**END OF SECTION 024119**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This Section includes but is not limited to the following:
   1. Under slab on grade vapor retarder
   2. Floor Anchor Pots
   3. Concrete Formwork and Accessories
   4. Sleeves and Blockouts for Concrete Work
   5. Concrete Form Release Agent
   6. Waterstops in Concrete
   7. Expansion Joint Material

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Section 033000 - Cast-in-Place Concrete
   2. Division 22 - Trench Drains

1.03 STANDARDS

A. All work of this section shall conform to industry standards and/or manufacturer’s recommendations.

B. ACI 301 "Specifications for Structural Concrete"

C. ACI 318 "Building Code Requirements for Structural Concrete".

D. ASTM E96 "Standard Test Methods for Water Vapor Transmission of Materials:.

E. ASTM E1643 "Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs".

1.04 SUBMITTALS

A. Submit pursuant to Section 013300 - Submittal Procedures.

B. Submit pursuant to Section 016000 - Product Requirements.

C. Product Data and installation instructions for the following:
   1. Vapor Retarders
   2. Concrete Form Release Agent
   3. Sleeves
   4. Waterstop
   5. Concrete Vertical Construction Joints
   6. Apparatus Bay Floor Anchor Pots

1.05 QUALITY ASSURANCE

A. All work of this section shall be performed by experienced workers familiar with the work and according to manufacturer’s recommendations and/or industry standards.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturer's published instructions.

B. Protect against moisture exposure and damage.

PART 2 PRODUCTS

2.01 FORMWORK MATERIALS

A. Description: In addition to ACI 301 requirements, provide forms that retain their shape and strength after exposure to severe weather conditions.

2.02 PLYWOOD FORMS

A. Description:
   1. For natural concrete finish, smooth or rough form: APA B-B Plyform or better.

2.03 FORM ACCESSORIES

A. Bevel (Chamfer) and Reveal (Rustication) Strips: Clear softwood, planed, not rough sawn. PVC or rubber may be used if held rigid and straight.
   1. Bevel size: 3/4 in. x 3/4 in. unless otherwise shown.
   2. Reveal size: 3/4 in. deep x 1-1/4 in. wide trapezoid at surface of concrete, unless otherwise shown.

B. Stiffeners, Clamps, Frames, Walers, Strongbacks, Braces, Scaffolds, Ties, Bolts and Other Components of Formwork Assemblies: Provide as needed to produce formwork specified in ACI 301.

C. Form Release Agent: Compound that will release forms without discoloring concrete, will not impart roughness of concrete and will not interfere with adhesion, color of coatings or other construction which is to be applied over concrete. Do not use oil. Agent must meet project VOC requirements.

2.04 EMBEDDED ITEMS

A. Sleeves: Galvanized steel or plastic with wall thickness not less than 1/8 in.

B. Block outs: Wood or rigid foam plastic; removable without damage to concrete.

2.05 SIDE FORMS

A. Description: Use clean steel or wood forms with stakes or other supports which will withstand fluid, placing and finishing pressures without bowing, inclining or leaking.
   1. Top Edges: Smooth and straight, suitable for use as screeds in guiding strike offs without bumps or chatter.

2.06 JOINT FILLER

A. Non-extruding, Resilient, Preformed Fiber Joint Filler: Asphalt saturated cellulose fibers or cork particles encased between two (2) asphalt saturated glass felt liners.
   1. Cap: Provide plastic cap at top edge of joint filler strip to protect filler from dirt intrusion and as a bond breaker when sealant is applied.

2. Sealant: See Section 079200 - Sealants.
3. Referenced standard: ASTM D1751.
4. Bond Breaker: 15 lb./sq. asphalt coated glass fiber base sheet cut in strips equal to full depth of joint.
    a. Referenced standard for base sheet: ASTM D4601, Type I.

2.07 CONSTRUCTION JOINT (VERTICAL (WALL) APPLICATIONS)

A. Key-Loc Joint System by Form-A-Key Products, Division of Cardinal Mfg. Co., Inc., Louisville, NY 40214, 502-361-1396; fax 502-363-5905 or approved equivalent.

B. Metal keyway shall be 24-gauge galvanized steel with dowel knockouts at 6" centers.

C. Wood forms for construction joints may be used in lieu of prefabricated metal keyways.

D. Accessories include splice pieces, stakes and clips and stay-in-place cap Model #2137.

2.08 SLAB ON GRADE VAPOR RETARDER

A. Slab on grade with radiant tubing.
    1. Insul-Tarp Insulation by Insulation Solutions, Inc., 401 Truck Haven Road, East Peoria, IL 61611 Phone 1-866-698-6562 for use below all slabs with radiant heat tubing.
        a. Seam Tape: 4” wide white polyethylene tape

B. Slab on grade unheated
    1. Vapor Retarder
        a. Vapor Retarder must have the following qualities:
            1) WVTR less than or equal to 0.006 gr/ft2/hr. as tested by ASTM E 96
            2) ASTM E 1745 Class A (Plastics)
            3) Vapor Retarder Products
                (a) Stego Wrap (15 mil) Vapor Barrier by Stego Industries, LLC, San Juan Capistrano, CA 877-464-7834, www.stegoindustries.com .
                (b) PERMINATOR® 15 mil under slab vapor barrier by W.R. Meadows, Inc., PO Box 338, Hampshire, IL 60140-0338 Phone: 800-342-5976
                (c) c) Yellow Guard 15 mil under slab vapor barrier by Poly-America, L.P., 2000 West Marshall Dr., Grand Prairie, TX 75051 800-527-3322
        b. Vapor Retarding Seam Tape
            1) Tape must have the following qualities:
                (a) Water Vapor Transmission Rate: ASTM E 96 - 0.3 perms or lower
        c. Vapor Proofing Mastic
            1) Mastic must have the following qualities:
                (a) Water Vapor Transmission Rate: ASTM E 96 - 0.3 perms or lower
        d. Pipe Boots
            1) Construct pipe boots from vapor barrier material, pressure sensitive tape and/or mastic per manufacturers’ instructions.

2.09 FLOOR ANCHOR POT

A. Champ Floor Anchor Pot-1600 as manufactured by CHAMP Frame Straightening Frame Equip. Inc., 2545 Millennium Drive, Elgin, IL 60124 Phone 800-382-1200. www.autobodytoolmart.com/champ-floor-anchor-pot-1600-p-11538.aspx
    1. Accessories
        a. Champ Instant Floor Plate for New Floors
        b. Champ Floor Anchor Pot Lids-1676
        c. 3/8” chain

2.10 WATERSTOP

A. Sika Greenstreak® PVC Waterstop or Architect Approved Equivalent meeting Army Corp. of Engineers CRD-C 572-74 requirements.
   1. #703 6" x 3/16" ribbed with centerbulb.
   2. Accessories: Provide junction making material and factory formed T's, L's and X's.

B. Hydrophilic Waterstop
   1. CETCO® Waterstop RX 101 or Architect Approved Equivalent.
   2. Adhesive: CETSEAL Sealant/Adhesive or manufacturer's recommended adhesive product.

PART 3 EXECUTION

3.01 VAPOR RETARDER INSTALLATION

A. General: Following leveling and tamping of granular base for slabs on grade, place vapor retarder sheeting with longest dimension parallel with direction of pour. Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.

B. Extend vapor barrier to the perimeter of the slab. If practicable, terminate it at the top of the slab, otherwise (a) at a point acceptable to the structural engineer or (b) where obstructed by impediments (such as dowels, waterstops, or any other site condition requiring early termination of the vapor barrier). At the point of termination, seal vapor barrier to the foundation wall, grade beam or slab itself.

C. Lap joints 6 inches (150 mm) and tape continuously per manufacturer’s installation instructions.

D. Apply seam tape to a clean and dry vapor barrier.

E. Seal all penetrations (including pipes) per manufacturer’s instructions.

F. Avoid the use of non-permanent stakes driven through vapor retarder. If non-permanent stakes are driven through vapor retarder, repair as recommended by vapor retarder manufacturer.

G. Once vapor retarder is installed limit traffic on vapor retarder to foot traffic necessary to install reinforcing, radiant tubing and concrete.

H. Repair damaged areas with vapor barrier material of similar (or better) permeance, puncture and tensile.

3.02 FLOOR ANCHOR POT INSTALLATION

A. Install anchor pot prior to pouring floor slab in accordance with manufacturer’s installation instructions. Set each pot with a small amount of concrete prior to slab pour.

3.03 WATERSTOP INSTALLATION

A. PVC Waterstop:
   1. PVC Waterstop must be installed prior to concrete placement to ensure proper positioning and concrete consolidation around the waterstop.
   2. All transitions, intersections, and splices must be heat welded to maintain continuity.
   3. Factory made fabrications shall be used at all intersections and changes in direction.

4. Support upper portion of waterstop with use of hog rings and wires to properly position the waterstop in the second pour.
5. Follow waterstop manufacture's installation guidelines.

B. Hydrophilic Waterstop;
1. Install in accordance with manufacturer's installation instructions using recommended adhesive.
2. Do not subject installed hydrophilic waterstop to submersion or remain in extended contact with water prior to encapsulation in concrete. If the waterstop exhibits swelling prior to encapsulation, it must be replaced with new material.

3.04 MODIFICATIONS TO ACI 301

A. The following provisions modify (change, delete from or add to) ACI 301. Where any part of ACI 301 is modified by these provisions, the unaltered parts of ACI 301 shall remain in effect. Where "acceptable" is used or "subject to acceptance" is required in ACI 301, acceptance shall mean approval by Architect or Structural Engineer of record.

B. Chapter 4, Formwork:
1. ADD to Par. 4.1.3. Form sides of footings except in rock that has been cut to precise footing profile.
2. ADD to Par. 4.2.7. Seal joints at temporary openings and between form pieces with compressible tape that will not leak grout or water; flush with exposed surface.
3. ADD to Table Par. 4.3.1: 7.C. Slope toward nosing in step treads: 1/16 in. +/- 1/32 in. Treads shall not pond water at any point.
4. Par. 4.4.2.1. DELETE "acceptable". No approval of form coating is required if the Specification for form release agent is met.
5. ADD to Par. 4.5.5. Minimum strength of concrete in beams and slabs at time of form removal: 75% of specified f'c as determined by cylinder compression tests. Re-shore until f'c equals 100% of design strength.

C. Chapter 6, Joints and Embedded Items.
1. Par. 6.1.4. DELETE "When required or permitted, bond shall be obtained by …" REPLACE with "Obtain bond by …".
2. ADD to Par. 6.2.2. When the Work is nearly complete, clean top of joint filler, install bond breaker and seal with self-leveling urethane sealant. Plastic cap at top of joint filler material may be used as bond breaker if depth of urethane will be equal to approximately half of joint width.
3. ADD to Par. 6.3.2. Set waterstops in place with centerline of waterstop at centerline of joint. Secure waterstops in straight lines without twisting. Wire extreme outer edge of waterstop to reinforcing on each side, or, in the case of split flanges, nail fully spread against joint form. Carry waterstops around corners, without splicing.
4. ADD to Par. 6.3.3. Use prefabricated Ts, Ls, and crosses so that all splices are butt joints.
5. ADD Par. 6.3.4. Clean dust, dirt, and hardened concrete from waterstops, then vibrate fresh concrete around waterstops so that full bond with concrete is ensured, free of voids.

D. Chapter 9, Repair of Surface Defects.
1. ADD Par. 9.1.1. Grind fins and projections as needed to allow smooth application of waterproofing and finishes.
2. ADD Par. 9.1.2. Fill honeycomb, bugholes, and other voids or depressions as needed to allow smooth application of waterproofing and finishes.

E. Chapter 10, Finishing of Formed Surfaces.

1. ADD to Par. 10.2.1. At surfaces to which waterproofing will be applied, provide rough form finish and prepare surface by grinding fins and projections, removing nails, and by filling honeycomb, bugholes, and other voids or depressions with firmly adhered grout.
2. ADD to Par. 10.2.2. Provide smooth form finish at exposed surfaces, whether or not shown to receive architectural finish.
3. ADD to Par. 10.4.2. In addition to walls, columns, ceilings, and soffits generally, surfaces exposed to public view include, but are not limited to, surfaces such as walls of interior and exterior stairways, elevator hoist ways, walls and ceilings in spaces or tunnels with 6 ft or greater headroom, and backs of parapet walls. Surfaces which will receive furring, contact plaster, or suspended ceiling are not exposed surfaces.

F. Chapter 11, Slabs.
1. ADD to Par. 11.2.1. Place interior slabs on ground over a subbase course of drainage fill that has been compacted to a thickness of at least 8 in., or as indicated in drawings, whichever is greater.
2. ADD the following to Par. 11.2:
   a. 11.2.4 Place and seal vapor retarder under base course or other substrate.
   b. 11.2.5 Lap vapor retarder sheet sides and ends 6 in. Turn sheets up 4 in. above top of subslab fill at walls and columns.
   c. 11.2.6 Protect vapor retarder from puncture before and during subslab fill placement.
3. ADD the following paragraphs to Par. 11.5:
   a. 11.5.1. Wall Isolation Joints. Isolate edges of interior slabs on ground from concrete wall surfaces with 1 layer of bond breaker felt or joint filler strip except as shown in drawings.
   b. 11.5.2. Column Isolation Joints. Form diamond-shaped area around each column, each side equal to 2'-6". After slabs have been cast, strip forms, install bond breaker at slab edges, then place concrete around columns.
   c. 11.5.3. Contraction joints (control joints, sawed joints). Cut alternate wires or bars in reinforcement passing through joint. Saw joints to a depth of 1/3 slab thickness as soon as concrete will not ravel. Vacuum or blow groove clean immediately after sawing and insert backer rod to keep joint clean during construction. At least 90 days later, or just before time of Substantial Completion, remove rod, clean groove of debris, replace rod and fill with dead level urethane sealant.
4. ADD the following paragraphs to Par. 11.9:
   a. 11.9.1.1. Provide Class A tolerances at floor areas as shown.
   b. 11.9.2.1. Finish all floor areas to Class B tolerance except as otherwise shown.
   c. 11.9.3.1. Class C flatness tolerances may be provided at floor areas which will receive mortar beds for finish materials.
5. ADD paragraph 11.10 Exterior Traffic Surfaces:
   a. 11.10.1. Provide broom finish at exterior walks, aprons, man-door slabs and ramps.

**END OF SECTION 031000**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Agreement, including General and Division 01 of the Project Manual, apply to the work of this Section.

1.02 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:
   1. Section 031000 - Concrete Forming and Accessories
   2. Section 033500 - Concrete Finishing

1.03 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. AISC - American Institute of Steel Construction

C. NRMCA - National Ready Mix Concrete Association

1.04 STANDARDS

A. Referenced Standards: These standards (latest edition or edition in force by AHJ) form part of this specification only to the extent they are referenced as specification requirements.
   1. ACI 117 - "Specification for Tolerances for Concrete Construction and Materials".
   2. ACI 301 - "Specifications for Structural Concrete for Buildings".
   3. ACI 302 - "Guide to Concrete Floor and Slab Construction".
   4. ACI 304 - "Guide for Measuring, Mixing, Transporting, and Placing Concrete".
   5. ACI 305R - "Guide to Hot Weather Concreting".
   6. ACI 306R - "Guide to Cold Weather Concreting".
   7. ACI 308.1 - "Standard Specification for Curing Concrete".
   8. ACI 308R - "Guide to External Curing of Concrete".
   9. ACI 318 - "Building Code Requirements for Structural Concrete".
   10. ACI 347R - "Guide to Formwork for Concrete".
   11. AISC 303 - "Code of Standard Practice for Steel Buildings and Bridges".
   12. ASTM A615 - "Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement".
   13. ASTM A775 - "Standard Specification for Epoxy-Coated Steel Reinforcing Bars".
   14. ASTM A1064 - "Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete".
   15. ASTM C33 - "Standard Specification for Concrete Aggregates".
   16. ASTM C40 - " Standard Test Method for Organic Impurities in Fine Aggregates for Concrete".
   17. ASTM C94 - "Standard Specification for Ready-Mixed Concrete".
   18. ASTM C150 - "Standard Specification for Portland Cement".
   19. ASTM C260 - "Standard Specification fr Air-Entraining Admixtures for Concrete".
   20. ASTM C494 - "Standard Specification for Chemical Admixtures for Concrete".
   21. ASTM C881 - "Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete".

22. ASTM C1077 - "Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation".
23. ASTM E1155 - "Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers".

1.05 ACTION SUBMITTALS

A. Pursuant to Section 013300 - Submittal Procedures.

B. Product Data: For each type of product.

C. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
   1. Indicate amounts of mixing water to be withheld for later addition at Project site.
   2. Submit mix designs for each type of concrete to be used on the Project at least 30 calendar days prior to the first scheduled concrete pour. The Contractor's or Concrete supplier's testing laboratory shall develop concrete mix designs and test all materials and mixes for conformance with ACI 301 and these specifications. The costs associated with development of the design mixes and testing of samples shall be included in the bid price.
   3. Submit the following:
      a. Name, address, and phone number of Contractor's or Ready Mix Supplier's testing laboratory.
      b. Mix proportions for each different mix design required.
      c. Source of fine aggregates and results of tests made in accordance with ASTM C33 and ASTM C40.
      d. Source of coarse aggregate and results of tests made in accordance with ASTM C33.
      e. Catalog cuts of all admixtures.
      f. Furnish test results for each mix design indicating slump, air-entrainment, water/cement ratio, admixtures included, fresh unit weight, temperature and test results (7, 28, 56 day results). Minimum two tests at each scheduled time period.
      g. If the concrete is intended to be pumped, design mix accordingly and submit certification it has been tested for pumping.
   4. If adopted mix fails to produce concrete meeting requirements for strength, air content and workability, the Architect may order additional cement or adjustments to mix proportions at no extra cost to the Owner.

D. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bend bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
   1. Shop drawings shall be at ¼" per foot scale and shall include elevation views of all walls and piers.

E. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
   1. Location of construction joints is subject to approval of the Architect.

1.06 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each of the following, signed by manufacturers:
   1. Cementitious materials.
   2. Admixtures.
   3. Form release agents.
   4. Steel reinforcement and accessories.
   5. Curing compounds and membranes.

6. Floor and slab treatments.
7. Adhesives.
8. Semirigid joint filler.
9. Joint-filer strips.

B. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

C. Furnish ready mix delivery slips to the Special Inspector indicating all batches weights, admixtures, water amounts, batch times, start and end discharge times and drum revolutions at mixing speed.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing and delivering ready-mixed concrete products and that complies with ASTM C94 requirements for production facilities and equipment.
   1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" or a New York State Department of Transportation currently approved plant.

B. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 for testing indicated.
   1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
   2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain coarse aggregate from single source, obtain fine aggregate from a single source, and obtain admixtures from single source from single manufacturer. To further insure consistency, coloration, finish and quality; all aggregates, cementitious materials, water and other ingredients shall each be secured from the same source for the duration of the project. All sub-contractors shall utilize the same source and utilize the same mix designs. Multiple suppliers will not be allowed.

1.08 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures. Tests shall have been conducted within three months of the submission date.

1.09 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 306R and as follows: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
   1. When average high and low temperature is expected to fall below 40° F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
   2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in concrete mix designs.

B. Hot-Weather Placement: Comply with ACI 305R and as follows:
   1. Maintain concrete temperature below 90° 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.

C. Special Conditions:
   1. The apparatus bay slab and adjoining rooms are heated with an in-slab hydraulic tubing.
   2. The tubing is tied to, and in contact with the mesh and/or reinforcing.
   3. Verify all tubing is placed below the saw cut depth.
   4. Any damage to the tubing during the placement of the concrete shall be fixed in a manner approved by the Architect, by the General Contractor at no cost to the Owner.

PART 2 PRODUCTS

2.01 CONCRETE, GENERAL

A. ACI Publications: Comply with the most current editions of the following unless modified by requirements in the Contract Documents:
   1. ACI 301.
   2. ACI 117.

2.02 FORM-FACING MATERIALS

A. Smooth-formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in larges practicable sizes to minimize number of joints.
   1. Plywood, metal, or other approved panel materials.
   2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
      a. B-B (Concrete Form), Class 1 or better; mill oiled, and edge sealed.
   3. Overlaid birch plywood.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Chamfer Strips: Wood, metal, PVC, or rubber strips, ¾ by ¾ inch, minimum.

D. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
   1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

E. Form ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
   1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
   2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.

2.03 STEEL REINFORCEMENT

A. Reinforcing Bars:
   1. ASTM A615, Grade 60, deformed.
   2. ASTM A775, Grade 60, deformed, epoxy coated (where specified on Contract Drawings).

B. Plain-Steel Welded-Wire Reinforcement: ASTM A1064, plain, fabricated from as-drawn steel wire into flat sheets.

2.04 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A615, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire or plastic according to CRSI's "Manual of Standard Practice," and as follows:
   1. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless steel bar supports.

2.05 CONCRETE MATERIALS

A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

B. Cementitious Materials:
   1. Portland Cement: ASTM C150, Type I.
      a. Fly Ash: ASTM C618, Class F. Use an amount that equals 15 percent of the total cement plus flyash weight.

C. Normal-Weight Coarse Aggregates: ASTM C33, No.57 or 67 coarse aggregate or better, graded. Provide aggregates from a single source.

D. Normal-Weight Fine Aggregate: ASTM C33, Clean, sharp, natural sand free from loam, clay, lumps or other deleterious substances.

E. Air-Entraining Admixture: ASTM C260.

F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Certified by manufacturer to contain no harmful effects on pex radiant tubing in heated concrete slabs. Do not use calcium chloride or admixtures containing calcium chloride.
   1. Water-Reducing Admixture: ASTM C494, Type A.
   2. Retarding Admixture: ASTM C494, Type B.
   3. Plasticizing and Retarding Admixture: ASTM C1017, Type II.
   4. High Range, Water-Reducing Admixture ASTM C494, Type F.

G. Water: ASTM C 94. Clean and drinkable. Maximum chloride ion content 0.1%.

2.06 CURING MATERIALS

A. Wet curing blankets for use on concrete flatwork: Polyethylene sheet backed with absorptive fibrous cellulose or other synthetic material.
   1. Products:
      a. PNA Construction Technologies; Hydracure.
      b. Raven Industries Inc.; Conkure.
      c. Universal Forrest Products; UltraCure.

B. Water: Potable.

C. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, dissipating for use on concrete surfaces **other than flatwork**.
   1. Products:
      a. Euclid Chemical Company (The); Kurez DR VOX.
      b. Kaufman Products, Inc.; Thinfilm 420.
      c. Lambert Corporation; Aqua Kure-Clear.

2.07 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.

B. Structural Bonding Agent: ASTM C881, Type II
   1. Qualities: Structural bonding adhesive, suitable for adhering freshly-mixed concrete to hardened concrete, moisture tolerant structural epoxy adhesive.
   2. Products:
      a. Sikadur 32 by Sika Corporation.
      b. Architect approved equivalent.

2.08 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
   1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Admixtures: Use admixtures according to manufacturer’s written instructions.

2.09 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings, Piers, Grade Beams, Exterior Stairs, and Foundation Walls: Normal-weight concrete.
   1. Minimum Compressive Strength: 4000 psi at 28 days.
   2. Maximum Slump Limits: 3 inches, plus or minus 1 inch.
   3. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-1/2 nominal maximum aggregate size.

B. Slabs-on-Grade and Interior slabs on metal deck: Normal-weight concrete.
   1. Minimum Compressive Strength: 4000 psi at 28 days.
   2. Maximum Slump Limit (Conventional Mix): 3 inches, plus or minus 1 inch.
   3. Maximum Slump Limit (Pump Mix): 6 1/2 inches, plus or minus 1 inch.
   4. Interior Slab Air Content: 3 percent max at point of deliver for ¾ inch nominal maximum aggregate size. Do not use air entrainment admixture at interior concrete slabs.

5. Exterior Slab Air Content: 6 percent max, plus or minus 1.5 percent at point of delivery for ¾ inch nominal maximum aggregate size.

2.10 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice".

2.11 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and furnish batch ticket information.
   1. When air temperature is between 80° and 90° F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90° F, reduce mixing and delivery time to 60 minutes.

PART 3 EXECUTION

3.01 FORMWORK INSTALLATION

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
   1. Class A, 1/8 inch for smooth-formed finished surfaces.
   2. Class B, ¼ inch for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Remove water from forms and excavations and divert water flow to avoid washing over, under or thru freshly placed concrete.

F. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
   1. Install keyways, reglets, recesses, and the like, for easy removal.
   2. Do not use rust-stained steel form-facing material.

G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

H. 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.

I. Chamfer exterior corners and edges of permanently exposed concrete.

J. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

K. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

L. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

M. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.
   1. Do not apply form release agent where concrete surfaces are to receive special finishes or applied coatings that may be affected by the form release agent.

3.02 EMBEDDED ITEM INSTALLATION

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
   2. Ensure that all inserts and embedded items are not disturbed during concrete placement.

3.03 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50° F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
   1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
   2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing materials are not acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.04 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
   1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars. Use reinforcing splices at minimum of locations and

only at locations of minimum stress. Splice locations shall be approved during shop drawing review phase. Rebar splice lengths shall be in accordance with ACI 318.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

F. Take necessary measures to ensure that reinforcement is not disturbed during the placement of radiant tubing and/or during the placement of concrete.

3.05 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
   1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
   2. Locate joints for beams, slabs, joists, and girders in the middle third of spans.
   3. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
   4. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
   1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Contraction Joints for elevated framed slabs and elevated mezzanine slabs.
   1. Form joints by sawing joints to a depth equal to one-third of slab thickness (2 inches maximum).
   2. Joints in elevated framed slabs and elevated mezzanines, when not shown on the contract documents, should be cut to create nearly square panels, or 20' - 0" o.c. in each direction, which ever yields smaller panels.
   3. Saw joints as soon as possible without raveling concrete.

E. Isolation Joints in Slab-on-Grade: After removing formwork, install joint filler strips at slab junctions with vertical surfaces, such as: column pedestals; foundation walls; grade beams; and other locations as indicated.
   1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
   2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 079200 - Sealants are indicated.

F. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Correct alignment and lubrication is essential for proper joint function. Lubricate one-half of dowel length

to prevent concrete bonding to one side of joint. Rotate dowel after concrete placement to loosen bond.

1. Speed Dowel System by Sika Greenstreak, 3400 Tree Court Industrial Blvd., St Louis, MO 63122 Phone: 800-325-9504 is an acceptable alternative to lubricating dowels.

3.06 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 to project site or during placement unless water has been held back from the mix at the batch plant. This amount of water must clearly be shown on the computerized batch ticket. In no case shall the amount of water exceed the amount withheld or the total batch amount in the mix design. Add water on site only in the presence of and with the permission of the Owner's representative. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
   1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
   2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
   3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
   1. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
   2. Maintain reinforcement in position on chairs during concrete placement.
   3. Screed slab surfaces with a straightedge and strike off to correct elevations.
   4. Slope surfaces uniformly to drains where required.
   5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

3.07 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
   1. Apply to concrete surfaces not exposed to public view.

B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.08 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, re-straightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. See Section 033500 - Concrete Finishing.

3.09 MISCELLANEOUS CONCRETE ITEM INSTALLATION

A. Filling in: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

C. All exposed horizontal and vertical wall and slab corners shall have a 3/4 inch chamfered edge.

D. Equipment Bases and Housekeeping Pads:
   1. Coordinate sizes and locations of concrete bases and housekeeping pads with Owner and Architect.
   2. Construct concrete bases and pads 6 inches high unless otherwise indicated; and extend bases/pads not less than 6 inches in each direction beyond the maximum dimension of supported equipment unless otherwise indicated.

3.10 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Maintain in moist condition at a relatively constant temperature for a period of time necessary for hydration of cement and attainment of design strength. Comply with ACI 306R for cold-weather protection and ACI 301 and ACI 305R for hot-weather protection during curing.
   1. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing.

B. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.

C. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

D. Cure concrete according to ACI 308R and ACI 308.1, by one or a combination of the following methods:
   1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
      a. Water.
      b. Continuous water-fog spray.
      c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12 inch lap over adjacent absorptive covers.

2. Wet curing Blanket: Cover concrete slab surfaces in widest practicable width, with sides and ends lapped at least 12 inches. Cure for not less than seven days. Immediately repair any holes or tears during curing period.
   a. Cure interior slabs only with wet curing blankets.
   b. Curing compounds may be used at exterior slabs.
3. Curing Compound: Do not use on slabs or other concrete flatwork. Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subject to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

E. Liquid sealer/hardener: See Section 033500 - Concrete Finishing.

3.11 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
   1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

3.12 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Agency: Engage a qualified testing and inspecting agency to perform test and inspections and to submit reports.

C. Inspections:
   1. Steel reinforcement placement.
   2. Headed bolts and studs.
   3. Verification of use of required design mixture.
   4. Concrete placement, including conveying and depositing.
   5. Curing procedures and maintenance of curing temperature.
   6. Verification of concrete strength before removal of shores and forms from beams and slabs.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C172 shall be performed according to the following requirements:
   1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. Yd., but less than 25 cu. Yd., plus one set for each additional 50 cu. Yd. or fraction thereof.
      a. When frequency of testing provides 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 C143; one test at point of placement for each truck delivery and for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change. Test the slump at the delivery truck.
   3. Air Content: ASTM C231, pressure method, for normal-wight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture. Test the air content at the point of concrete deposit into the formwork (i.e. at the pump hose discharge).

4. Concrete Temperature: ASTM C1064; one test hourly when air temperature is 40° F and below or 80° F and above, and one test for each composite sample. Test the temperature at the delivery truck.
5. Compression Test Specimens: ASTM C31.
   a. Cast and laboratory cure three sets of two standard cylinder specimens for each composite sample. Cast the cylinder specimens with concrete taken at the point of concrete deposit into the formwork (i.e. at the pump hose discharge).
6. Compressive-Strength Tests: ASTM C39; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days. Reserve one set of two specimens and test at 56 days when concrete fails to meet the design strength at 28 days.
   a. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
7. Strength of each concrete mixture will be satisfactory if every average of any three-consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
8. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7 and 28-day tests.
9. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42 or by other methods as directed by Architect.
10. Additional testing and inspection, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
11. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

E. Measure floor and slab flatness and levelness according to ASTM E1155 within 48 hours of finishing.

**END OF SECTION 033000**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Agreement, including General and Supplementary Conditions, and Division 01 of the Project Manual, apply to work of this Section.

B. Section 031000 - Concrete Forming and Accessories.

C. Section 033000 - Cast-In-Place Concrete.

1.02 SCOPE

A. Finishing slabs on grade, elevated slabs and monolithic floor slabs.

B. Testing for floor flatness.

C. Repair of defective concrete.

D. Surface treatment with concrete hardener and sealer.

1.03 STANDARDS

A. All work of this section shall conform to industry standards, manufacturer's recommendations and the ACI Manual of Concrete Practice.

B. ACI 301 "Specifications for Structural Concrete for Buildings".

C. ACI 302.1R "Guide for Concrete Floor and Slab Construction"

D. ACI 303 "Guide to Cast-In-Place Architectural Concrete Practice".

E. ASTM E1155 "Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers".

1.04 SUBMITTALS

A. Submit pursuant to Section 013300 - Submittal Procedures.

B. Submit pursuant to Section 016000 - Product Requirements.

C. Product Data: Submit manufacturer's product data for each type of concrete sealer, clearly indicating locations each type of sealer will be used.

D. Samples: Provide two (2) 6" x 6" x 2" concrete samples, fully cured, with 2 coats of the proposed exposed interior concrete wall sealer applied for approval by the Architect.

1.05 QUALITY ASSURANCE

A. All work of this section shall be performed by experienced workmen familiar with the work and according to manufacturer's recommendations, ACI 301 and industry standards.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturer's published instructions.

B. Protect against moisture exposure and damage.

PART 2 PRODUCTS

2.01 CONCRETE SEALER

A. Exterior Concrete
   1. AQUAPEL from L&M Construction Chemicals, a product brand of Laticrete International or Architect approved equivalent.
   2. Apply to all exterior concrete pavement, slabs, stoops, aprons, sidewalks and patios.
   3. Handle and apply according to manufacturer's recommendations.
   4. Apply sealer to slabs that are a minimum of 28 days old, have been thoroughly moist cured and have been allowed to air dry.

B. Exposed Interior Concrete Slabs and Stair Treads
   1. Seal Hard from L&M Construction Chemicals, a product brand of Laticrete International or Architect approved equivalent.
   2. Apply two coats in accordance with manufacturer's recommendations.

PART 3 EXECUTION

3.01 FINISHING UNFORMED SURFACES (SLABS)

A. Scratched Finish:
   1. After placing, consolidating, and striking-off slabs, level surface to a tolerance not exceeding 1/8 in. in 2 ft when tested with a 2 ft straight edge. Slope surfaces uniformly to drains.
   2. After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.
   3. A 2' x 2' area of concrete shall be prepared and finished as a sample for the Owner and Architect to approve the finish and roughness.

B. Floated Finish: (Apparatus bays, mezzanines and adjacent rooms)
   1. After placing, consolidating, and striking-off slabs, level surface to a tolerance not exceeding 1/8 in. in 2 ft when tested with a 2 ft straight-edge. Slope surfaces uniformly to drains. Do not work surface until ready for floating.
   2. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units. Check and level surface plane to a tolerance not exceeding 1/4 in. in 10 ft when tested with a 10 ft straightedge. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
   3. See Paragraph 3.03 for additional tolerance requirements. The more stringent tolerance dictates.
   4. These slabs should be finished with a mild, soft broom finish in the direction of drainage.
      a. The Contractor will prepare a 24" x 24" test panel or similar sample of the finish for approval by the Owner and Architect.
      b. Said sample will remain on the job site during finishing operations and will be used as a guide for the slab finish.

C. Troweled Finish: (Non-Bay Areas, rooms to receive tile or carpet)
   1. After floating, steel-trowel slab surface to a smooth, even, impervious finish free from trowel marks. For exposed to view concrete slabs, give slab surface a second steel troweling to a burnished finish, uniform in texture and appearance. Grind smooth surface defect which would telegraph through applied floor covering system.

D. Slip Broom Finish: (Exterior Concrete)

1. After placing, consolidating, and striking-off slabs, level surface to a tolerance not exceeding 1/8 in. in 2 ft when tested with a 2 ft straightedge. Slope surfaces uniformly to drain. Do not work surface until ready for floating.
2. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units. Check and level surface plane to a tolerance not exceeding 1/4 in. in 10 ft when tested with a 10 ft straightedge. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
3. Immediately after trowel finishing, slightly roughen concrete surface by brooming with fiber bristle broom in straight, parallel lines perpendicular to main traffic route. Coordinate required final finish with the Architect before application.

E. Caution: Do not use jitterbugs at any time.

3.02 FINISHING FORMED SURFACES (INTERIOR & EXTERIOR)

A. Exposed to view surfaces: Patch all form tie holes and rub to produce a smooth, uniform finish. Patching material to match concrete in color and texture.

3.03 TOLERANCES (INTERIOR SLABS)

A. An independent testing agency, as specified in Section 014523 - Testing and Inspection Services, will inspect finished slabs for flatness.

B. Measure for F(F) and F(L) tolerances for floors in accordance with ASTM E1155, within 72 hours after slab installation.

C. Finish concrete to achieve the following tolerances:
1. Exposed to View and Foot Traffic: F(F) 20 and F(L) 15.
2. Slabs to be Covered with Thin Floor Coverings (i.e., resilient flooring, ceramic flooring): 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.
3. Slabs to be Covered with Wood Flooring: 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.
4. Slabs to be Covered with Carpet, Carpet Tile, Rubber Flooring and Other Slabs: Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 20; with minimum values of flatness, F(F) 17; and of levelness, F(L) 15.
5. The F(L) values listed above are not applicable to elevated slab on deck. Only F(F) values apply to elevated slabs.

D. Correct the slab surface if tolerances are less than specified.

E. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process. Costs for re-measurement testing will be borne by the Contractor.

3.04 REPAIR OF DEFECTIVE WORK

A. Repair of Unformed Surfaces (Slabs): Test unformed surfaces, such as monolithic slabs, for smoothness and to verify that surface planes conform to tolerances specified for each surface and finish. Correct low and high areas as specified. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using a template having required slope.
1. Repair finished unformed surfaces that contain defects which adversely affect durability of concrete. Surface defects include crazing, cracks in excess of 0.01 in. wide or which

penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, pop-outs, honeycomb, rock pockets, and other objectionable conditions.

2. Repair defective areas, except random cracks and single holes not exceeding 1-inch diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4 in. clearance all around.
    a. Dampen concrete surfaces in contact with patching concrete and apply specified bonding compound. Place patching concrete after bonding compound has dried. Mix patching of same materials to provide concrete of same type or class as original concrete. Place, compact and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
3. Repair isolated random cracks and single holes not over 1 in. in diameter by dry-pack method. Groove top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose particles.
4. Correct high areas in unformed surfaces by grinding, after concrete has cured at least 14 days.
5. Correct low areas in unformed surfaces during, or immediately after completion of, surface finishing operations by cutting out low areas and replacing with fresh concrete if floor is exposed or self-leveling cement-based product approved by the Architect. Self-leveling product used must be compatible with all types of finished flooring being used. Finish repaired areas to blend into adjacent concrete. Use specified bonding or patching compound.

B. Repair of Formed Surfaces (Walls).
1. Repair finished unformed surfaces that contain defects which adversely affect durability of concrete. Surface defects include crazing, cracks in excess of 0.01 in. wide or which penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, pop-outs, honeycomb, rock pockets, and other objectionable conditions.
2. Repair defective areas, except random cracks and single holes not exceeding 1-inch diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4 in. clearance all around.
    a. Dampen concrete surfaces in contact with patching concrete and apply specified bonding compound. Place patching concrete after bonding compound has dried. Mix patching of same materials to provide concrete of same type, color and/or class as original concrete. Cure in same manner as adjacent concrete.
3. Repair isolated random cracks and single holes not over 1 in. in diameter by dry-pack method. Groove top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose particles.

C. Make structural repairs with prior approval of Architect as to method and procedures, using structural patching mortar.

3.05 SEALER APPLICATION

A. Clean concrete of all dirt, laitance, contaminants, oil, existing coatings or membrane curing compounds before application.

B. Install sealers in accordance with manufacturer’s written instructions and recommendations.

**END OF SECTION 033500**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the project Manual, apply to work of this Section.

B. Section 040513 - Mortar

C. Section 040523 - Masonry Accessories

D. Section 042200 - Concrete Unit Masonry

E. Section 042300 - Glass Unit Masonry

F. Section 079200 - Sealants

1.02 REFERENCES

A. Except as shown or specified otherwise, the Work of this Section shall meet the requirements of the following reference standards:
   1. Design Procedure and Allowable Stresses: Building Code Requirements for Reinforced Concrete ACI 318 of the American Concrete Institute.
   2. Prestressed Concrete Institute MNL 117 “Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products” - 3rd Edition, primarily Appendix J.
   3. Prestressed Concrete Institute’s “Architectural Precast Concrete Design Manual, 2nd Edition”.
   4. ASTM standard as stated herein.

1.03 DEFINITIONS

A. Architectural Precast Concrete: Plant cast, architecturally finished, precast concrete units generally referred to in this Section as precast units.

1.04 SUMMARY

A. This specification covers all labor, materials and services for the furnishing and setting of the integrally colored architectural precast concrete units as indicated on the Contract Drawings and specifications herein. Contractor has the option to provide these units either in precast concrete or limestone (see 044300). All units must be of the same manufacturer unless noted otherwise.
   1. Precast concrete sills.
   2. Precast heads and keystones.
   3. Precast watertable.
   4. Precast date stone.
   5. Engraved precast medallion (this can be limestone on its own).

1.05 SUBMITTALS

A. Submit pursuant to Section 0133000 - Submittal Procedures.

B. Submit pursuant to Section 016000 - Product Requirements.

C. Shop Drawings:
   1. Prepared by an experienced professional detailer, showing complete information for fabrication and installation of precast concrete units.

a. Show layout, dimensions and identification of each precast unit corresponding to sequence and procedure of installation.
b. Make design modifications only as necessary to meet field conditions and to ensure proper fitting of the work and only as acceptable to the Architect.

2. The fabricator shall submit the shop drawings to the GC who shall verify all drawing dimensions and coordinate the shop drawings with field conditions and other trades. The GC shall submit the shop drawings to the Architect for approval. The fabricator shall not start production until the shop drawings and color are approved by the Architect and GC in writing.

D. Product Data: Manufacturer's catalog sheets, specifications, and installation instructions.

E. Quality Control Submittals:
1. Manufacturer's Qualifications Data: Architectural precast concrete manufacturer's name and address, and names and addresses of 5 similar projects where the proposed manufacturer's precast units have been in service for 5 years.

F. Samples:
1. Minimum size - 6” x 6” x 2” to illustrate the quality, color and surface finish texture.
2. Color: Fabricator must develop a custom colored mix to match a colored sample provided by the Architect. The color sample to match would either be an earth tone color shade (such as Indiana limestone color, off-white, buff, brown, brick orange, brick red, light gray, dark gray, dull yellow) or pure white. Painted, stained or coated precast is not acceptable. Unless otherwise noted, all the precast units on the project will be the same color and of the same mix design.
3. Texture: Smooth, dense, fine-grained texture achieved by acid etching to thoroughly remove all surface cement paste.

## 1.06 QUALITY ASSURANCE

A. Manufacture: Precast units shall be plant fabricated.

B. The fabricator shall have a minimum of 5 years successful experience in fabrication of architectural precast concrete units, similar to units required for this project. Fabricator must be an APA (Architectural Precast Association) Certified Plant or a PCI Prestressed/Precast Concrete Institute) certified Plant for category AT or A1 (Architectural Precast). Fabricator must adhere to procedure that are applicable to the manufacturing of Architectural Precast Concrete trim pieces as outlined in Appendix J of PCI MNL-117 (3rd Edition) and the PCI Design manual (2nd Edition).

## 1.07 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Load, transport, and unload precast units by methods that will prevent damage.

B. Storage: Store precast units on firm surfaces off the ground. Protect from dirt and staining. Upon removal from the casting plant, protect precast units from freezing temperatures and rapid loss of moisture for a minimum period of 4 days.

C. Handling: Lift and support precast units at design support points.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cement: ASTM C 150, Type I, Type II or Type III Portland cement, except as otherwise indicated.
   1. Cement for Exposed Surfaces/Facing: White, buff, light gray or dark gray Portland cement as necessary to match required color of concrete and mortar.

B. Aggregates: ASTM C 33, except as otherwise indicated.
   1. Exposed/Facing Aggregates: Clean, hard, durable, non-staining, selected and graded aggregate of required appearance, uniform in quality, and free from thin and elongated pieces.

C. Mortar: ASTM C 270, Type S, except as otherwise indicated.
   1. Exposed Mortar Joints:
      a. Mortar: Match Color of precast unit.

D. Water: Fresh, clean, and free from injurious amounts of oils, acids, alkalis, salts, organic material, and other deleterious substances.

E. Air-entraining Admixture: ASTM C 260.

F. Reinforcing Steel:
   1. Bars: ASTM A 615, deformed.
   2. Welded Wire Fabric: ASTM A 185, galvanized.
   3. Tie Wire: Galvanized.

G. Metal Accessories: Anchors, plates, clip angles, seat angles, inserts, bolts, shims, and other necessary devices and accessories required for a complete installation. Unless otherwise indicated, metal accessories shall be steel and hot dipped galvanized after fabrication, or 300 series stainless steel.

H. Shop Paint for Galvanized Steel: FS TT-P-641, Type II.

I. Cold Galvanizing Compound: Single component compound giving 93 percent pure zinc in the dried film and meeting the requirements of DOD-P-21035A (NAVY).

J. Source of Materials: Individual materials shall be obtained from a single source for all similar precast units.

2.02 MANUFACTURED UNITS

A. Continuous sills

B. Date Stone

C. Headers

D. Watertable

E. Keystones

F. Medallion

2.03 CONCRETE MIXES

A. Concrete shall be proportioned to comply with the following, except as otherwise indicated:
   1. Compressive Strength: Minimum 5000 psi at 28 days.
   2. Air-Entrainment: 5% to 8% (by volume) total air content. Use air-entraining admixture, not air-entrained cement.
   3. Color: to be selected by Architect

B. The quantity of water used shall not exceed 5 gallons per 94-pound bag of cement.

C. Freeze-Thaw Resistance: Freeze-thaw test specimens shall have a minimum durability factor of 70 when tested in accordance with ASTM C 666, Procedure B.

D. Water Absorption: Facing mix absorption test specimens shall have an average water absorption of 6% (by dry weight) or less when tested in accordance with ASTM C 67 for a 24-hour submersion test.

2.04 FABRICATION

A. Units 48" or less in length shall be cast as a single piece. Units greater than 48" total length shall be cast in pieces of equal length.

B. Forms shall conform to the shape, lines, and dimensions of the precast units to be produced, be sufficiently tight to prevent leakage of cement paste, and be constructed to prevent damage to the concrete. Forms shall be rigidly assembled, braced, and stiffened as required to produce castings within the specified tolerances.

C. Steel reinforcement shall be accurately positioned and securely held in place by devices that will not be exposed on or mar the appearance of exposed surfaces on the precast units.

D. Build-in metal accessories at the time units are cast and, wherever practicable, fasten anchors and inserts to the steel reinforcement.

E. Place concrete, facing and backing, in a continuous operation for each unit until the full thickness is reached and the unit is completely cast. Place concrete in a manner which will avoid segregation.

F. Consolidate concrete by vibration so that the concrete is thoroughly worked around the steel reinforcement and other embedded items, and into corners and angles of the forms.

G. Finishes for Exposed Surfaces:
   1. Surfaces Without Exposed Aggregate Facing: Smooth form finish or floated finish as applicable.

H. Finishes for Concealed Surfaces: Form finish or screeded finish as applicable.

I. Curing: Cure precast units in the forms for 16 to 20 hours after casting. Prevent loss of moisture from the units, and supply additional moisture and heat as required by environmental conditions. Continue curing after removal from the forms by moist or steam curing for a minimum of 48 hours unless otherwise approved. Maintain units above 50 degrees F during curing.

J. Shop Painting: Apply one coat (minimum 3.0 mils wet film thickness) of shop paint to surfaces of metal accessories, except surfaces to be field welded and contact surfaces of high-strength bolted connections (if any).

K. Lettering and/or Artwork Staining: All cut or engraved letters or other artwork shall be stained with a Lithochrome Stain. Color as selected by the Architect.

2.05 SOURCE QUALITY CONTROL

A. Tests for Air Content: Determine air content of each batch of concrete in accordance with ASTM C 173. Record results of tests and furnish a copy of test results to the Architect.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions: Examine surfaces to receive precast units for defects that will adversely affect the execution and quality of the Work. Check location and condition of required bearing surfaces, anchors, and inserts. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION

A. Surface Preparation: Thoroughly clean surfaces of adjoining construction of loose and foreign matter.

3.03 INSTALLATION

A. Install precast units in their designed positions and in accordance with the approved setting drawings.
   1. Adjust units true to line, with uniform joint width.
   2. Anchor precast units securely to supporting construction.
   3. Mortar joints to be 3/8” unless noted otherwise.

3.04 ADJUSTING

A. Touch-up of Metal Accessories: Clean and repair welded and abraded surfaces of galvanized metal with a 2 mil (dry) minimum thick coating of cold galvanizing compound; comply with compound manufacturer's application instructions. Touch-up shop paint with same type of paint used for shop coat; include marred surfaces, field bolts, and field welds.

B. Corrective Patching: Patch and refinish minor damage to match adjacent surfaces. Cure patches.

3.05 CLEANING

A. Remove excess sealant and mortar and droppings immediately after soiling.

B. After completion of installation and other activities liable to soil the precast units, clean exposed surfaces of the units with soap powder in clean water applied by scrubbing with stiff fiber brushes. If recommended by the precast unit manufacturer, a cleaning solution which will not be harmful to the units or the joints may be used in lieu of soap and water. Immediately after cleaning, thoroughly rinse units with clean water.

3.06 PROTECTION

A. Protect precast units from damage during construction.

3.07 PERFORMANCE REQUIREMENTS

A. Applicable standards for inspection and quality control shall be Appendix J (Architectural Trim Requirements) in PCI MNL - 117 “Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products” (3rd Edition) and PCI’s Architectural Precast Concrete Design Manual, 2nd Edition”.

B. The Architectural Precast Concrete units shall show no obvious repairs or imperfections other than minimal color variations when viewed with the unaided eye at a 20-foot distance in good typical daylight illumination.

C. Any unacceptable precast units that cannot be repaired to the Architect’s satisfaction in accordance with the aforementioned criteria are deemed unacceptable and are to be replaced by the Contractor.

**END OF SECTION 034500**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. Precast Bollards.

B. Setting material, grouts, sealants and caulks.

C. Installation of steel units to receive precast bollards.

D. Installation of concrete substrate to receive precast bollards.

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM)
   1. ASTM C150/C150M
   2. ASTM C33/C33M
   3. ASTM C260/C260M
   4. ASTM C494/C494M
   5. ASTM C128
   6. ASTM C31/C31M

B. Precast Concrete Institute PCI (CERT)

C. American Concrete Institute ACI 318

1.04 SUBMITTALS

A. Pursuant to Section 013300 - Submittal Procedures.

B. Pursuant to Section 016000 - Product Rquirements.

C. Shop Drawings
   1. Submit shop drawings of all precast concrete items showing detail sections and profile for all precast items. Details shall show all reinforcing and special hardware required for fastening.

D. Samples
   1. Submit small physical samples of all available colors in all available finishes for initial color/finish selection. If requested by Architect provide two larger samples of selected colors and finishes.

1.05 PERFORMANCE REQUIREMENTS

A. Compressive Strength: 5000 p.s.i.

B. Air Content: 6-8%

C. Water-Cement Ratio: .45:1

1.06 QUALITY ASSURANCE

A. PCI Standards: Produced by a PCI Certified Plant according to all PCI provisions and recommendations.

B. Precast manufacturing plant shall be certified, category AT - Architectural Trim, by the Precast Concrete Institute (PCI) at the time of bidding.

C. Manufacturer's Instructions: In addition to specified requirements, comply with precast concrete manufacturer's instructions and recommendations for substrate preparation, material storage, mixing and application, finishing and curing.

D. Qualifications: Precast Concrete Manufacturer and Trade Contractor must have a minimum of 5 years of successful experience on projects of similar magnitude and complexity to that indicated project.

E. Manufacturer to supply a written Quality Assurance Program and Procedure Manual..

1.07 DELIVERY, STORAGE AND HANDLING

A. Packaging and Shipping: Precast concrete to be palletized and shrink wrapped, delivered in original unopened packaging with legible manufacturer identification, including size, piece number, quantities, manufacture date and inspectors initials.

B. Storage and Protection: Precast concrete to be stored in secure area in original packaging. Protect from damage by other trades.

1.08 WARRANTY

A. Manufacturer/Installer shall warrant installed system for a period of 2 years from date of substantial completion against failure of workmanship and materials.

PART 2 PRODUCTS

2.01 PRECAST DECORATIVE BOLLARDS

A. Manufacturer:
   1. Tectura Designs - Wausau Tile, Inc., 9001 Business Highway 51, Rothschild, WI 54474. Phone: 800-388-8728 or Architect approved equivalent matching in style, texture and color.

B. Materials:
   1. Portland Cement: ASTM C-150 specifications for Portland Cement.
   2. Aggregates: All aggregates to meet ASTM C-33 specifications, cleaned and properly graded to size. Aggregates shall be blended to meet individual project requirements.
   3. Reinforcement and Hardware: conform with ACI and manufacturer's design.
   4. Caulks and Sealants: Polyurethane or acrylic sealant as per Section 079200.
      a. Color as selected by the Architect from the manufacturer's full color range.
   5. Sealer: Colorless, pure acrylic water-repellent penetrating sealer. Sealer to maintain natural look of concrete surface with no glaze or gloss, darkening or color change.

C. Size and Style:
   1. Model WS6125; 15 inch dia. x 38 inch high.

D. Color:
   1. Pigments used shall be inorganic, resistant to alkalinity and used per manufacturer's recommendations.
   2. Color as selected by Architect from manufacturer's standard Weatherstone and/or Acid Washed Colors.

E. Sizing Tolerances:
   1. All units to conform to shop drawings, with a 1/8" tolerance in dimension.

F. Precast Surfaces and Edges:
   1. All exposed edges to have minimum 1/8" chamfer to prevent chipping.
   2. All precast concrete finished surfaces to be sealed with a sealer approved by manufacturer.

G. Foundation: Provide cast-in-place sonotube foundation as detailed on Contract Drawings.
   1. Provide 3” diameter schedule 40 galvanized pipe to connect foundation to bollard.
   2. Top of foundation must be finished, level and smooth.
   3. Provide smooth rubbed finish on any portion of foundation exposed to view.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install anchors and bollards plumb and level.

B. Set accurately in setting method as shown on approved shop drawing.

C. Set bollard in a double circular bead of caulk on top of foundation.

D. Caulk any gaps between precast bollard and foundation.

3.02 PROTECTION

A. Protect installed products from damage during construction until completion of the project.

**END OF SECTION 034813**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SCOPE

A. This Section includes grouting of the following:
   1. Base plates, leveling plates, bearing plates and sleeves.
   2. Concrete masonry unit (CMU) cores where specified or shown on Contract Drawings.
   3. Concrete masonry unit (CMU) cores where other items are attached or secured to CMU whether indicated on Contract Drawings or not.
   4. Concrete masonry bond beams.
   5. Hollow metal door frames located in concrete and/or CMU walls.
   6. Other miscellaneous grouting as shown on Contract Drawings or required by individual specifications.
   7. Adhesive type epoxy grout for dowel and/or fastener anchorage.

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Section 042200.11 - Reinforced Unit Masonry
   2. Section 051200 - Structural Steel Framing
   3. Section 055000- Metal Fabrications
   4. Section 055100 - Metal Stairs, Handrails and Railings

1.03 STANDARDS

A. All work of this section shall conform to industry standards and/or manufacturer’s recommendations.

B. ASTM C33 - "Standard Specification for Concrete Aggregates".

C. ASTM C109 - "Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 in. or [50 mm] Cube Specimens)".

D. ASTM C150 - "Standard Specification for Portland Cement".

E. ASTM C476 - "Standard Specification for Grout for Masonry".

F. ASTM C494 - "Standard Specification for Chemical Admixtures for Concrete".

G. ASTM C827 - "Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures".

H. ASTM C1107 - "Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)".

1.04 SUBMITTALS

A. Submit pursuant to Section 013300 - Submittal Procedures.

B. Submit pursuant to Section 016000 - Product Requirements.

C. Manufacturer's product data for pre-mixed non-shrink grout and adhesive type epoxy grouts.

D. Submit mix designs with test reports for all field mixed or ready mix supplied grouts. Provide source reports for all grout components i.e. cement, sand, admixtures (if any), water and any other ingredients.

E. Certificates of Compliance for all grout products used on the project.

1.05 QUALITY ASSURANCE

A. All work of this section shall be performed by experienced workers familiar with the work and according to manufacturer's recommendations and/or industry standards.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturer's published instructions.

B. Protect against moisture exposure and damage.

PART 2 PRODUCTS

2.01 NON-METALLIC, NON-SHRINK GROUT

A. Description: Premixed, non-staining, non-gassing grout, requiring only the adding of water, suitable for use as plastic, flowable, or fluid mix with no shrinkage in either the plastic or the hardened state.
   1. Compressive strength at 28 days, from flowable mix: pass ASTM C109; 5000 lb./sq. in. minimum.
   2. Volume change from plastic to hardened state: pass ASTM C827; -0%, to +2% maximum.

B. Producers:
   1. Euclid NS Grout, by The Euclid Chemical Company.
   2. Five Star Grout, by Five Star Products, Inc.
   3. MasterFlow 885 by Master Builders.
   4. Architect approved equivalent.

2.02 GROUT FOR CONCRETE UNIT MASONRY

A. Cement: Portland cement shall be ASTM C150 Type I or Type II, containing less than 0.6 percent alkali.

B. Aggregate:
   1. General: Aggregate shall be non reactive and shall be washed before use. When sources of aggregate are changed, test reports shall be provided for the material from the new source prior to commencing grout work.
   2. Fine Aggregate: Fine aggregate shall be washed natural sand conforming to ASTM C33 Fine Aggregate Spec.
      a. Use fine grout for spaces up to 1 1/2" wide or to fill cells up to 4" in size.
   3. Coarse Aggregate (Coarse grout only): Washed crushed stone conforming to the gradation requirements of ASTM C33 Size No. 8 (3/8" to No. 8).
      a. Use course grout only to fill cells having larger dimensions.

C. Admixtures:
   1. Water Reducing Retarder: Water reducing retarder shall comply with ASTM C494, Type D.

D. Water:

1. Water for mixing and curing shall be potable, shall not contain more than 1000 mg/l of chlorides as Cl, nor more than 1300 mg/l of sulfates as SO4, and shall not contain impurities which may change the setting time by more than 25 percent or a reduction of more than 5 percent of the compressive strength of the grout at 14 days when compared to the results for grout made with distilled water.

E. Compressive strength at 28 days: 3,000 psi.

F. Mix Ratio:
   1. 1 part Portland cement
   2. 0.1 part hydrated lime or lime putty
   3. Aggregate as follows:
      a. For fine grout, use fine aggregate in a volume of 2.2 to 3.0 times the sum of the volumes of the cementitious materials.
      b. For a course grout with fine aggregate, use aggregate in a volume of 2.25 to 3.0 times the sum of the volumes of the cementitious materials.
      c. For a course grout with course aggregate, use aggregate in a volume of 1 to 2 times the sum of the volumes of the cementitious materials.
      d. Maintain a slump of 8 to 10 inches.

2.03 ADHESIVE RESIN FOR DOWEL OR FASTENER ANCHORAGE

A. ICC approved, structural epoxy; prepackaged in cartridges for manually or pneumatically operated caulk gun and automatically mixed thru the nozzle.
   1. Hilti HIT-HY 200-R Adhesive Anchoring System.
   2. Hilti HIT-RE500 V3 Injectable Epoxy Mortar.
   3. Architect approved equivalent.

PART 3 EXECUTION

3.01 INSTALLATION

A. Prepare surfaces, install non-shrink grout, and cure pursuant to manufacturer’s recommendations.

B. Holes required for grouting or adhesive resin application shall be; brushed clean; blown clean with compressed air and are to be free of dust and/or water.

C. Install grout in driest, stiffest possible mix, pursuant to manufacturer's published mixing instructions, that will assure filling of voids. Fill space between structural support member and bearing structure and work the grout so as to assure full contact and no voids. Trim and seal exposed edges.

D. Install adhesive resin in accordance with manufacturer's instructions. Verify components are within expiration dates.

3.02 FIELD QUALITY CONTROL

A. Owner will engage the services of an independent testing agency to perform special inspections of all grout placement and random compressive strength testing of grout in accordance with the Special Inspection requirements.

**END OF SECTION 036000**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED SECTIONS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This Section includes mortar for all concrete unit masonry, ACMU Veneer masonry, Stone masonry, and precast concrete units.

B. Related Sections
1. Section 034500 - Precast Architectural Concrete
2. Section 040523 - Masonry Accessories
3. Section 042200 - Concrete Unit Masonry
4. Seciton 042200.11 - Reinforced Unit Masonry
5. Section 042300 - Glass Unit Masonry
6. Section 044300 - Stone Masonry
7. Section 079200 - Sealants

1.03 STANDARDS

A. All work of this section shall conform to industry standards and/or manufacturer’s recommendation.

B. ASTM C91 "Standard Specifications for Masonry Cement".

C. ASTM C109 "Standard Test Method for Compressive Strength of Hydraulic Cement Mortars".

D. ASTM C144 "Standard Specification for Aggregate for Masonry Mortar".

E. ASTM C150 "Standard Specification for Portland Cement".

F. ASTM C207 "Standard Specifications for Hydrated Lime for Masonry Purposes".

G. ASTM C270 "Standard Specifications for Mortar for Unit Masonry".

H. ASTM C780 "Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry".

I. ASTM C979 "Standard Specification for Pigments for Integrally Colored Concrete".

1.04 SUBMITTALS

A. Submit pursuant to Section 013300 - Submittal Procedures.

B. Submit pursuant to Section 160000 - Product Requirements.

C. Submit certificates of compliance and manufacturer's technical data describing: cement, lime, sand and admixture products specified.

D. Submit manufacturer's technical data describing integral coloring specified.

E. Submit small mortar samples depicting integral coloring. Provide manufacturer's entire range of available colors. Plastic samples representing available colors are not acceptable.

F. Mortar mix designs for each type of mortar. Include description of type and proportions of ingredients.
   1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109 for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.

G. Submit results of tests of field specimens.

1.05 QUALITY ASSURANCE

A. All work of this section shall be performed by experienced workers familiar with the work and according to manufacturer's recommendations and/or industry standards.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturer's published instructions.

B. Protect against moisture exposure and damage.

PART 2 PRODUCTS

2.01 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II.
   1. Provide white cement for integral coloring where required to obtain desired mortar color.

B. Sand: ASTM C144; local mason sand.

C. Water: Clean, potable and salt free.

D. Lime: ASTM C207, Type S mortar.

E. Provide all cement products from one manufacturer.

2.02 ADMIXTURES

A. Admixtures containing calcium chlorides are prohibited.

B. All mortar for exterior concrete masonry applications shall contain "Dry-Block" integral water repellent mortar admixture. Do not use "Dry-Block" integral water repellent mortar admixture with clay masonry applications.
   1. Apply at dosage recommended by the manufacturer.

2.03 INTEGRAL COLORING

A. Product: dry mixture of pure, non-fading, alkali-resistant iron-oxide pigments possessing uniform dispersion characteristics specifically intended for mixing into mortar and complying with ASTM C979.

B. Color selection by Architect.

2.04 MORTAR MIX

A. Prepare mortar mixes pursuant to "Property Specification Requirements" of ASTM C270 for types indicated on Drawings and herein specified. Do not exceed manufacturer's recommended pigment to cement ratio in colored mortar.

B. Exterior Concrete Unit Masonry (ACMU)
   1. Mortar:
      a. Type S (minimum average compressive strength at 28 days: 1,800 lb./sq. in.).
      b. Mix: Portland cement/lime/sand.
   2. Admixture:
      a. Coloring pigments, color as selected by Architect.
      b. Must contain admixture for waterproofing
         1) Submittals must specify water repellent agent.
         2) Submit product literature for approval prior to using mortar on any finished area.

C. Interior Concrete Unit Masonry
   1. Mortar:
      a. Type S (minimum average compressive strength at 28 days: 1,800 lb./sq. in.).
      b. Mix: Portland cement/lime/sand.
      c. Color: Standard gray
         1) Standard gray at CMU to be painted.

D. Tests
   1. Prepare mix designs and conduct tests using a recognized laboratory.

PART 3 EXECUTION

3.01 MIXING

A. Mix mortar by methods that will ensure accurate proportioning of all required ingredients to a uniform consistency.

B. Mechanically mix between 3 to 5 min. Hand mixing is prohibited.

C. Select ingredients that are compatible.

D. Do not combine two air entraining materials within same mortar mix.

3.02 RETEMPERING

A. Use mortar within 2-1/2 hours of initial mixing.

B. Discard unused mortar after it has begun to set. Do not re-temper mortar that has begun to set.

3.03 ADMIXTURES

A. Mix admixtures into mortar pursuant to manufacturer's published instructions.

3.04 INTEGRAL COLORING

A. Provide integral coloring to mortar for all exterior walls and interior ACMU walls if any.

B. Mix into mortar pursuant to manufacturer's published instructions.

3.05 FIELD QUALITY CONTROL

A. Inspectors: Owner will engage qualified independent inspectors to perform inspections and prepare reports. Allow inspectors access to scaffolding and work area, as needed to perform inspections.

B. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests, inspections and prepare test reports:
   1. Payment for these services will be made by Owner.

C. Mortar Tests: Test each type of mortar in accordance with ASTM 780, testing with same frequency as masonry samples.
   1. Test three samples for each 5,000 square feet of wall area or portion thereof; test one sample at 7 days and two samples at 28 days for each set.

**END OF SECTION 040513**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Specifications, apply to work of this Section.

1.02 SUMMARY

A. This section includes the following masonry related items:
   1. Metal horizontal joint reinforcement for masonry.
   2. Wall ventilation for masonry.
   3. Masonry veneer anchors.
   4. In wall cavity mortar netting with insect barrier.
   5. Thru wall flashing.
   6. Masonry Control Joints.
   7. Masonry Partition Anchors and Z Ties.
   8. Grout Screen.
   9. Masonry anchorage to steel columns and beams.
   10. Expansion and adhesive anchor bolts.

B. Related Sections:
   1. Section 034500 - Precast Architectural Concrete
   2. Seciton 040513 - Mortar
   3. Section 042200 - Concrete Unit Masonry
   4. Section 044300 - Stone Masonry
   5. Section 076200 - Sheet Metal Flashing and Trim

1.03 STANDARDS

A. All work of this section shall conform to industry standards and/or manufacturer’s recommendations.

B. ASTM A82 "Standard Specification for Steel Wire, Plain, for Concrete Reinforcement".

C. ASTM A153 "Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware".

D. ASTM A641 "Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire".

E. ASTM A951 "Standard Specification for Masonry Joint Reinforcing".

F. ASTM D2287 "Standard Specification for Non-rigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds".

G. "Building Code Requirements and Specification for masonry Structures" and Companion Commentaries (latest edition) (ACI-530/530.1; ASCE-5; TMS-402/602).

1.04 SUBMITTALS

A. Submit pursuant to 013300 - Submittal Procedures.

B. Submit pursuant to 016000 - Product Requirements.

C. Submit certificates of compliance and manufacturer's technical data for but not limited to: horizontal joint reinforcing, movement joints products, anchors, thru-wall flashing, mortar netting, wall ventilation and rigid ties.

1.05 QUALITY ASSURANCE

A. All work of this section shall be performed by experienced workers familiar with the work and according to manufacturer's recommendations and/or industry standards.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturer's published instructions.

B. Protect against moisture exposure and damage.

PART 2 PRODUCTS

2.01 HORIZONTAL JOINT REINFORCEMENT WITH TIES OR ANCHORS

A. Description: two or more parallel longitudinal deformed rods weld connected with transverse cross rods which forms a ladder design.

B. Provide with out-to-out longitudinal rod spacing two in. less than out-to-out of CMU wythe width.

C. Exterior Application:
   1. Side Rods: Two rods, 3/16-inch diameter.
   2. Cross Rods: 9 gauge.
   3. Finish: hot dip galvanized 1.5 oz. per sq. ft., ASTM A153, Class B-2.
   4. Pintle: super-heavy-duty eyelets, pintles are flattened and serrated.
      a. Embed pintles (hooks) in the mortar joint and extend into the veneer a minimum of 1 ½", with at least 5/8" mortar cover to the outside face.

D. Products: #270 ML Adjustable Eye-Wire by Hohmann & Barnard, Inc., (www.h-b.com). Or approved equivalent.

2.02 HORIZONTAL JOINT REINFORCEMENT WITHOUT TIES OR ANCHORS

A. Description: two or more parallel longitudinal deformed rods weld connected to a continuous diagonally oriented cross rod which forms a "ladder" design.

B. Provide with out-to-out side rod spacing two in. less than out-to-out total wall system width.
   1. Lap side rods minimum of 6" at splices u.o.n.

C. Exterior Application:
   1. Side Rods: 2 min., 3/16-inch diameter.
   2. Cross Rods: 9 gauge.
   3. Finish: hot dip galvanized 1.5 oz. Per sq. ft., ASTM A153, Class B-2.

D. Interior Application:
   1. Side Rods: 2 min., 3/16-inch diameter.
   2. Cross Rods: 9 gauge.
   3. Finish: mill galvanized minimum of .10 oz. psf.

E. Products: #220 Ladder Mesh by Hohmann & Barnard, Inc. (www.h-b.com), or approved equal.

2.03 MASONRY VENEER ANCHORING SYSTEM TO EXISTING BUILDING CMU

A. Description: Masonry fastener assembly for refacing a masonry veneer to existing masonry construction with a minimum 3/4" cavity.

B. Product: #BL-5407 Repair and Restoration Anchors by Hohmann & Barnard, Inc.
   1. Finish: Hot-dip galvanize.
   2. Base plate: 16-gauge.
   3. Wire tie: 3/16" diameter.

C. Fastener: BL-523 Brass Expansion Bolt.

D. Spacing:
   1. 16" horizontally and 16" vertically, unless noted otherwise.
   2. Provide additional anchors within 8" horizontally of any opening or outside corner and space anchors that are within 8" of any opening at 8" o.c. vertically.
   3. Provide additional anchors located within 4" of the top of the veneer, 16" o.c. horizontally.

2.04 VENEER ANCHORING SYSTEM (HB-213)

A. Description: vertically adjustable mechanical anchoring system for anchoring masonry veneer to metal stud wall construction.

B. Provide 14-gauge HB-213 with 3/16-inch diameter 2X-Hook as manufactured by Hohmann & Barnard, Inc. or approved equivalent.
   1. Embed 2X-Hook in the veneer mortar joint a minimum of 2”, with at least 5/8” mortar cover to the outside face.

C. Install at wall studs through exterior gypsum wall board.
   1. Space mechanical ties at 24” o.c. horizontally and 16” o.c. vertically when wall studs are 24” o.c.
   2. Space mechanical ties at 16” o.c. horizontally and 24” o.c. vertically when wall studs are 16” o.c.
   3. At openings in veneer (windows, doors, louvers, etc.) that exceed 16” in any direction, place additional mechanical ties around the perimeter of the opening at 36” o.c. maximum and shall be placed within 12” of the perimeter of the opening.

D. Finish: hot dip galvanized.

2.05 VENEER ANCHORING SYSTEM (THROUGH INSULATION TO CMU OR CONCRETE WALLS)

A. Description: Single screw veneer tie anchoring system for masonry veneer to concrete masonry or concrete construction with plastic wing nut. Maximum spacing is 1.78 square feet.

B. Provide: 3/16” diam. compressed leg 2X-Hook veneer anchor, ASTM A82/A82M (70 ksi. yield strength), hot dip galvanized.
   1. Embed pintles (hooks) in the mortar joint and extend into the veneer a minimum of 1-1/2”, with at least 5/8” mortar cover to the outside face.

C. Install directly to CMU and concrete walls.
   1. At CMU walls space mechanical ties at 24” o.c. vertically (with 12” tall veneer) and 16” o.c. horizontally.
   2. At concrete walls, space mechanical ties at 12” o.c. vertically (with 12” tall veneer) and 20” o.c. horizontally.

3. Install at 12” o.c ea. way within 16” around perimeter of openings in veneer that exceed 16” in any direction.
4. Predrill CMU and concrete to accept screw.

D. Finish: type 304 stainless steel with polymer coated screw.

E. Product: 2-Seal Thermal Concrete Wing Nut Anchor with 2X-Hook by Hohmann & Barnard, Inc. (www.h-b.com), or approved equal.

2.06 MASONRY ANCHORING SYSTEM (MASONRY ANCHORED TO STRUCTURAL STEEL)

A. Description: vertically adjustable mechanical anchoring system for masonry to steel construction. All columns that face and are adjacent (within 2 inches) to masonry shall have masonry anchors on those sides for full height of masonry. All steel beams that face masonry shall have masonry anchors on the web of the beam facing the masonry for the full length of the beam.

B. For vertical applications (faces of columns): Provide #317 (1/4-inch diameter) continuous wire rod anchor welded to steel members. Use #316's when CMU is parallel with steel. Use #318 triangular ties when CMU is perpendicular to steel. All as manufactured by Heckmann Building Products, Inc. or approved equivalent. Where face of columns are covered by spray foam insulation, use Hohmann & Barmard HB-213-2x (12 ga. backplate) adjustable veneer anchors welded or mechanically fastened to steel columns.

C. For horizontal applications (webs of beams): Provide #315 (1/4-inch diameter) wire rod anchors welded to steel members. The veneer ties are to be a triangular wire, 3/16-inch diameter. Use #316's when CMU is parallel with steel. Use #318 triangular ties when CMU is perpendicular to steel. All as manufactured by Heckmann Building Products, Inc. or approved equivalent.

D. Install as indicated on the drawings. When not indicated space triangular ties at 16 inches on center for vertical applications and space anchors and triangular ties at 16 inches on center for horizontal applications.

E. Finish: #315’s and #317’s furnish plain or galvanized, painted with steel in shop. #316's and #318's hot dip galvanized 1.5 oz. per sq. ft. ASTM A153, Class B-2.

2.07 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60

2.08 MOVEMENT JOINT PRODUCTS

A. Hohmann & Barnard or approved equivalent
1. Control joint - RS Series Rubber Control Joint
   a. Preformed Control Joint Gaskets: Rubber - ASTM D2000
   b. Designed to fit standard sash block and to maintain lateral stability
   c. Install in as continuous piece vertically as possible.
2. Joint Stabilization Anchors
   a. Slip-Set Stabilizer
   b. Finish: hot dip galvanized.
   c. Install at masonry vertical control joints at 2’-0” o.c. vertically.
3. Veneer Control Joint-NS Closed Cell Neoprene Sponge with Slip-Set Stabilizers at 2’-0” o.c. vertically.

2.09 GROUT SCREEN

A. Hohmann & Barnard or approved equivalent
   1. MGS Mortar/Grout Screen based on CMU thickness.
   2. Use where required to maintain grout in filled cells.

2.10 THROUGH-WALL FLASHING (BASE FLASHING, THRU-WALL FLASHING)

A. Perm-A-Barrier by GCP Applied Technologies, Inc. or Architect approved equivalent, field adhered to a 26-gauge stainless steel drip edge, 2" wide with a 3/16" hemmed drip. Secured at the top by a 1/8" x 1", 304 stainless steel termination bar in 12' lengths, fastened at each stud in all stud-wall back-up situations. Fasten termination bar at 12" o.c. at CMU back-up walls. The flexible flashing material is to be a minimum of 8 mil, high density, cross laminated polyethylene film integrally bonded to 32 mils of rubberized asphalt.
   1. Install in accordance with manufacturer's printed instructions at all exterior conditions.
   2. Mortar shall be bedded above and below the flashing.
   3. Flash all shelf angles including but not limited to lintels, bond beams, sills, wall bases and any other obstructions to natural flow of water within the wall cavity.
   4. Install end dams a minimum of 1" high at all shelf angles, sills and other ends.
   5. Lap all joints a minimum of 6" and seal with manufacturers approved mastic.
   6. Cut, form and seal all inside and outside corners.
   7. Any penetration of the flashing must be sealed.
   8. All thru wall flashings to rise a minimum of 8" to the interiors. Use termination bar and caulk at exterior sheathing and CMU.

2.11 WALL DRAINAGE AND VENTILATION

A. Description: cell ventilation and weep unit.
   1. Provide "Quadro Vent™ as manufactured by Hohmann & Barnard, Inc. or approved equivalent.
   2. Install directly on top of through wall flashings and at highest point in cavity at 32" o.c. in ACMU.
   3. Color: to be selected by Architect.
   4. If cell vent appears in profiled unit (Bullnose, chamfered, etc.) trim cell vent to profile shape.

2.12 IN WALL CAVITY MORTAR NETTING

A. Description: 90% open polymeric mesh with insect barrier to allow unobstructed passage of air and water as base of wall cavity.

B. Product: Mortar Net® with Insect Barrier, by Mortar Net Solutions™, 10" high by thickness required.

C. Match product size to cavity size. Cavity should be no more than ¼" wider than 1" thick material and 2" thick material, and 0.4" thick material should touch both the outer wythe and the inner wall. For cavities larger than 2", place rigid insulation of sufficient height to extend at least 6" above the top of the Mortar Net® with Insect Barrier against the outside of the inner wythe and of appropriate thickness to reduce the cavity to the appropriate size or add additional layers of Mortar Net® to fill width of cavity.

2.13 EXPANSION BOLTS (ATTACHING STEEL MEMBERS TO MASONRY WALLS)

A. Description: Stud type with a single piece three section wedge and zinc plated in accordance with ASTM B633 or where specified, type 304 or type 316 stainless steel. See drawings for locations where stainless steel is required. Anchors shall be installed in drilled holes per manufacturer's recommendations.

B. Product: Hilti Kwik Bolts, diameter as specified, by Hilti Corp. or approved equal.

2.14 ADHESIVE ANCHOR BOLTS (ATTACHING STEEL MEMBERS TO MASONRY ELEMENTS)

A. Description: Threaded anchor rods, nut and washer, a cylindrical mesh screen tube and an injectable adhesive (components A and B) material. Screen tube and anchors shall be installed in drilled holes and per manufacturer's recommendations. Anchor rods supplied in accordance with ASTM A 36, or if required: ASTM F 593 (AISI 304 stainless steel). Nuts shall be furnished to meet the requirements of the above anchor rod specifications. Anchors rods (non-stainless steel), nuts and washers to be zinc plated in accordance with ASTM A 153.

B. Product: Hilti HIT-HY 10 PLUS, diameter as specified, by Hilti Corp. or approved equal.

2.15 RIGID TIES (ATTACHING INTERSECTING MASONRY WALLS TOGETHER WHEN TOOTHING IS UNATTAINABLE)

A. Description: Mild steel "Z" ties, 1/4" thick, 1 1/2" wide x 24" long, with 2" long bent legs, hot dip galvanized. Install at 16" o.c. vertically into fully grouted cores. Adjust overall length when field conditions do not permit use of 24" length. Use longest possible length that permits bent legs to fall in grouted cores.

B. Product: Rigid Partition Anchor Type #344 by Hohmann & Barnard, Inc. or Bent Anchor Type 140 by Heckmann Building Products, Inc. or approved equivalent.

2.16 PARTITION TOP ANCHOR

A. Description: Mild steel, 12 gauge, 8" long with 2" long bent legs, hot dip galvanized. Install at 24" o.c. horizontally. Provide NS-Neoprene sponge in gap between top of CMU and bottom of anchor.

B. Product: PTA Type #422 by Hohmann & Barnard, Inc. or approved equivalent.

PART 3 EXECUTION

3.01 GENERAL

A. If more than one value or requirement is specified, see Drawings for location.

3.02 HORIZONTAL JOINT REINFORCEMENT

A. Place horizontal joint reinforcing as follows:
   1. In solid wall panels, for interior and exterior walls, place at a vertical spacing of 16 in. on center vertically.
   2. In exterior parapets, place at a vertical spacing of 8 in. on center vertically.

B. Place horizontal joint reinforcement in
   1. All concrete unit masonry walls.

C. Place reinforcing in the two (2) bed joints above and below window, louver and door wall openings, extending a minimum of 24" beyond the opening (except at vertical control joints). At other special conditions, place horizontal joint reinforcement as described in manufacturer's published instructions and as illustrated on Drawings.

D. Lap side rods at each end joint a minimum of 6 in. for normal shrinkage stresses.

E. Install prefabricated corner and tee assemblies at each wall corner and intersection.

F. Miter and butt end joints are prohibited.

G. Place horizontal joint reinforcement in approximate center of out-to-out wall assembly and assuring a 5/8 in., minimum, mortar coverage on exterior face.

H. Install horizontal joint reinforcement continuous, terminating only at vertical control joints.

3.03 REINFORCED VERTICAL CELLS (VERTICAL REINFORCEMENT)

A. Place vertical reinforcement in concrete masonry cells as indicated on Drawings using wire-tying or prefabricated bar positioners. Wet-setting reinforcement is not permitted. Comply with requirements in ACI 530.1/ASCE 6/TMS 402/602.

B. Fill concrete masonry cells with fine or course gravel concrete grout (not mortar) as described in Section 042200 "CONCRETE UNIT MASONRY". Grout is specified in Section 036000 “GROUTING’.

C. Place, tie, secure and lap reinforcement pursuant to Section 042200. Vertical bars must be placed within 1/2 inches of the location required within the thickness (out of plane) of the wall. For 12” CMU walls or pilaster, this tolerance can be increased to 3/4 inch.

D. Reinforcement Bars shall be lapped at splices as follows:

| **Bar Size** | **Min. Lap Distance** |
|---|---|
| #4 | 24 inches |
| #5 | 30 inches |
| #6 | 36 inches |
| #7 | 42 inches |

3.04 BENDING, CUTTING AND SPLICING REINFORCEMENT

A. Make bends and splices in reinforcement only where indicated, or prior-approved by Architect. Bend reinforcement only when cold, and prior to any placement in construction, forming around a steel pin of diameter at least 6 times the reinforcement size. Cut bars only by approved sawing, shearing or welding methods. Make ends of reinforcement straight, square, clean and free of defects before splicing. Do not heat or weld bends and splices at points of maximum stress. Clip and bend any tie wires as required to direct the ends away from external surfaces of masonry walls.

B. Where welding is necessary, provide materials and perform welding in accordance with AWS requirements.

3.05 MORTAR NET

A. Install as per manufacturer’s instructions.

B. Install continuous length of mortar net immediately above all through-wall flashings in masonry veneer applications.

3.06 EXPANSION/CONTROL JOINTS IN MASONRY VENEER

A. Install Joint Stabilization Anchors at 2’-0” o.c. vertically in veneer expansion/control joints. Field bend joint stabilization anchors where CJ/EJs occur at perpendicular veneer. Provide NSTA - Closed Cell Neoprene Sponge in veneer control joints.

**END OF SECTION 040523**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes
   1. Face brick.
   2. Mortar and grout.
   3. Ties and anchors.
   4. Cavity Drainage Mat System.
   5. Miscellaneous masonry accessories.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For the following:
   1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.

C. Samples for Initial Selection:
   1. Face brick, in the form of straps of five or more bricks.
   2. Colored mortar.

D. Samples for Verification: For each type and color of the following:
   1. Face brick, in the form of straps of five or more bricks.
   2. Pigmented and colored-aggregate mortar. Make Samples using same sand and mortar ingredients to be used on Project.

1.04 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type and size of the following:
   1. Masonry units.
   2. Pre-blended, dry mortar mixes. Include description of type and proportions of ingredients.
   3. Anchors, ties, and metal accessories.

B. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.05 QUALITY ASSURANCE

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

C. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.
   1. ASTM C67 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile; 2017.

D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Build mockup of typical wall area as shown on Drawings.
   2. Build mockups for each type of exposed unit masonry construction in sizes approximately 60 inches long by 48 inches high by full thickness, including accessories.
      a. Include a sealant-filled joint at least 16 inches long in mockup.
      b. Include through-wall flashing installed for a 24 inch (600-mm) length in corner of exterior wall mockup approximately 16 inches down from top of mockup, with a 12 inch length of flashing left exposed to view (omit masonry above half of flashing).
      c. Include metal studs, sheathing, building wrap, veneer anchors, flashing, cavity drainage material, and weep holes in mockup.
   3. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.
   4. Protect accepted mockups from the elements with weather-resistant membrane.
   5. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
      a. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver pre-blended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store pre-blended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.07 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
   1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.

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 come in contact with such masonry.
   1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
   2. Protect sills, ledges, and projections from mortar droppings.
   3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.

4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ERTA/ASCE 6/TMS 602.

D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ERTA/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.01 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

2.02 BRICK

A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units.
   1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
   2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
   3. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

B. Face Brick: Facing brick complying with ASTM C 216.
   1. Products: Subject to compliance with requirements, provide the following:
      a. Standard Modular size brick unless indicated otherwise. Texture, color and finish shall be selected by Architect from a manufacturer's standard brick selection. For assistance, contact: Rocco Maggio of Consolidated Brick: 127 W. 24th Street, 3rd Floor, New York, NY 10011. Tel.: 516-410-9030.
      b. Syosset Blend as manufactured by Glen Gery Brick and distributed by Consolidated Brick; Contact: Rocco Maggio, Tel.: 516-410-9030.
      c. Or approved equal.
   2. Grade: SW.
   3. Type: FBS
   4. Initial Rate of Absorption: Less than 30g/30 sq. in. (30g/194 sq. cm) per minute when tested per ASTM C 67.
   5. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."

2.03 MORTAR MATERIALS

A. Portland Cement: ASTM C 150, Type I. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of Portland cement and hydrated lime containing no other ingredients.

D. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.

E. Colored Cement Product: Packaged blend made from Portland cement and hydrated lime and mortar pigments, all complying with specified requirements, and containing no other ingredients.
   1. Products: Subject to compliance with requirements, provide the following:
      a. Colored Portland Cement-Lime Mix
         1) Capital Materials Corporation; Riverton Portland Cement Lime Custom Color.
         2) Holcim (US) Inc.; Rainbow Mortamix Custom Color Cement/Lime.
         3) Lafarge North America Inc.; Eaglebond Portland & Lime.
         4) Or Approved Equal.
   2. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
   3. Pigments shall not exceed 10 percent of Portland cement by weight.
   4. Pigments shall not exceed 5 percent of masonry cement by weight.

F. Aggregate for Mortar: ASTM C 144.
   1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
   2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.

2.04 REINFORCEMENT

A. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.

B. Masonry Joint Reinforcement for Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 0.187 inch (4.75 mm) diameter, hot-dip galvanized, carbon-steel continuous wire.

2.05 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
   1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.
   2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304.
   3. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
   4. Stainless-Steel Sheet: ASTM A 666, Type 304.

B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of veneer.

C. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
   1. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch (25.4 mm) of masonry face, made from 0.187-inch diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.

D. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to metal studs, and as follows:
   a. Structural Performance Characteristics: Capable of withstanding a 100-lbf (445-N) load in both tension and compression without deforming or developing play in excess of 0.05 inch (1.3 mm).
2. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section.
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) Heckmann Building Products Inc.; 315-D.
      2) Hohmann & Barnard, Inc.; DW-10HS.
3. Thermal Wing Nut Anchor for Metal Stud Construction: 2-Seal reinforced flame-resistant plastic Wing Nut Anchor with 1 1/2 inch diameter Type 304 Stainless Steel / bonded EPDM washer to seal against insulation and secure insulation to backup. Additional washer on Anchor barrel seals against the Air Barrier. Length of each Anchor shall be as required by the detailed sheathing and insulation depths. Each anchor shall be provided with a Hot-Dip Galvanized, 3/16 inch diameter Compressed Leg 2X-Hook with offsets as required to provide a minimum of 2 inch engagement of the masonry veneer. Space 16 inches on center in each direction maximum or less if indicated on the drawings.
   a. Manufacturer:
      1) Hohmann & Barnard, Inc.
      2) Or approved equal.
   b. For Seismic requirements, provide 3/16 inch diameter continuous Hot-Dip Galvanized wire in conjunction with the 2X-HOOK Seismic Pintle.
4. Polymer-Coated, Steel Drill Screws for Steel Studs: ASTM C 954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 (4.83-mm) diameter by length required to penetrate steel stud flange with not less than three exposed threads, and with organic polymer coating with salt-spray resistance to red rust of more than 800 hours per ASTM B 117.

## 2.06 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:
   1. Fabricate through-wall metal flashing embedded in masonry from stainless steel, with ribs at 3-inch (76-mm) intervals along length of flashing to provide an integral mortar bond.

B. Flexible Flashing: Use the following unless otherwise indicated:
   1. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy.
      a. Products: Subject to compliance with requirements, provide the following:
         1) Mortar Net USA, Ltd.; Total Flash.
         2) Or approved equal.
      b. Monolithic Sheet: TPO Elastomeric thermoplastic flashing, 0.040 inch (1.0 mm) thick with integral stainless steel drip edge, drainage matrix, stainless steel termination bar with #14 x 2" fasteners at 6" o.c., integral weeps.
      c. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.

C. Application: Unless otherwise indicated, use the following:
   1. Where flashing is indicated to receive counterflashing, use metal flashing.
   2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
   3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge.

4. Where flashing is fully concealed, use flexible flashing.

2.07 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Pre-molded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

B. Weep/Vent Products: Use one of the following unless otherwise indicated:
   1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe, in color selected from manufacturer's standard.
      a. Products: Subject to compliance with requirements, provide one of the following:
         1) Heckmann Building Products Inc.; No. 85 Cell Vent.
         2) Hohmann & Barnard, Inc.; Quadro-Vent.
         3) Wire-Bond; Cell Vent.
   2. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe; in color selected by the Architect from manufacturer's standard.
      a. Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
         1) Mortar Net USA, Ltd.; Mortar Net Weep Vents.
         2) Or approved equal.

C. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
      b. Mortar Net USA, Ltd.; Mortar Net.
      c. CavClear Masonry Mat; MasonPro, Inc.
   2. Provide one of the following:
      a. Cavity Wall Drainage System: Total Flash System as manufactured by Mortar Net USA, Ltd. System is an all-inclusive flashing/drainage system with adhered cavity drainage/mortar collection material, drip edge, termination bar, weep tabs with included fasteners and adhesives. This system replaces the separate requirements for flashing, weeps, mortar collection products, drip edge and termination bar.
      b. Or an approved equal system.

2.08 FULL HEIGHT MASONRY DRAINAGE MAT

A. Manufacturer and Type: CavClear Masonry Mat as manufactured by Archovations, Inc., 701 Second Street, Hudson, WI 54016, (715) 381-5773 or approved equal.
   1. Description: Full-height Air Space Maintenance and Cavity Drainage Mat. The masonry drainage mat shall be specifically designed for masonry cavities to prevent mortar from contacting the backup and ensure water management. The masonry drainage mat shall be fluid conducting, non-absorbent, mold and mildew resistant polymer mesh consisting of 100% recycled plastic with binder fibers. Masonry drainage mat is to be a non-woven textile product in random pattern and have voids no greater than 1/4" in diameter. Masonry mat is to be designed for substantially continuous installation behind the full-height of all masonry.
   2. Masonry Drainage Mat Thickness: Select masonry mat thickness of as indicated on the drawings inches to allow no more than 3/8 inch tolerance between the masonry mat and masonry wythe.
   3. Sizes: 16 inch high by 8 foot length pieces and/or 8 inch high by 8 foot long pieces as needed to accommodate building components.

2.09 WEEP VENTS

A. Manufacturer and Type: CavClear Weep Vents as manufactured by Archovations, Inc., 701 Second Street, Hudson, WI 54016, (715) 381-5773 or approved equal.
   1. Description: Non-woven mesh with notched bottom.
   2. Color: as selected by the Architect from the manufacturer's full color offering to match mortar.
   3. Size: 3/8 inch by size to match masonry unit dimensions.

2.10 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. EaCo Chem, Inc.
      b. ProSoCo, Inc.

2.11 MORTAR MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
   1. Do not use calcium chloride in mortar.
   2. Use Portland cement-lime mortar unless otherwise indicated.
   3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Pre-blended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a pre-blended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.
   1. Pigments shall not exceed 10 percent of Portland cement by weight.
   2. Pigments shall not exceed 5 percent of masonry cement by weight.
   3. Mix to match Architect's sample.
   4. Application: Use pigmented mortar for exposed mortar joints with the following units:
      a. Face brick.

D. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.
   1. Application: Use colored aggregate mortar for exposed mortar joints with the following units:
      a. Face brick.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

A. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

B. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

C. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
   1. Mix units from several pallets or cubes as they are placed.

D. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C67. Allow units to absorb water so they are damp but not wet at time of laying.

3.03 TOLERANCES

A. Dimensions and Locations of Elements:
   1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch.
   2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.
   3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:
   1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
   2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet , 1/4 inch in 20 feet, or 1/2 inch maximum.
   3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
   4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
   5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch (12 mm) maximum.
   6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m) or 1/2 inch (12 mm) maximum.
   7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:
   1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch , with a maximum thickness limited to 1/2 inch; do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
   2. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3 mm).

3. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.04 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in bond pattern indicated on Drawings; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

C. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

3.05 MORTAR BEDDING AND JOINTING

A. Lay hollow brick as follows:
   1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
   2. With entire units, including areas under cells, fully bedded in mortar at starting course on footings or foundation walls.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.06 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:
   1. Provide an open space not less than 1/2 inch (13 mm) wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
   2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
   3. Space anchors as indicated, but not more than 16 inches o.c. vertically and 24 inches o.c. horizontally.

3.07 ANCHORING MASONRY VENEERS

A. Anchor masonry veneers to wall framing with masonry-veneer anchors to comply with the following requirements:
   1. Fasten anchors with metal fasteners of type indicate as specified by manufacturers. Use two fasteners unless anchor design only uses one fastener.

2. Embed tie sections in masonry joints. Provide not less than 2 inches (50 mm) of air space between back of masonry veneer and face of sheathing.
3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Maximum vertical offset of bed joints from one wythe to the other shall be 1 1/4 inch when utilizing adjustable wall ties such as pintle ties.
5. Pintle ties shall have two legs of W2.8 wire size minimum.
6. Space anchors as indicated, but not more than 16 inches o.c. vertically and 16 inches (407 mm) o.c. horizontally, with not less than 1 anchor for each 1.77 sq. ft. of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 8 inches (203 mm), around perimeter.

3.08 EXPANSION JOINTS

A. General: Install expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span expansion joints without provision to allow for in-plane wall or partition movement.

B. Form expansion joints in brick as follows:
1. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
2. Build flanges of factory-fabricated, expansion-joint units into masonry.
3. Build in compressible joint fillers where indicated.
4. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Section 079200 "Joint Sealants."

C. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 079200 "Joint Sealants," but not less than 3/8 inch (10 mm).
1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.09 LINTELS

A. Install galvanized steel lintels where indicated on drawings.

B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.10 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows unless otherwise indicated:
1. For Total Flash System at base of wall: Install as directed by manufacturer.
2. At lintels, extend flashing a minimum of 8 inches (204 mm) into masonry at each end. At heads and sills, extend flashing 8 inches at ends and turn up not less than 2 inches to form end dams.

C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

D. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/vent products to form vents.

E. Install masonry drainage mat continuously throughout full-height of all exterior masonry cavities during construction of exterior wythe; follow manufacturer's installation instructions. Verify that air space width is no more than 3/8 inch greater than masonry mat thickness. Install horizontally between joint reinforcement. Stagger end joints in adjacent rows. Use multiple layers at bottom of wall and above through-wall flashings when air space depth exceeds masonry mat thickness by more than 3/8 inch. Extend extra mat at least to top of base flashing. Butt adjacent pieces to moderate contact. Fit to perimeter construction and penetrations without voids.

F. Place weep vents in head joints at exterior wythe of cavity wall located immediately above ledges and flashing, spaced 24 inches on center, unless otherwise shown. Leave the side of the masonry units forming the vent space un-buttered and clear of mortar. Install with notched side down. Slide vent material into joint as the two masonry units forming the weep vent are placed.

3.11 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.

B. Inspections: Level 1 special inspections according to the "International Building Code."
   1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.

3.12 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
   1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
   2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
   3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
   4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
   5. Clean brick by bucket-and-brush hand-cleaning method described in "BIA Technical Notes 20."
   6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

3.13 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste; including excess or soil-contaminated sand, waste mortar, and broken masonry units and masonry cut-offs by crushing and mixing with fill material as fill is placed.
   1. Crush masonry waste to less than 4 inches (100 mm) in each dimension.
   2. Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.

C. Legally dispose of off-site, any excess masonry waste.

**END OF SECTION 042113**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Specifications, apply to work of this Section.

B. Section 034500 - Precast Architectural Concrete

C. Section 036000 - Grouting

D. Section 040513 - Mortar

E. Section 040523 - Masonry Accessories

F. Section 042300 - Glass Unit Masonry

G. Section 044300 - Stone Masonry

1.02 SCOPE

A. Furnish labor and materials necessary to install a complete system.

B. Concrete Masonry Units (CMU) and Architectural Concrete Masonry Units (ACMU) as shown on Drawings and specified herein.

C. Mortar, grout and masonry accessories are specified elsewhere.

1.03 STANDARDS

A. ASTM specification standards C-55, C-90 and C-140.

B. ACI-530/ASCE5/TMS402 "Building Code Requirements for Concrete Masonry Structures and Commentary".

C. ACI-531.1/ASCE 6/TMS 602 "Specifications for Concrete Masonry Construction".

D. National Concrete Masonry Association Manual of Facts

E. National Concrete Masonry Association (NCMA) Tek-Spec #1.

1.04 SUBMITTALS

A. Submit pursuant to Section 013300 - Submittal Procedures.

B. Submit pursuant to Section 016000 - Product Requirements.

C. Samples: Submit two full blocks (face shells are acceptable) of each ACMU color and finish used.

D. Material Certificates: For each type and size of the following:
   1. Masonry units:
      a. Include material test reports substantiating compliance with requirements.
      b. For masonry units include data and calculations establishing average net-area compressive strength of units.
   2. Integral water repellant used in Architectural Concrete Masonry Units (ACMUs).

E. Certification of Compliance: Furnish test reports attesting to compliance with UL-263 or certificates attesting to compliance with UL-618, each or both of which acknowledge compliance with fire ratings specified and strength requirements specified.

1.05 QUALITY ASSURANCE

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 402/602 unless modified by requirements in the Contract Documents.

1.06 DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturer's published instructions.

B. Protect against moisture exposure and damage

C. Deliver and handle materials in such a manner as to prevent damage. Store concrete unit masonry and packaged material above ground on wood pallets or blocking and protect from weather until used. Immediately remove from job site all damaged or otherwise unsuitable material.

D. Receive, store, and protect construction materials in ways that prevent water from entering materials.

E. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

F. Deliver pre-blended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store pre-blended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.

G. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.07 SPECIAL INSPECTIONS

A. The Owner will engage the services of a Special Inspector for this project. The Special Inspector will provide inspection and testing requirements as necessary in accordance with the provisions of the Building Code.

B. In accordance with the Statement of Special Inspections, the Special Inspector shall provide, and coordinate inspections and verifications as noted on Contract Drawings.

C. The Special Inspector shall submit copies of reports to Architect, Engineer, Owner's Site Representative and Contractor on day that tests are made. Include date of testing, weather conditions, building location and test location.

1.08 SAMPLE PANEL

A. Before commencing concrete unit masonry work, erect a sample panel at job site for each separate exposed concrete masonry wall or partition. Locate panels where directed by Architect.

B. Sample panel size for each wall or partition: not less than 6 ft wide by 4 ft high or size shown on Contract Drawings. Construct each sample panel representative of color and texture of the concrete unit masonry and veneer masonry, cavity insulation, bond, reinforcement, jointing, mortar, flashing, weeps and workmanship. Build in conjunction with ACMU and limestone/precast sample panel. Modify panel as required by Architect.

C. Do not start **any** concrete unit masonry work until sample panel has been approved by Architect **in writing**. Leave approved sample panel in place during erection of masonry work. Protect approved sample panel against weather and damage. Remove sample panel from site when so directed by Architect.

D. Sample panel should be used for testing of cleaning methods.

1.09 PROJECT/SITE CONDITIONS

A. At end of day, or during a shut-down, protect top surface of all masonry to prevent rain from entering the masonry. Install protection, adequately anchored, to prevent water intrusion to cover top surface and extend a minimum of 2 ft down all sides of masonry.

B. Brace walls according to NCMA and ANSI requirements.

C. Prevent and remove immediately any mortar, grout and soil droppings that come in contact with CMU/ACMU.

D. Protect base of walls from rain-splashed mud and mortar by means of coverings on ground and over wall surface.

E. Cold Weather Requirements: Comply ACI 530.1 Specification Section 1.8 - Project Conditions.

F. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 402/602.

G. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

PART 2 PRODUCTS

2.01 INTERIOR CONCRETE MASONRY UNITS

A. Hollow load bearing, normal weight, Type I, conforming to ASTM C90, Type 1. Specified concrete masonry strength, f'm = 2,000 psi. (masonry unit net area compressive strength = 2,800 psi.).

B. Hollow non-load bearing, normal weight, Type I, conforming to ASTM C129, fire resistance rating: 2 hour conforming to UL 618, as indicated on Drawings.

C. Unit Thickness: as indicated on drawings using longest standard units compatible with coursing. See Drawings for unit heights.

D. When more than one combination of criteria is specified, see Drawings for locations.

2.02 EXTERIOR ARCHITECTURAL CONCRETE MASONRY UNITS (ACMU)

A. Exterior Architectural Load Bearing Veneer Units - Split Face, and Smooth Face: Normal weight units, with physical properties of ASTM C-55, 3500 psi net area compressive strength and a

maximum 10 lb./c.f. absorption. Maximum lineal shrinkage of .045. Nominal thickness of 4" with nominal face dimensions as required. ASTM C-150 Portland Cement with ASTM C-33 fine and coarse natural, local aggregates. All exterior ACMU shall be as supplied from one source.

1. Zappala Block Co., Broadway and Fifth Ave., Rensselaer, NY 12144, Phone (518) 465-1685.
   a. Color #1: **TBD.**
   b. Color #2: **TBD.**

B. Unit Size: See Drawings for unit height and length.

C. When more than one combination of criteria is specified, see Drawings for locations.

D. ACMU shall be manufactured with an integral water repellent such as "Dryblock".
   1. Manufacturer's submittal must provide written certification indicating water repellant agent.

E. After final cleaning all exterior ACMU and ACMU mortar joints shall be treated with two coats of field applied sealer, per manufacturer's printed instructions.
   1. Monopole Inc. AQUA SEAL Heavy Duty
   2. PROSOCO Sure Klean Custom Masonry Sealer
   3. Architect approved equivalent creating no color change in ACMU.

F. Shapes: Provide special shapes for lintels, corners, jambs, sashes, control joints, headers, water tables, bond beams and other special conditions.

2.03 MASONRY LINTELS

A. General:
   1. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.
   2. Steel Lintels: Install multiple Steel angle lintels as indicated on the drawings. Provide Hot-dip galvanized lintels for exterior installations.

PART 3 EXECUTION

3.01 PREPARATION

A. Examine all surfaces to receive parts of the Work specified herein. Verify all dimensions of in-place and subsequent construction. Application or installation of materials constitutes acceptance of the adjacent and underlying construction.

B. In cavity wall construction, verify all masonry veneer anchors extending thru cavity wall insulation are clean of all spray foam insulation and/or other foreign substances. Any required cleaning of masonry eyelets, plates, etc. must be completed **before** the start of veneer construction. Verify cleaning method has not damaged or bent veneer anchors.

3.02 GENERAL WORKMANSHIP

A. Provide all masonry construction aligned, plumb and true in required layout, making straight level courses, unless otherwise specifically indicated. Construct masonry to full thickness as shown with masonry units of sizes as noted and specified, using whole units wherever possible. Cut masonry neatly by power saw to obtain sharp edges without damage, as approved for providing required bond pattern and proper fit at all adjoining construction. Build-in items and leave accurate openings necessary to accommodate installation of other work, in a manner to

maintain required strength and appearance of masonry construction. Fill solidly around conduit passing through masonry, using mortar.

B. Install pursuant to ASTM E835 unless specifically illustrated to the contrary.

C. No CMU smaller than 4" small be installed in any wall or work area.
   1. The mason shall contact the Architect for interpretation if it appears that smaller than 4" CMU is required.
   2. If the mason installs CMU smaller than 4", he, she or they shall bear the responsibility to remove and replace all effected work.

D. All exposed CMU/ACMU at corners to be return corner block. Exposed outside corners of interior CMU to be bullnose.

## 3.03 CONSTRUCTION TOLERANCES

A. Construct unit masonry within following tolerances:
   1. Maximum variation from plumb in vertical lines and surfaces of columns, walls, and arises and in alignment of head joints:
      a. 1/4 in. in 10 ft.
      b. 3/8 in. in a story height not to exceed 20 ft.
      c. 1/2 in. in 40 ft or more.
   2. Maximum variation from plumb for external corners, expansion joints and other conspicuous lines:
      a. 1/4 in. in any story or 20 ft maximum.
      b. 1/2 in. in 40 ft or more.
   3. Maximum variation from level of grades for exposed lintels, sills, parapets, horizontal grooves, joints, and other conspicuous lines:
      a. 1/4 inches in any bay or 20 feet.
      b. 1/2 in. in 40 ft or more.
   4. Maximum variation from plan location of related portions of columns, walls and partitions:
      a. 1/2 in. in any bay or 20 ft.
      b. 3/4 in. in 40 ft or more.
   5. Maximum variation in cross-sectional dimensions of columns and thicknesses of walls from dimensions shown on Drawings:
      a. Minus 1/4 in.
      b. Plus 1/2 in.

## 3.04 COURSING

A. Lay walls/partitions as shown on Drawings.

## 3.05 MORTAR BEDDING AND JOINTING

A. Lay hollow units with full mortar coverage on horizontal and vertical face shells. Bed webs in all courses of piers, columns, and pilasters, and in starting course on footings and solid foundation walls, and where adjacent to cells or cavities to be reinforced or filled with grout or concrete. Lay solid units with full head and bed joints.

B. Mortar joints: 3/8 thick except where otherwise indicated.
   1. Exposed joint profile: concave.
   2. Concealed joint profile: flush
      a. All CMU to receive ceramic tile shall have all joints in that face finished flush and smooth.
   3. Locations of different joint widths and profiles are shown on Drawings.

C. Bond intersecting non-load bearing walls together in same manner as load bearing walls, except that non-load bearing partitions 8 in. or less in thickness may be anchored to each other and to other walls with Architect approved types of accessories specified in Section 040523 Masonry Accessories.

D. Provide preformed resilient filler strips specified, minimum 3/8-inch think, between tops of walls and undersides of slabs, or decks, or against abutting construction. Set filler strips in joints as masonry is laid up with lengths of strips butted together and all strips firmly compressed. Use solid masonry units, solidly filled units, or end units at such locations.

E. At steel and/or structural concrete columns, provide anchors specifically designed and suited to each condition encountered and as specified in Section 040523 - Masonry Accessories as applicable.

F. At steel columns and elsewhere as indicated, provide preformed resilient filler strips specified. Completely cover all surfaces of columns to be encased in masonry. Neatly fold and fit covering tightly against flange and web surfaces and secure against displacement by taping or tying in place as applicable.

G. Where masonry units abut steel and/or structural concrete columns where such joints are exposed to view, use corner block units to create a straight line joint/interface between the two materials.

H. Lintels:
   1. Install loose lintels in all required locations (masonry openings wider than 18 inches). Note that not all openings requiring loose lintels are detailed on the Contract Drawings. Provide steel angle lintels itemized in the loose lintel schedule on the Contract Drawings. Lintels at exterior openings and where otherwise indicated shall be galvanized.
   2. Provide minimum 8 inches bearing at each jamb, U.N.O. and bed lintels in mortar.

I. Refer to Section 040523 - Masonry Accessories for information on thru-wall flashing.

J. Grout hollow metal frames in masonry walls solidly with grout. Perform grouting without clogging holes, boxes, or spaces, required for the proper installation, or operation of hardware.

K. Provide weep capability in mortar joints at 32” on center horizontally at base of each exterior wall by means of a manufactured insert installed in accord with manufacturer's published instructions.

L. Provide vent capability in mortar joints at 32” on center horizontally at the tops of all cavity walls by means of a manufactured insert installed in accordance with manufacturer’s published instructions.

M. Pointing: During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point up all joints at corners, openings and adjacent work to provide a neat, uniform appearance.

N. Set precast or limestone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
   1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
   2. Allow cleaned surfaces to dry before setting.
   3. Wet joint surfaces thoroughly before applying mortar.

3.06 INSTALLATION

A. Lay out walls in advance for accurate spacing of bond patterns with uniform joint widths and for accurate locating of openings, movement-type joints, returns and offsets. Avoid the use of less-than-half-size units at corners, jambs and where possible at other locations. Where required to provide bond pattern, dry cut units with saw and then thoroughly clean to remove cementitious sawings. Install to fit adjoining work neatly, all with clean, sharp, unchipped edges.

B. Use only dry CMU - do not wet.

C. Build walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other construction.

D. Lay masonry in a one-half running bond pattern with vertical joint in each course centered on units in courses above and below unless indicated otherwise on drawings.

E. All masonry shall be laid on a full bed of mortar coverage or horizontal and vertical face shells and webs. All head and bed joints to be tooled.

F. Fill cores in hollow CMUs with grout a minimum 24” under bearing plates, beams, lintels, posts, and similar items unless otherwise noted.

G. When stopping and resuming work, in each course rack back 1/2-unit length. Do not tooth. Clean exposed surfaces of set masonry and remove loose CMU/ACMU and mortar prior to laying new CMU/ACMU.

H. Care shall be taken when laying exterior ACMU to maintain visual appearance of wall by placing units with similar split face profiles adjacent to each other. Every effort shall be made to avoid excessive protrusions of adjacent split faces at mortar joints.

3.07 PLACING REINFORCEMENT

A. Provide joint reinforcement of types required for locations indicated or specified. Remove all deleterious matter from surfaces before placement, including loose rust and scale adversely affecting bond to mortar or grout. Install reinforcement in accurate position, aligned true and secured against displacement, with a minimum mortar cover of 5/8 in. at exterior face of walls and 1/2 in. at other locations.

B. Provide deformed steel bars as vertical or horizontal reinforcement in masonry construction where indicated or specified. Place vertical bar reinforcing in as continuous lengths as practicable, inserting after laying of masonry and before grouting. Use approved devices to support vertical reinforcement at top, bottom, and intervals not exceeding 160 bar diameters. Wet-setting reinforcement is not permitted. Install horizontal bars as masonry is laid up. Lap all bar reinforcement by distance equal to 48 diameters.

C. Vertical bars must be placed within 1/2 inches of the location required within the thickness (out of plane) of the wall. For 12” CMU walls or pilaster, this tolerance can be increased to 1 inch.

D. Reinforce bond beams with two (2) #5 bars unless otherwise noted.

E. Provide minimum vertical reinforcing of one #4 bar in window and door jambs, at ends of walls, corners, and each side of vertical control joints. Locate bar a maximum of 16 inches from end of CMU. If typical vertical wall reinforcing noted is larger than #4, use the larger size.

3.08 GROUTING OF WALL CONSTRUCTION

A. Use specified "fine" grout mixture to fill wall spaces up to 1-1/2 in. wide or to fill cells up to 4 in. size in hollow masonry units, and use specified "coarse" grout mixture only to fill spaces or cells having larger dimensions at all locations. Grout walls only after setting mortar has stiffened, and columns or pilasters have been braced or tied, as required to prevent displacement of masonry and reinforcement or ties due to pressure of grout pours. Clean and wet surfaces of preceding pour before placing new grout. Provide grouting in continuous manner, with not less than 30 minutes nor more than 1 hr between lifts of any given pour. If grouting is stopped more than 1 hr, form a horizontal construction joint by stopping pour 2 in. below top of uppermost masonry course. Remove all debris, mortar droppings or other matter from cavities and cells before grouting. Consolidate each grout lift with a rod to provide uniform flow into all spaces or voids.
   1. Low-lift Grouting Method: Provide low-lift grouting as the laying of masonry and placement of reinforcement progresses. For grouting of wall spaces, first lift may be placed up to 16 in. high but limit all subsequent pours to maximum 12 in. lifts placed before masonry coursing is 24 in. higher than preceding pour. For grouting of cells in adjacent hollow masonry units, allow setting mortar to cure at least 4 hr after laying masonry, and place grout in cells up to top masonry course at a maximum 48 in. height above preceding pour.

3.09 CONTROL JOINTS

A. Refer to Section 040523 - Masonry Accessories for information on products.

B. Install control joints at locations shown on the Drawings. If locations of control joints are not shown, provide vertical control joints spaced not to exceed 28 feet; locate joints at points of natural weakness in the masonry Work. This would include doors, windows, overhead doors and changes in heights of walls.

C. Mortar Control Joints: Fill abutting cells of masonry units with mortar after installing asphalt felt at one side of joint to break the bond. Rake out joints to a depth of 3/8 inch.

D. Pre-molded Control Joint Strips: Provide sash block units as required. Install joint strip as the Work progresses. Compress strips as masonry units are laid.

E. Build non-bearing partitions to a distance 3/8 to 3/4 in. from structural soffit above. When structure above has deflected from building loads placed upon it, wedge partition to structural soffit with metal or slate wedges and fill top joint with mortar.

F. Do not butter masonry units to steel members, except where masonry bears on steel. Maintain ½ inch clearance. Fill vertical clearances with ½ inch semi-rigid fiberglass or other sort, incombustible board material.

G. Straighten and position anchors and protruding reinforcement which were place in reinforced brick lintel concrete so as to bond fine grout to concrete beam.

3.10 REPAIR MASONRY

A. At completion of the Work, fill with mortar and suitably tool all holes in joints of masonry surfaces to be exposed or painted. Repair any cracks in masonry. Cut out and repoint defective joints.

B. Repair masonry construction as required due to damaged or defective work and where required to accommodate adjacent materials in an approved manner so that patching is not visually apparent.

C. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match and install in fresh mortar, pointed to eliminate evidence of replacement.

D. When pointing, tool all joints required to enlarge any voids or holes, except weep holes, and then completely fill with mortar. Point up all joints including corners, openings and adjacent construction to provide a neat, uniform appearance, prepared for application of sealants.

3.11 CLEANING

A. Shall commence after mortar is thoroughly set and cured. Remove large mortar particles by hand with wooden or non-metallic tools. Test cleaning methods on sample wall panel, leaving 1/4 panel uncleaned for comparison purposes.

B. Obtain Architect's approval of sample cleaning before proceeding with cleaning of CMU/ACMU.

C. Clean CMU/ACMU using ProSoCo EK 2010 All Surface Cleaner or approved equal. Handle and apply per manufacturer's written instructions.

D. No acid or acid based cleaners shall be used. Follow cleaning methods as per National Concrete Masonry Association Tek Spec 08-4A.

E. Dry brush CMU/ACMU walls at end of each day's work and after final pointing. Leave clean and free from mortar spots and droppings.

3.12 FIELD APPLIED SEALER

A. Apply two coats in accordance with manufacturer's instructions on all exterior ACMU and ACMU mortar joints.

B. Protect adjacent work (precast, limestone, windows, doors, fascia, etc.) from sealer over spray.

3.13 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

**END OF SECTION 042200**

**PAGE INTENTIONALLY BLANK**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. The extent of each type of reinforced unit masonry work is indicated on the Contract Drawings and in the schedules.

1.03 SUBMITTALS

A. Mill Certificates: Submit steel producers' certificates of mill analysis, tensile and bend tests for reinforcement steel required for project.

B. Shop Drawings: Submit shop drawings for fabrication, bending and placement of reinforcement bars. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures". Show bar schedules, diagrams of bent bars, stirrup spacing, lateral ties and other arrangements and assemblies as required for fabrication and placement of reinforcement for unit masonry work.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General: Refer to Section "Unit Masonry" for masonry materials and accessories not included in this section.

B. Reinforcement Bars: Provide deformed bars of following grades complying with ASTM A 615, except as otherwise indicated.
   1. Provide Grade 60 for bars No. 3 to No. 18, except as otherwise indicated.
   2. Shop-fabricate reinforcement bars which are shown to be bent or hooked.

PART 3 - EXECUTION

3.01 PLACING REINFORCEMENT

A. 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.

B. Position reinforcement accurately at the spacing indicated. Support and secure vertical bars against displacement. Horizontal reinforcement may be placed as the masonry work progresses. Where vertical bars are shown in close proximity, provide a clear distance between bars of not less than the nominal bar diameter or 1" (whichever is greater).
   1. For columns, piers and pilasters, provide a clear distance between vertical bars as indicated, but not less than 1-1/2 times the nominal bar diameter or 1-1/2", whichever is greater. Provide lateral ties as indicated.

C. Splice reinforcement bars where shown; do not splice at other points unless acceptable to the Architect. Provide lapped splices, unless otherwise indicated. In splicing vertical bars or attaching to dowels, lap ends, place in contact and wire tie.

1. Provide not less than minimum lap indicated, or if not indicated, as required by governing code.

D. Embed metal ties in mortar joints as work progresses, with a minimum mortar cover of 5/8" on exterior face of walls and 1/2" at other locations.

E. Embed prefabricated horizontal joint reinforcement as the work progresses, with a minimum cover of 5/8" on exterior face of walls and 1/2" at other locations. Lap units not less than 6" at ends. Use prefabricated "L" and "T" units to provide continuity at corners and intersections. Cut and bend units as recommended by manufacturer for continuity at returns, offsets, column fire-proofing, pipe enclosures and other special conditions.

F. Anchoring: Anchor reinforced masonry work to supporting structure as indicated.
1. Anchor reinforced masonry wall to non-reinforced masonry where they intersect.

3.02 INSTALLATION, GENERAL

A. Refer to Section "Unit Masonry" for general installation requirements of unit masonry.

B. Temporary Formwork: Provide formwork and shores as required for temporary support of reinforced masonry elements.
1. Construct formwork to conform to shape, line and dimensions shown. Make sufficiently tight to prevent leakage of mortar, grout, or concrete (if any). Brace, ties and support as required to maintain position and shape during construction and curing or reinforced masonry.

3.03 INSTALLATION OF REINFORCED CONCRETE UNIT MASONRY

A. General:
1. Do not wet concrete masonry units (CMU).
2. Lay CMU units with full-face shell mortar beds. Fill vertical head joints (end joints between units) solidly with mortar from face of unit to a distance behind face equal to not less than the thickness of longitudinal face shells. Solidly bed cross-webs of starting courses in mortar. Maintain head and bed joint widths shown, or if not shown, provide 3/8" joints.
a. Where solid CMU units are shown, lay with full mortar head and bed joints.

B. Walls:
1. Pattern Bond: Lay CMU wall units in 1/2 running bond with vertical joints in each course centered on unit sin courses above and below, unless otherwise indicated. Bond and interlock each course at corners and intersections. Use special-shaped units where shown, and as required for corners, jambs, sash, control joints, lintels, bond beams and other special conditions.
2. Maintain vertical continuity of core or cell cavities, which are to be reinforced and grouted, to provide minimum clear dimension indicated and to provide minimum clearance and grout coverage for vertical reinforcement bars. Keep cavities free of mortar. Solidly bed webs in mortar where adjacent to reinforced cores or cells.
3. Where horizontal reinforced beams (bond beams) are shown, use special units or modify regular units to allow for placement of continuous horizontal reinforcement bars. Place small mesh expanded metal lath or wire screening in mortar joints under bond beam courses over cores or cells of non-reinforced vertical cells, or provide unit with solid bottoms.
a. Option: Where all vertical cores are not shown to be grouted, Contractor may elect to fill all vertical cores with grout. In which case, requirements for mortar bedding of cross-webs and closing of core spaces below bond beams do not apply.

C. Columns, Piers and Pilasters:

1. Use CMU units of the site, shape and number of vertical core spaces shown. If not shown, use units which provide minimum clearances and grout coverage for number and size of vertical reinforcement bars shown.
2. Provide pattern bond shown, or it not shown, alternate head joints in vertical alignment.
3. Where bonded pilaster construction is shown, lay wall and pilaster units together to maximum pour height specified.

D. Grouting:
1. Use "Fine Grout" per ASTM C 476 for filling spaces less than 4" in one or both horizontal directions.
2. Use "Coarse Grout' per ASTM C 476 for filling 4" spaces or larger in both horizontal directions.
3. Grouting Technique: At the Contractor's option, use either low-lift or high-lift grouting techniques subject to requirements which follow.

E. Low-Lift Grouting:
1. Provide minimum clear dimension of 2" and clear area of 8 sq. in. in vertical cores to be grouted.
2. Place vertical reinforcement prior to laying of CMU. Extend above elevation of maximum pour height as required for splicing. Support tin position at vertical intervals not exceeding 192 bars diameters nor 10 ft.
3. Lay CMU to maximum pour height. Do not excess 5' height of if bond beam occurs below 5' height stop pour st course below bond beam.
4. Pour grout using chute or container with spout. Rod or vibrate grout during placing. Place grout continuously; do not interrupt pouring of grout for more than one hour. Terminate grout pours 1-1/2' below top course of pour.
5. Bond Beams: Stop grout in vertical cells 1-1/2" below bond beam course. Place horizontal reinforcing in bond beams; lap at corners and intersections as shown. Place grout in bond beam course before filling vertical cores above bond beam.

F. High-Lift Grouting:
1. Do not use high-lift grouting technique for grouting of CMU unless minimum cavity dimension and area is 3' and 10 sq. in., respectively.
2. Provide cleanout holes in first course at all vertical cells which are to be filled with grout.
   a. Use units with one face shell removed and provide temporary supports for units above, or use header units with concrete brick supports, or cut openings in one face shell.
3. Construct masonry to full height of maximum grout pour specified, prior to placing grout.
   a. Limit grout lifts to a maximum height of 5' and grout pour to a maximum height of 24', for single wythe hollow concrete masonry walls, unless otherwise indicated.
4. Place vertical reinforcement before grouting. Place before or after laying masonry units, as required by job conditions. Tie vertical reinforcement to dowels at base of masonry where shown and thread CMU over or around reinforcement. Support vertical reinforcement at intervals not exceeding 192 bars diameters nor 10'.
   a. Where individual bars are placed after laying masonry, place wire loops extending into cells as masonry is laid and loosen before mortar sets. After insertion of reinforcement bar, pull loops and bar to proper position and tie free ends.
5. Where reinforcement is prefabricated into cage units before placing, fabricate units with vertical reinforcement bars and lateral ties of size and spacing indicated.
6. Place horizontal beam reinforcement as the masonry units are laid.
7. Embed lateral tie reinforcement in mortar joints where indicated. Place as masonry units are laid, at vertical spacing shown.
   a. Where lateral ties are shown in contact with vertical reinforcement bars, embed additional lateral tie reinforcement in mortar joints. Place as shown, or if not shown, provide as required to prevent grout blowout or rupture of CMU face shells, but

provide not less than No. 2 bars or 8-gauge wire ties spaced 16" o.c. for members with 20" or less side dimensions, and 8" o.c. for members with side dimensions exceeding 20".

8. Preparation of Grout Spaces: Prior to grouting, inspect and clean grout spaces. Remove dust, dirt, mortar droppings, loose pieces of masonry and other foreign materials from grout spaces. Clean reinforcement and adjust to proper position. Clean top surface of structural members supporting masonry to ensure bond. After final cleaning and inspection, close cleanout holes and brace closures to resist grout pressures.
9. Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist displacement of masonry units and breaking of mortar bond. Install shores and bracing, if required, before starting grouting operations.
10. Place grout by pumping into grout spaces unless alternate methods are acceptable to the Architect.
11. Limit grout pours to sections which can be completed in one working day with not more than one hour interruption of pouring operation. Place grout in lifts which do not exceed 5'. Allow not less than 30 minutes, nor more than one hour between lifts of a given pour. Rod or vibrate each grout lift during pouring operation.
    a. Place grout in lintels or beams over openings in one continuous pour.
12. Where bond occurs more than one course below top of pour, fill bond beam course to within 1" of vertical reinforced cavities, during construction of masonry.
13. When more than one pour is required to complete a given section of masonry, extend reinforcement beyond masonry as required for splicing. Pour grout to within 1-1/2" of top course of first pour. After grouted masonry is cured, lay masonry units and place reinforcement for second pour section before grouting. Repeat sequence if more pours are required.

**END OF SECTION 042200.11**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This Section includes, but not limited to, the following:
   1. Exterior Glass Block Windows.

B. Related Sections: The following Sections contain requirements that relate to this Section.
   1. Section 040513 - Mortar
   2. Section 042200 - Concrete Unit Masonry
   3. Section 079200 - Sealants

1.03 SUBMITTALS

A. Submit pursuant to Section 0133000 - Submittal Procedures.

B. Submit pursuant to Section 016000 - Product Requirements.

C. Product Data: Catalog sheets, specifications, and installation instructions for glass blocks and accessories specified. Provide product data sheets for reinforcement, panel anchors, expansion joint material.

D. Certifications: Provide certifications for glass block requiring a fire resistance rating, thermal properties, light transmission, and/or other specified properties.

E. Samples:
   1. Glass Block: Full size units, each type required.
   2. Reinforcement: 12-inch-long, full section.
   3. Expansion Strip: 12-inch-long, full section.
   4. Panel Anchor: One (1).
   5. Color Mortar Sample: 1/2" x 1/2" x 5" long sample.

1.04 QUALITY ASSURANCE

A. Single Source Responsibility for Glass Unit Masonry Assemblies: Obtain each type and pattern of glass unit masonry from a single source with resources to furnish products of consistent quality in appearance and physical properties without delaying the progress of the Work.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver glass block for use in exposed work on pallets. Handle by mechanical means, by hand or tongs. Dumping will not be permitted.

B. Store glass block off the ground in unopened cartons to prevent contamination by mud, dust or other materials likely to cause staining or other defects.

C. Cover glass block, when necessary, to protect from the elements.

D. Protect accessories from the elements.

1.06 PROJECT CONDITIONS

A. Proceed with installation of glass unit masonry assemblies only when ambient and material temperatures are 40 degrees F and rising for the first 48 hours after construction.

B. Sequence and coordinate completion of glass unit masonry so that sealants and joint fillers can be installed immediately after mortar has attained final set.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Seves Glass Block Inc., 10576 Broadview Rd., Broadview Hts, OH 44147, Phone: (877) 738-3711, or Architect approved equivalent.

2.02 GLASS BLOCK

A. High Performance, Premier Collection NUBIO 8x8x41.1 Energy Glass Block.

B. Physical Properties for Straight Units:
   1. Sound Transmission Glass: 39.
   2. U-Value: 0.19.
   3. Thermal Resistance R Value (hr. ft2F/Btu): 5.26 or higher.
   4. Visible Light Transmission: Minimum 60 percent.

C. Contractor's Option:
   1. Provide in energy efficient glass block panels manufactured by a glass block supplier.
      a. Must utilize specified glass block.
      b. Must be a single unit matching window size.

2.03 GLASS UNIT MASONRY ACCESSORIES

A. Panel Reinforcement: Ladder-type, welded-wire units prefabricated with deformed, continuous side rods and plain cross rods into straight lengths of not less than 10 feet, and complying with the following requirements:
   1. Stainless-Steel Wire: ASTM A 580, Type 304 or 316, for use in reinforcement of exterior panels.
   2. Wire Size: 0.148-inch diameter.
   3. Spacing of Side Rods: 2 inches o.c.
   4. Spacing of Cross Rods: Not more than 16 inches apart.

B. Panel Anchors: Glass block manufacturer’s standard stainless-steel perforated steel strips, 22 gauge by 1-3/4 inches wide by 19 inches long. Type 304 stainless steel.

C. Asphalt Emulsion: Water-based asphalt emulsion of type recommended by glass block manufacturer.

D. Glass-Fiber Expansion Strips: Glass-fiber strips, yellow in color, complying with requirements of glass block manufacturer, 3 pound per cubic foot density, and 3/8-inch-thick by 4 inches wide by 24 inches long.

E. Plastic-foam Expansion Strips: Polyethylene foam, white in color, complying with requirements of glass block manufacturer, and 3/8-inch-thick by 4 inches wide by 24 inches long.

F. Sealant: See Section 079200 - Sealants.

2.04 MORTAR MIXES

A. Comply with referenced standards and with manufacturer's written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortar of uniform quality and with optimum performance characteristics.
   1. Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, and antifreeze compounds, unless otherwise indicated. Do not use calcium chloride.
   2. Combine and thoroughly mix cementitious materials, water, and aggregates in a mechanical batch mixer, unless otherwise indicated. Discard mortar when it has reached initial set.

B. Mortar for Glass Unit Masonry Assemblies: Comply with ASTM C 270, Proportion Specification for Type S mortar. Limit cementitious materials in mortar to Portland cement and lime.

C. Mortar for Glass Unit Masonry Assemblies: Provide mortar, mixed according to glass block manufacturer's listing with testing and inspecting agency, for fie-resistance rating indicated.
   1. Mix mortar to produce a stiff but workable consistency that is drier than mortar for brick or concrete masonry.
   2. For mortar in exterior panels, include waterproofing admixture in mortar mix according to written instructions of admixture manufacturer.
   3. For pointing mortar in exterior panels, include waterproofing admixture in mortar
   4. mix according to written instructions of admixture manufacturer.

D. Pigmented Mortar: Select and proportion pigments with other ingredients to produce color required.
   1. Color: As selected by Architect.
   2. Limit mineral-oxide pigments to not more than 10 percent of cement content by weight.

PART 3 EXECUTION

3.01 INSTALLATION

A. Examine sills, jambs, and heads surrounding glass unit masonry assemblies for compliance with requirements for installation tolerances and other conditions affecting performance of glass unit masonry assemblies. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Advise installers of other construction about specific requirements for placement of dovetail slots and other inserts required to anchor and support glass unit masonry assemblies. Furnish installers of other construction with drawings or templates showing locations of these items.

C. Construction Tolerances: Set glass block to comply with the following tolerances:
   1. Variation from Plumb: For lines and surfaces of vertical elements and arris, do not exceed ¼ inch in 10 feet, 3/8 inch in 20 feet, or ½ inch in 40 feet or more.
   2. Variation from Level: For bed joints, and other conspicuous lines, do not exceed ¼ inch in 20 feet or ½ inch in 40 feet or more.

3. Variation of Linear Building Line: For positions shown in plan and related portions of walls and partitions, do not exceed ½ inch in 20 feet or ¾ inch in 40 feet or more.
4. Variation in mortar-Joint Thickness: Do not vary from joint thickness indicated by more than plus or minus 1/16 inch.

D. Sill, Head, and Jamb Preparation: Apply a heavy coat of asphalt emulsion to sill; allow drying before placing mortar. Place expansion strips at jambs and heads, taking care to extend them to sill. Trim expansion strips to produce width required to fit glass-block construction indicated.
1. Adhere expansion strips to heads and jambs with asphalt emulsion.

3.02 CONSTRUCTING GLASS UNIT MASONRY ASSEMBLIES

A. Set glass block with completely filled bed and head joints, with no furrowing.

B. Install glass block to comply with dimensional tolerances specified, with courses accurately spaced and coordinated with other construction.

C. Install panel reinforcement in horizontal joints at spacing indicated and to run continuously from end to end of panels; comply with the following requirements:
1. Do not bridge expansion joints with panel reinforcement.
2. Place panel reinforcement in joints immediately above and below all openings within glass unit masonry assemblies.
3. Lap panel reinforcement not less than 6 inches if more than one length necessary.
4. Embed panel reinforcement in mortar bed by placing lower half of mortar bed first, pressing panel reinforcement into place and covering with upper half of mortar bed, and then trowel it smooth.

D. Install panel anchors at locations indicated and in same horizontal joints where panel reinforcement occurs. Extend panel anchors at least 12 inches into joints and bend within expansion joints at edges of panels and across the head. Attach panel anchors as follows:
1. For in-place unit masonry assemblies, attach panel anchors with ¼ inch diameter expansion anchors, 2 per panel anchor.
2. For new unit masonry assemblies, embed other ends of panel anchors, after bending portions crossing expansion joint, in horizontal mortar joints closet in elevation to joints in glass unit masonry assemblies containing panel anchors.
3. For steel members, attach panel anchors with ¼ inch diameter steel bolts in tapped holes in steel members.

E. Use rubber mallet to tap units into position. Do not use steel tools, and do not allow units to come into contact with metal accessories and frames.

F. Use wedges in mortar joints of lower courses where needed to prevent mortar from being squeezed out of joints.

G. Keep expansion joints free of mortar.

H. Rake out joints indicated to be pointed to a uniform depth sufficient to accommodate pointing material, but not less that joint width.
1. Point joints at exterior face of exterior panels with mortar.
2. Point joints at both faces of exterior panels with mortar.
3. Point joints at exterior faces of exterior panels with sealant.
4. Point joints at both faces of exterior panels with sealant.

5. Point joints at both faces of both exterior and interior panels with sealant.

I. Fill raked joints and voids with pointing mortar. Place and compact pointing mortar in layers not greater than 3/8 inch thick. Compact each layer thoroughly and allow to become thumbprint hard before applying next layer.

J. Tool exposed joints slightly concave when pointing mortar is thumbprint hard. Use a smooth jointer larger than joint width.

K. Remove wedges or spacers, if used, and fill voids with mortar.

L. Clean glass unit masonry assemblies as work progresses. Remove mortar fins and smears before tooling joints, while mortar is still plastic, using a clean, wet sponge or a scrub brush with stiff fiber bristles. Do not use hash cleaners, acids, abrasives, steel wool, or wire brushes when removing mortar or cleaning glass unit masonry assemblies.

3.03 CLEANING

A. On surfaces adjacent to glass unit masonry assemblies, remove mortar and other residue resulting from installation of glass block, in a manner approved by manufacturers of materials involved.

B. Remove excess sealants with commercial solvents of type recommended by sealant manufacturer. Exercise care not to damage sealant in joints.

C. Perform final cleaning of glass unit masonry assemblies when surface is not exposed to direct sunlight. Start at top of panel using generous amounts of clean water. Remove water with clean, dry, soft cloths; change cloths frequently to eliminate dried mortar particles and aggregate.

**END OF SECTION 042300**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This section includes:
   1. Limestone sills
   2. Limestone Heads and Keystones
   3. Engraved limestone medallion
   4. Limestone watertable
   5. Limestone date stone
   6. Contractor's Option:
      a. These units may be furnished as precast concrete (see 034500).
      b. All units must be of the same manufacturer, unless otherwise noted.

B. Related Sections include the following:
   1. Section 040513 – Mortar
   2. Section 040523 – Masonry Accessories
   3. Section 042200 – Concrete Unit Masonry
   4. Section 042300 - Glass Unit Masonry
   5. Section 079200 – Sealants

1.03 STANDARDS

A. All work of this section shall conform to industry standards and/or manufacturer’s recommendations.

1.04 SUBMITTALS

A. Submit pursuant to Section 013300 – Submittal Procedures.

B. Submit pursuant to Section 016000 – Product Requirements.

C. Shop Drawings: Setting and detail drawings showing dimensions, sections, jointing, anchoring, and setting number of each stone.

D. Product Data: Suppliers' catalog sheets and specifications for stone units; and catalog sheets, specifications, and installation instructions for accessories.

E. Samples:
   1. Stone: Each kind and type specified, 12 inches x 12 inches x one inch, showing quality, color range and veining, grain, and finish. Sample shall show representative sandblasted etching and tint coloring.

F. Quality Control Submittals:
   1. Certificates:
      a. Qualifications: Statements certifying that the stone supplier and the installer have the specified qualifications.
      b. Stone: Statement certifying that each kind and type of stone provided for this project meets the requirements of these specifications.

1.05 QUALITY ASSURANCE

A. Qualifications:
   1. Stone Supplier: Firm with 10 years of experience specializing in cutting the required kind and type of stone.
   2. Installer: Firm with 5 years of experience specializing in installing cut stone.

B. Source Quality Control: Stone of a given color range and grain shall come from a single quarry.

C. Defects:
   1. Do not use stone units with chipped arises, cracks, voids, stains, or other defects which will be visible in the finished Work.
   2. Do not patch or hide defects. Remove defective stone units from the Site.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Store stone in a manner that will prevent wetting, soiling, staining, and other damage.

B. Handle stone in a manner that will prevent chipping, staining, and other damage. Use suitable lifting devices. Protect stone with suitable wood or other rigid cushioning materials.

1.07 PROJECT CONDITIONS

A. Environmental Requirements; Cold Weather Conditions:
   1. At temperatures below 40 degrees F, maintain mortar temperature between 40 degrees F and 120 degrees F. If necessary, heat mixing water and sand to produce the required results.
   2. At temperatures between 40 degrees F and 32 degrees F, protect masonry from rain and snow for 24 hours after laying.
   3. At temperatures between 32 degrees F and 20 degrees F, provide wind breaks and cover the masonry to prevent wetting and freezing. Maintain masonry above freezing for not less than 24 hours using auxiliary heat or insulating blankets.
   4. At temperatures below 20 degrees F, provide heated enclosures for laying the masonry. At the end of the workday, maintain the enclosures and keep the Work from freezing for not less than 24 hours.
   5. Do not lower freezing point of mortar by use of antifreeze, calcium chloride or other additives.
   6. Do not use frozen materials or materials coated with ice or frost.

PART 2 PRODUCTS

2.01 LIMESTONE

A. Type: Indiana Oolitic Limestone; ASTM C 568, Class II.

B. Color: Buff.

C. Grade: Meet Indiana Limestone Institute of America (ILI) grade description.
   1. Standard.

D. Finish:
   1. Smooth; machine-planed with tool marks removed by hand.

2.02 MORTAR TYPES

A. Type S: For parging and setting exterior stone masonry.

B. Color to match stone.

2.03 ACCESSORIES

A. Anchors: Type 302/304 stainless steel bars, 1/8 x 1-1/4 inches unless otherwise shown on the Drawings.

B. Cramps: Type 302/304 stainless steel bars, 1/8 x 1 inch unless otherwise shown on the Drawings.

C. Dowels: Type 302/304 solid stainless-steel rods, not less than 3/8-inch diameter.

D. Anchor Bolts, Washers, and Nuts: Type 304 stainless steel.

E. Dovetail Anchor Slot Concrete Inserts: 22 gage galvanized steel, with filler strip; slot sized to fit dovetail anchor.

F. Setting Buttons/Pads: Lead.

G. Letter Artwork Staining: All cut or engraved letters or other artwork shall be stained with a Lithochrome Stain. Color as selected by the Architect.

H. Stone Cleaner: Non-staining cleaning solution which will not harm stone or mortar.

2.04 FABRICATION

A. Cut stone to the required dimensions and profiles, with surfaces finished to true planes.
   1. Cut or drill to form chases, openings, reveals, reglets, and similar spaces and features shown and as required for contiguous work.
   2. Cut or drill holes and sinkages for anchors, supports, fasteners, and necessary lifting devices. If possible, do not locate holes or sinkages within 2 inches of exposed surfaces.
   3. Unless otherwise shown, cut stone for a uniform joint width of 1/4 inch.
   4. Units 48" or less in length shall be cut as a single piece.
   5. Units Greater than 48" in length shall be cut to be equal length pieces.

B. Tolerances: Stone shall be cut within the indicated tolerances for the specified finish. In the case of optional tolerance specifications, comply with the most stringent tolerances unless otherwise indicated.
   1. Limestone: Fabrication tolerances in the "ILI Handbook" by the Indiana Limestone Institute of America, Inc.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine surfaces to receive cut stone for defects that will adversely affect the execution and quality of the Work. Do not proceed until unsatisfactory conditions are corrected.
   1. Verify that required built-in anchorage items are installed in designed locations.

3.02 PREPARATION

A. Just prior to setting stone, clean surfaces that support the Work of this Section.

B. Clean stone before setting by scrubbing with fiber brushes, followed by a thorough drenching with clear water. Use only mild cleaning solutions that contain no harsh or caustic abrasives or fillers.

C. If stone is not wet at time of setting, drench or sponge stone with clean water except do not wet expansion joint or control joint surfaces that require sealant.

3.03 INSTALLATION

A. Install stone plumb and true to line in level courses, unless otherwise shown. Set stone in full mortar setting bed and completely fill joints, accessory sinkages, and lifting holes with mortar, except keep expansion joints, control joints, and other required cavities free of mortar.
   1. Set lugged sills with ends only embedded in setting mortar. Point open joint 1 inch deep with pointing mortar.
   2. Parge the back of limestone that is used as facing against concrete.

B. Solidly build-in accessories, supports, and contiguous items of other trades unless otherwise shown or directed.

C. Set stone with 1/4-inch wide joints and beds, unless otherwise shown. If necessary, temporarily use wet wooden wedges for proper spacing.
   1. Tolerance: Maximum variation of + 1/4 of specified width.

D. After mortar has set "thumb-print" hard, rake out exposed joints 3/4 inch deep. Brush face of joints clean. Remove wooden wedges when setting bed will maintain stone in position without movement.

3.04 POINTING

A. Except where joints are to be pointed with sealant, wet the raked joints and point full with pointing mortar. Cut joints flush and neatly tool surface of joints slightly concave. Finish joints that abut other masonry to match the joint finish of the adjacent masonry.

3.05 CLEANING

A. Clean the stone after completion of setting, pointing, and other Work liable to soil the stone.
   1. Carefully remove excess mortar and other encrusted matter.
   2. Clean soiled surfaces of stone with ProSoCo-Enviro Klean 2010 - All Surface Cleaner or Architect approved equivalent. Use non-metallic tools.
      a. Do not use any acid bearing cleaner on limestone.
   3. Remove any remaining stains by rubbing with a carborundum stone and restore the specified surface finish.
   4. Flush stone with clean water to remove any remaining residue of cleaning agent and dirt.

3.06 PROTECTION

A. Protect face materials against staining. Remove misplaced mortar immediately.

B. Protect newly laid masonry from exposure to precipitation, excessive drying, freezing, soiling, backfill, and other harmful elements.

C. Cover top of walls with non-staining, waterproof, temporary covering when work is not in progress. Protective covering shall overhang each side of wall a minimum of 2 feet and be securely anchored.

D. Protect sills, ledges, off-sets, and similar features from drippings and other damage during construction.

**END OF SECTION 044300**

**PAGE INTENTIONALLY BLANK**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Structural steel.
   2. Grout.
   3. Base Plates

B. Related Requirements:
   1. Division 01- "Quality Requirements" for independent testing agency procedures and administrative requirements.
   2. Section 053100 "Steel Decking" for field installation of shear connectors through deck.
   3. Section 055000 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame not defined as structural steel.
   4. Section 055100 "Metal Stairs"
   5. Section 099100 "Painting" for surface-preparation and priming requirements.
   6. Section 133419 "Metal Building Systems" for structural steel.

1.03 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.

C. Heavy Sections: Rolled and built-up sections as follows:
   1. Shapes included in ASTM A6/A6M with flanges thicker than 1-1/2 inches (38 mm).
   2. Welded built-up members with plates thicker than 2 inches (50 mm).
   3. Column base plates thicker than 2 inches (50 mm).

1.04 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.05 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.06 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication of structural-steel components.
   1. Shop drawings and required calculations shall bear the seal and signature of a registered Professional Engineer licensed in the state in which the project is located. Structural steel shop drawings will not be reviewed without said seal and signature.
      a. A full set of engineered calculations for all beam to column moment connections shall be submitted to the engineer of record for approval. The steel fabricator drawings shall not be reviewed without said engineering calculations affixed with a seal and signature of a professional engineer licensed in the state in which the project is located.
   2. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
   3. Include embedment Drawings.
   4. Indicate profiles, sizes, spacing and locations of structural members, openings, attachments, fasteners, connections, cambers, holes and other pertinent data. Include locations of structural members, openings, attachments and loads.
   5. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
   6. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
   7. For structural steel connections indicated to comply with design loads, include structural design data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Delegated-Design Submittal: For structural-steel connections indicated to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.07 INFORMATIONAL SUBMITTALS

A. Qualification Data: For installer / fabricator.

B. Welding certificates: Submit certificates certifying that welders employed in the work have met AWS qualifications within in the previous 12 months.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural steel, including chemical and physical properties. Indicate structural strength, destructive and non-destructive test analysis.

E. Product Test Reports: For the following:
   1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
   2. Direct-tension indicators.
   3. Tension-control, high-strength, bolt-nut-washer assemblies.
   4. Shear stud connectors.
   5. Shop primers.
   6. Non-shrink grout.

1.08 QUALITY ASSURANCE

A. Fabricator shall have a minimum of five (5) years documented experience with performing the work of this section.

B. Installer Qualifications: A qualified installer specializing in performing the work of this section with a minimum of three (3) years of documented experience.

C. Delegated Connection Designer: Connections not fully detailed on the contract drawings shall be designed under the direct supervision of a professional structural engineer experienced in the design of this work and licensed in the state in which the work is located. The shop drawings shall bear the seal and signature of same professional engineer.

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.
   2. Welders who are welding structural members fabricated in the shop or in the field, must have a NYSDOB issued welder licence.

E. Comply with applicable provisions of the following specifications and documents:
   1. AISC Code of Standard Practice for Steel Buildings and Bridges - AISC 303.
   2. AISC Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings - AISC 360.
   3. RCSC's "Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts."

1.09 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and handle products to/at the site under the supervision of Division 01 of this Project Manual.

B. Schedule deliveries of materials to the site at intervals which will ensure uninterrupted progress of the work.

C. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
   1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

D. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
   1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
   2. Clean and experience. who bolts and nuts that become dry or rusty before use.
   3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F1852 fasteners and for retesting fasteners after lubrication.

1.10 COORDINATION

A. Coordinate the work under Division 01 specification of this Project Manual.

B. Coordinate the selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturer's recommendations to ensure that shop primers and topcoats are compatible with one another.

C. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions and directions for installation.

D. Coordinate the work of this section with utility installations and all other adjacent work.

E. Coordinate the work of this section such that general progress of the Work in not interrupted.

1.11 FIELD MEASUREMENTS

A. Verify that field measurements are as shown on the plans and approved shop drawings.

B. The contractor is responsible for the proper location and elevations of the work.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated where beam end reactions are not shown on drawings. Connection designer shall design shear connections to resist the reaction resulting from the maximum allowable uniform load of the beam found in the AISC Specification being applied along its full length.
   1. Select and complete connections using AISC 360.
   2. Use Load and Resistance Factor Design; data are given at factored-load level.

B. Moment Connections: Type FR, fully restrained. Provide design and details of moment connections to resist forces shown on the contract drawings.

C. Construction: Moment frame.

2.02 STRUCTURAL-STEEL MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. W-Shapes: ASTM A 992/A 992M.

C. Channels, Angles, M-Shapes: ASTM A 36/A 36M.

D. Plate and Bar: ASTM A 36/A 36M.

E. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade C, seamless structural tubing.

F. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.
   1. Weight Class: as indicated on the contract documents.
   2. Finish: Black except where indicated to be galvanized.

G. Welding Electrodes: Comply with AWS requirements.

2.03 BOLTS, CONNECTORS, AND ANCHORS

A. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
   1. Finish: Hot-dip zinc coating.
   2. Direct-Tension Indicators: ASTM F959/F959M, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with mechanically deposited zinc coating finish.

B. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers; all with plain finish.

C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A490 (A 490M), Type 1, heavy-hex steel structural bolts or tension-control, bolt-nut-washer assemblies with splined ends; ASTM A563, Grade DH, (ASTM A563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers with plain finish.
   1. Direct-Tension Indicators: ASTM F959, Type 490 (ASTM F 959M, Type 10.9), compressible-washer type with plain finish.

D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F1852, Type 1, round head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
   1. Finish: Plain.

E. Shear Connectors: ASTM A108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

F. Anchor Bolts: ASTM A307, Grade C for non-moment resisting anchor rods. ASTM F1554, 36 and 55 ksi yield strength for moment resisting anchor rods.
   1. Nuts: ASTM A563 heavy-hex carbon steel.
   2. Plate Washers: ASTM A36/A36M carbon steel.
   3. Washers: ASTM F436/F436M, Type 1, hardened carbon steel.
   4. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.

G. Threaded Rods: ASTM A 36/A 36M.
   1. Nuts: ASTM A563 ASTM A563M heavy-hex carbon steel.
   2. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
   3. Finish: Plain.

H. Clevises: Made from cold-finished carbon steel bars, ASTM A108, Grade 1035.

I. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A108, Grade 1030.

J. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A108, Grade 1018.

2.04 PRIMER

A. Primer: Comply with Division 09

B. Primer: SSPC-Paint 15, Type I, red oxide.

C. Ensure primer is compatible with required topcoat.

D. Galvanizing Repair Paint: ASTM A 780/A 780M.

2.05 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

B. Grout shall consist of a premixed compound with cement, water reducing and plasticizing additives capable of developing a minimum compressive strength of 7000 psi at 28 days.

2.06 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.
   1. Camber structural-steel members where indicated.
   2. Fabricate beams with rolling camber up.
   3. Identify high-strength structural steel according to ASTM A6/A6M and maintain markings until structural steel has been erected.
   4. Mark and match-mark materials for field assembly.
   5. All wide flange structural steel members shall be fabricated in accordance with ASTM A992/A992M. All miscellaneous steel members including channels, angles, S, HP, and M shapes shall be fabricated in accordance with ASTM A36/A36M.
   6. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
   7. All shop connections shall be welded or high strength bolted.
   8. Bearing surfaces shall be planed true to provide full bearing over the entire surface.
   9. Continuously seal joined members by intermittent welds and plastic filler. Grind welds smooth where exposed or where interference with other building materials is encountered,
   10. Splicing is not permitted unless indicated on the Contract Documents or accepted on the final approved Shop Drawings.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
   1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces. Mechanically thermal cut bolt holes shall not be permitted unless prior approval by the Architect is obtained in writing.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 2, "Hand Tool Cleaning." or SSPC-SP 3, "Power Tool Cleaning." unless a more stringent cleaning method is required for selected primers and / or other coatings.

F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

G. Shop prime non-exposed steel members after fabrication in accordance with SSPC- PA. Do not prime surfaces that will be fireproofed, field welded or are in contact with concrete or high strength bolts.

H. Paint exposed structural steel members in accordance with the applicable Division 09 Specification section.

I. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
   1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning unless approved by the Architect in writing.
   2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
   3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.07 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM F3125/F3125M, Grade A325 or Grade A490 Bolts" for type of bolt and type of joint specified.
   1. Joint Type: Snug tightened unless otherwise shown on the contract documents or required by the connection designer.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
   1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.08 SHOP PRIMING

A. Shop prime steel surfaces except the following:
   1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
   2. Surfaces to be field welded.
   3. Surfaces of high-strength bolted, slip-critical connections.
   4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
   5. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
   1. SSPC-SP 2, "Hand Tool Cleaning."
   2. SSSPC-SP 3, "Power Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
   2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.09 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A123/A123M.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize lintels, shelf angles and welded door frames attached to structural-steel frame and located in exterior walls.

2.10 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
   1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
   1. Inspection and Tests will not relieve the contractor of responsibility for providing materials, fabrication and erection procedures in compliance with the specified requirements. The contractor shall verify that all materials meet or exceed the requirements specified in these specifications, Contract drawings and related references. Materials not in compliance with the specified requirements will be rejected and required to be removed from the site.

C. Bolted Connections: Inspect and test shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM F3125/F3125M , Grade A325 or Grade A490 Bolts."

D. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M type required for materials being welded and the following inspection procedures, at testing agency's option:
   1. Liquid Penetrant Inspection: ASTM E165/E165M.
   2. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
   3. Ultrasonic Inspection: ASTM E164.
   4. Radiographic Inspection: ASTM E94.

E. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
   1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
   2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other drawings for compliance with requirements.
   1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other drawings showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected. Commencement of installation will indicate that the erector accepts the conditions which exist.

3.02 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
   1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.
   2. Clean bearing surfaces and other surfaces which will be in permanent contact with the work.

3.03 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Proceed with the installation only after unsatisfactory conditions have been corrected. Commencement of installation will indicate that the erector accepts the conditions which exist.

C. Allow for erection loads and for sufficient temporary bracing to maintain structure safe, plumb and in true alignment until completion of erection and installation of permanent bracing.

D. Coordinate placement of anchors in concrete or masonry construction for securing bearing plates.

E. Erect all components in accordance with the approved shop drawings.

F. Field weld components and shear studs as indicated on approved shop drawings and in accordance with AWS D1.1/D1.1M.

G. Do not field cut or alter structural members without written approval of the Engineer.

H. Bearing Plates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
   1. Set plates for structural members on wedges, shims, or setting nuts as required.
   2. Weld plate washers to top of baseplate.
   3. Snug-tighten Pretension anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
   4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
   5. Coordinate placement of anchors in concrete or masonry construction for securing base plates.

I. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

J. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
   1. Level and plumb individual members of structure.

2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

K. Splice members only where indicated.

L. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.

M. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

N. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

O. Erect all components in accordance with approved shop drawings. After erection, prime welds, abrasions and surfaces not shop primed or galvanized as required, except surfaces to be in contact with concrete.

P. Field weld components and shear studs as indicated on the approved shop drawings and in accordance with AWS D1.1/D1.1M.

## 3.04 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM F3125/F3125M, Grade A325 or Grade A490 Bolts" for type of bolt and type of joint specified.
   1. Joint Type: Snug tightened Pretensioned unless specifically identified as pretensioned or slip-critical on the contract documents or calculations by the Delegated Connection designer.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
   1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
   2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
   3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.
   4. Connections and abrasions shall be cleaned, prepared and finished in the same manner and with the same materials used in shop finishing.

## 3.05 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
   1. Verify structural-steel materials and inspect steel frame joint details.
   2. Verify weld materials and inspect welds.
   3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Bolted Connections: Inspect and test high strength bolted connections according to RCSC's "Specification for Structural Joints Using ASTM F3125/F3125M, Grade A325 or Grade A490 Bolts."

D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.
   1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
      a. Liquid Penetrant Inspection: ASTM E165/E165M.
      b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
      c. Ultrasonic Inspection: ASTM E164.
      d. Radiographic Inspection: ASTM E94.

E. Post Installed Mechanical Anchors, Adhesive Anchors and Screw Anchors: Comply with 2020 New York State Building Code Table 1705.3.
   1. The special inspection shall include the verification of compliance with approved construction documents and standards established by the Commissioner pursuant to Section 28-113.2.2 of the Administrative Code.

F. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
   1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
   2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

G. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.06 TOLERANCES

A. All members shall be installed within AISC tolerances and as follows:
   1. Maximum variation from plumb: 1/4" (6mm) per story, non-cumulative.
   2. Maximum offset from true alignment: 1/4" (6mm).

3.07 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A780/A780M.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
   1. Clean and prepare surfaces by SSSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

C. Touchup Painting: Cleaning and touchup paintign are specified in Section 099100 "Painting".

D. Touchup Priming: Cleaning and touchup priming as specified in Division 9 or compatible primer established at the fabricators shop to be compatible with the final finish.

3.08 ADJUSTING

A. All misfits due to errors in location, fabrication, inaccuracies in the setting of anchor bolts or other items of attachment or support shall be immediately reported to the Engineer and corrected in a manner subject to the approval of the Engineer.

B. Submit method of correction to the Architect under Division 01 Specification provisions.

C. Proceed with corrective work only after receiving written approval from the Architect.

D. All corrections shall be made at no additional cost to the Owner.

**END OF SECTION 051200**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Open web steel joists with bridging.
   2. Joist Girders with bridging.
   3. Loose bearing plates and anchors for site placement.
   4. Framed openings greater than 18 inches.
   5. Joist accessories.

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."

C. Fabricator: Company specializing in performing the work of this section with a minimum of Five (5) years of documented experience.

D. Erector: Company specializing in performing the work of this section with a minimum of Three (3) years of documented experience.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of joist, accessory, structural steel paint, high strength bolts including nuts and washers.

B. Shop Drawings:
   1. Include layout, designation, number, type, location, and spacing of joists.
   2. Include joining and anchorage details, bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
   3. Indicate locations and details of bearing plates to be embedded in other construction.
   4. Indicate welded connections with AWS D2.0 welding symbols. Indicate weld lengths.
   5. Design of connections not detailed on the drawings shall be accomplished under the direct supervision of a professional structural engineer experienced in the design of this work and licensed in the state in which the project is located.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and professional engineer.

B. Welding certificates.
   1. Submit certificates certifying that welders employed on the project have met AWS Qualification within the last 12 months.

C. Manufacturer certificates: Certify that products meet or exceed specified requirements..

D. Mill Certificates: For each type of bolt.

E. Qualification Data: For Manufacturer. Company specializing in performing the work of this section with minimum of 5 years documented experience.

F. Erector: Company specializing in performing the work of this section with minimum of 3 years documented experience.

G. Design connections not detailed on the drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the project is located.

H. Field quality -test and inspection reports.

I. Research / Evaluation Reports: For Joists.

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. Maintain one copy of document on site.
   2. 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 and under the provisions of Section 016500.

B. Schedule deliveries of materials to the site at intervals which will ensure uninterrupted progress of the work.

C. Do not store or handle joists in a manner which will damage or distort the joists or supporting structures.

D. Do not store joists directly on the ground.

E. Store materials in a manner which will permit easy access for inspection and identification.

F. 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.

1.09 FIELD MEASUREMENTS

A. Verify that field measurements are as shown on the drawings and approved shop drawings and as required by the manufacturer.

B. The contractor is responsible for the proper locations and elevations of all work involved in this section.

1.10 COORDINATION

A. Coordinate the work under provisions of Division 01 specification of the contract documents.

B. Coordinate the work of this section with utilities and mechanical work installation and all other adjacent work.

C. Coordinate the placement of anchor bolts with the installation of masonry work.

D. Coordinate the work of this section such that the progress of the construction work is not interrupted.

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.

2.02 K, LH-SERIES, AND JOIST GIRDERS

A. Manufacture steel joists of type indicated according to "Standard Specifications for Open Web Steel Joists, K-Series", “Standard Specifications for Longspan Steel Joists, LH-series and Deep Longspan Steel Joists, DLH-Series” in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
   1. Joist Type: K-series steel joists and KCS-type K-series steel joists. Size as indicated on the drawings.
   2. Joist Type: LH series steel joists. Size as indicated on the drawings.
   3. Joist Girders: Size as indicated on the drawings.
   4. Acceptable manufacturers:
      a. Vulcraft Nucor Group.
      b. Canam.
      c. Or approved equal

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. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds and methods used in correcting the welding work.

D. Welding Materials: AWS D1.1; type required for the materials being welded.

E. Provide holes in chord members for connecting and securing other construction to joists.

F. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated, complying with SJI's "Specifications" - ASTM A36

G. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications" - ASTM A36.

H. Camber joists according to SJI Standard Specifications.

I. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches (1:48).

J. Weld threaded lugs to chords for attachment of wood nailers

K. Frame special sized openings in joist chord framing member configurations as detailed.

L. Design and fabricate top and/or bottom chord bridging for net uplift on steel roof joists as per design loads provided on the contract drawings and in accordance with the New York State Building Code and SJI Standard Specifications.

M. Bolts, Nuts and Washers: ASTM A325; galvanized to ASTM A153 for galvanized members; thread excluded from the shear pane; beveled washers for connection to members with flange slope greater than 1:20.

2.03 PRIMERS

A. Primer: SSPC-Paint 15, Type 1, red oxide or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

2.04 FINISHES

A. Prepare joist surfaces in accordance with SSPC SP-2 or SSPC SP-3.

B. Shop prime joists after fabrication in accordance with SSPC PA-1. Do not prime surfaces that will be fireproofed, field welded or in contact with concrete.

C. Field welds, connections, and abrasions shall be cleaned, prepared and finished in the same manner and with the same materials used for shop finishing.

2.05 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 A 36/A 36M steel with integral anchorages of sizes and thicknesses indicated. Shop prime paint.

C. 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 (13 mm) of finished wall surface unless otherwise indicated.
   1. Finish: Plain; uncoated.

D. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts galvanized to ASTM A153; threads excluded from the shear plane; beveled washers for connection to members with flange slope greater than 1:20; ASTM A 563 (ASTM A 563M) heavy hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M) hardened carbon-steel washers.
   1. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.

E. Welding Electrodes: Comply with AWS standards.

F. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20, ASTM A 780.

G. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.06 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. Shop prime joists after fabrication in accordance with SSPC PA-1. Do not prime surfaces scheduled to be fireproofed, field welded or to be in contact with concrete.

C. Field weld, connections and abrasions shall be cleaned, repaired and finished in the same manner and with the same materials used for shop finishing.

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. Verify existing conditions under the provisions of Section 013100 - PROJECT MANAGEMENT AND COORDINATION.

C. 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.
   1. Before installation, splice joists delivered to Project site in more than one piece.
   2. Clean joist bearing surfaces of any debris or foreign matter.
   3. Verify bearing surface is smooth and flat.
   4. Coordinate placement of anchors in concrete or masonry construction for securing bearing plates.
   5. Field weld components and shear studs as indicated on approved shop drawings in accordance with AWS D1.1/D1.1M.
   6. Space, adjust, and align joists accurately in location before permanently fastening.
   7. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction and remain plumb and in true alignment until completion of erection and installation of permanent bridging and bracing.
   8. Delay rigidly connecting bottom- chord extensions to columns or supports until dead loads have been applied.

C. 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.

D. Frame openings greater than 18 inches with supplementary framing.

E. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with Research Council on Structural Connection's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.

F. 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.

G. Do not permit erection of decking until joists are braced, bridged and secured.

H. Do not field cut or alter structural members without the approval of the joist fabricator and the Engineer.

I. After erection; prime welds, abrasions and surfaces not shop primed, except surfaces to be in contact with concrete.

3.03 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to inspect field welds, bolted connections and to perform field tests and inspections and prepare test and inspection reports.

B. Testing and analysis of components shall be performed under the provisions of Section 014500 - QUALITY CONTROL.

C. Inspection and tests will not relieve the Contractor of responsibility for providing materials and fabrication and erection procedures in compliance with specified requirements. The Contractor is to verify that all materials meet the requirements specified in these specifications.

D. Materials not in compliance with the specified requirements will be rejected.

E. 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. Ultrasonic Testing: ASTM E 164.
      d. Radiographic Testing: ASTM E 94.

F. Visually inspect bolted connections.

G. High-strength, field bolted connections will be tested and verified according to procedures in RCSC's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts."

H. Correct deficiencies in Work that test and inspection reports have indicated are not in compliance with specified requirements.

I. Perform additional testing to determine compliance of corrected Work with specified requirements.

J. Additional testing will be performed to determine compliance of corrected Work with the specified requirements.

3.04 TOLERANCES

A. All joists shall be installed within SJI tolerances and the following:
   1. Maximum variation from plumb: 1/4 inch.
   2. Maximum offset from true alignment: 1/4 inch.

3.05 ADJUSTING

A. All misfits due to errors in location or fabrication or inaccuracies in the setting of anchor bolts or other items of attachment or support shall be immediately reported to the Architect and corrected in such a manner subject to the approval by the Architect.

B. Submit method of correction to the Architect for approval under the provisions of Section 014500 - QUALITY CONTROL.

C. Proceed with corrective work only after receiving written approval from the Architect.

D. All corrections shall be made at no additional cost to the Owner.

3.06 PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Touchup Painting: After installation, promptly clean, prepare, and prime welds, rust spots, and abraded surfaces of joists, bearing plates, and accessories which are not shop primed, except surfaces to be in contact with concrete.
   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. Protect finished work under the provisions of Section 015000 - TEMPORARY FACILITIES AND CONTROLS.

D. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure that joists and accessories are without damage or deterioration at time of final acceptance by the Owner.

**END OF SECTION 052100**

**PAGE INTENTIONALLY BLANK**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Roof deck and accessories.
   2. Composite floor deck.
   3. Non-composite form deck and accessories.
   4. Formed steel cant strips.
   5. Pourstop angles, cell closures and end forms to contain wet concrete.
   6. Bearing plates and angles
   7. Framing for openings up to and including 18 inches.
   8. Closure panels for cell voids.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated provide deck profile characteristics and dimension, structural properties and finish.
   1. Include a statement indicating costs for each product having recycled content.

B. Shop Drawings:
   1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction. Indicate temporary shoring of decking where required. Indicate welded connections using standard AWS A2.0 welding symbols and indicate net weld lengths.

1.04 INFORMATIONAL SUBMITTALS

A. Submit under the provisions of Section 013300 - SUBMITTALS.

B. Welding certificates.

C. Product Certificates: For each type of steel deck by product manufacturer.

D. Manufacturer's instructions: indicate special installation sequence and special instructions required for proper installation.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
   1. Power-actuated mechanical fasteners.

F. Research/Evaluation Reports: For steel deck.

1.05 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

B. Installer: Company specializing in performing the work of this section with a minimum of Three (3) years of documented experience.

C. Design deck layout, spans, fastening and joints under the supervision of a Professional Structural Engineer experienced in the design of this work and licensed in the State in which the project is located.

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

E. Fire-Test-Response Characteristics: Where indicated, provide steel deck units identical to those tested for fire resistance per ASTM E119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

F. FM Global Listing: Provide steel roof deck evaluated by FM Global and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

G. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

H. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of pre-consumer recycled content is not less than 25 percent.

1.06 PERFORMANCE REQUIREMENTS

A. Metal decking design shall be in accordance with SDI Design Manual for Composite Decks, Form Decks, and Roof Decks. Substitutions shall be designed to meet or exceed published section properties of the specified materials. Section properties shall be computed in accordance with American Iron and Steel Institute Specification for the Design of Cold Formed Steel Structural Members.

B. Lateral deflection of diaphragm shall not exceed 1/500 of the story height. Maximum vertical deflection shall not exceed l/240 of the span length.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Cut plastic wrap to encourage ventilation.

C. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

D. Do not handle products in a manner which will distort or damage materials.

E. Do not store decking directly on the ground.

F. Store materials in a manner which will permit ease of access for inspection and identification.

G. Schedule delivery of the materials to the site at intervals which will ensure uninterrupted progress of the work.
   1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

1.08 FIELD MEASUREMENTS

A. Verify that field measurements are as shown on the contract drawings and approved shop drawings as required by the manufacturer.

B. The contractor is responsible for the proper locations and elevations of the work of this section.

1.09 COORDINATION

A. Coordinate the work of this section with all other adjacent work.

B. Coordinate the work such that the general progress of the work is not interrupted.

1.10 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

B. Metal decking design shall be in accordance with SDI Design Manual for Composite Decks, Form Decks, and Roof Decks. Substitutions shall be designed to meet or exceed published section properties of the specified materials. Section properties shall be computed in accordance with the American Iron and Steel Institute Specification for the Design of Cold Formed Steel Structural Members

C. Lateral deflection of diaphragm shall not exceed 1/500th of the story height. Maximum vertical deflection shall not exceed L/240th of the span length.

D. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

E. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

PART 2 - PRODUCTS

2.01 METAL ROOF DECK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Nucor Corp.; Vulcraft Division.
   2. Canam.
   3. New Millennium Building Systems.
   4. Substitutions shall be permitted only after receiving approval from the Architect.

B. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
   1. Galvanized and Shop-Primed Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Minimum 33 Ksi yield strength, G60 zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
      a. Color: Manufacturer's standard.
   2. Deck Profile: Type B or as indicated on the drawings.
   3. Profile Depth: 1-1/2 inches (38 mm) or as indicated on the drawings.
   4. Design Uncoated-Steel Thickness: 20 gauge unless otherwise indicated.
   5. Span Condition: Simple span.

6. Side Laps: Overlapped.

2.02 COMPOSITE FLOOR DECK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Nucor Corp.; Vulcraft Group.
   2. Canam.
   3. New Millennium Building Systems.
   4. Or approved equal.

B. Composite Form Deck: Fabricate ribbed-steel sheet composite form-deck panels to comply with "SDI Specifications and Commentary for Composite Steel Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
   1. Prime-Painted Steel Sheet: ASTM A1008/A1008M, Structural Steel (SS), Grade 80 (550) minimum, with top and underside surface shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
      a. Color: Manufacturer's standard.
   2. Galvanized and Shop-Primed Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 80 (550), G60 (Z180) zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
      a. Color: Gray.
   3. Profile Depth: As indicated on the contract drawings.
   4. Design Uncoated-Steel Thickness: As indicated on the contract drawings.
   5. Span Condition: Simple span.
   6. Side Laps: Overlapped.

2.03 NON-COMPOSITE FORM DECK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Nucor Corp.; Vulcraft Group.
   2. Canam.
   3. New Millennium Building Systems.
   4. Or approved equal.

B. Non-composite Form Deck: Fabricate ribbed-steel sheet no composite form-deck panels to comply with "SDI Specifications and Commentary for Non-composite Steel Form Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
   1. Prime-Painted Steel Sheet: ASTM A1008/A1008M, Structural Steel (SS), Grade 80 (550) minimum, with top and underside surface shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
      a. Color: Manufacturer's standard.
   2. Galvanized and Shop-Primed Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 80 (550), G60 (Z180) zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
      a. Color: Gray.
   3. Profile Depth: 1-5/16 inch. or as indicated on the contract drawings..
   4. Design Uncoated-Steel Thickness: 24 gage, 0.0239 inch (0.61 mm).
   5. Span Condition: Simple span.
   6. Side Laps: Overlapped.

2.04 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Welded Materials: AWS D1.1/D1.1M.

C. Primer: Flexible, Rust inhibitive.

D. Touch-up Primer: Red Oxide Type.

E. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

F. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8-mm) minimum diameter.

G. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber. one inch thick profile to fit tight to decking in compression.

H. Shear Connectors: 3/4 inch diameter. 4 1/2" inch long welded headed studs. locate as indicated on the contract drawings.

I. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), of same material, gage and finish as deck; of profile indicated or required for application.

J. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 31 for overhang and slab depth.

K. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.

L. Weld Washers: Mild steel, uncoated, 3/4 inch outside diameter, 1/8 inch thick.

M. Recessed Sump Pans: Single-piece steel sheet, 14 gage or 0.0747 inch (1.90 mm) thick, of same material and finish as deck, with 3-inch (76-mm) wide flanges and sloped recessed side pans of 1-1/2inch (38-mm) minimum depth below deck surface. For drains, cut holes in the field.

N. Galvanizing Repair Paint: ASTM A780/A780M.

O. Bearing Plates and Angles: ASTM A36/A36M steel, unfinished.

P. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

Q. Closure Panels: Neoprene Blend-FR as manufactured by Carrington Specialty Products, Inc., or approved equal.
   1. Fire-rated Neoprene-blend formed to match profile of deck at each location.
   2. Install compatible backer rod and sealant to seal all edge conditions airtight.
   3. Physical Characteristics:
      a. Nominal Density: 5 to 7 pcf.
      b. Tensile Strength: 50 psi.
      c. Elongation: 150% to break.
      d. Compression Set: 50% of original thickness.

e. Compression Strength: 2 to 5 psi (at 25% deflection).
f. Working Temperature: -40 to 160 degrees F.
g. Water Absorption by Weight: 5% maximum.
h. Flammability: HF-1 as per UL 94.

2.05 SOURCE QUALITY CONTROL

A. Testing and analysis of components will be performed under provisions of Section 014500 - QUALITY CONTROL.

B. Inspection and tests will not relieve the Contractor of responsibility for providing materials and fabrication and erection procedures in compliance with specified requirements. The Contractor is to verify that all materials meet or exceed the requirements specified in these specifications.

C. Materials not in compliance with the specified requirements will be rejected

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected. Beginning of installation means that the installer accepts the existing conditions.

3.02 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Clean all bearing surfaces of debris and foreign matter.

E. Verify bearing surface is smooth and flat.

F. Bear decking on steel supports with 1 1/2 inch (38 mm) minimum bearing.

G. Provide decking free of amounts of lubricants or oils which would impair the adhesion of spray on fireproofing or painting.

H. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

I. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

J. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

K. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

L. Fasten deck to steel support members at ends and intermediate supports with fusion welds at 12 inches on center maximum, parallel with the deck flute and at each transverse flute. Weld washers are to be used only with decks 24 gage or thinner.

M. Mechanically fasten male/female side laps at 24 inches on center maximum for decking thinner than 20 gage. Weld male/female side laps at 18 inches on center maximum for decks 20 gage and heavier.

N. Reinforce steel deck openings from 6 to 18 inches (150 to 460 mm) in size with 2 inch x 2 inch x 1/4 inch (50 mm x 50 mm x 6 mm) steel angles. Place angles perpendicular to flutes; extend minimum two flutes beyond each side of opening and fusion weld to deck at each flute.

O. Install 6 inch (150 mm) minimum wide sheet steel cover plates, of same thickness as decking, where deck changes direction. Fusion weld 12 inches (300 mm) on center maximum.

P. Install sheet steel closures and angle flashings to close openings between deck and walls, columns and openings.

Q. Install single row of foam flute closures above walls and partitions perpendicular to deck flutes.

R. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

S. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.03 FLOOR-DECK INSTALLATION

A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
   1. Weld Diameter: 3/4 inch (19 mm), nominal.
   2. Weld Spacing: Weld edge ribs of panels at each support. Space additional welds an average of 12 inches (305 mm) apart, but not more than 18 inches (457 mm) apart.
   3. Weld Spacing: Space and locate welds as indicated.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of half of the span or 36 inches (914 mm), and as follows:
   1. Mechanically fasten with self-drilling, No. 10 (4.8-mm-) diameter or larger, carbon-steel screws.
   2. Fasten with a minimum of 1-1/2-inch- (38-mm-) long welds where deck is thicker than 20 gauge..

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:
   1. End Joints: Lapped.

D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated. Where steel angles are not utilized, install stops at floor edge upturned to the top surface of the slab to contain wet concrete. Provide stop of sufficient strength to remain in place and stationary without distortion.

E. Floor deck closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and deck.

F. Position floor drain pans with the flanges bearing on the top surface of deck. Fusion weld at each deck flute.

G. Install piercing hanger tabs at 14 inches (355 mm) apart in both directions, within 9 inches (228 mm) of walls at ends, and not more than 12 inches (305 mm) from walls at sides unless otherwise indicated.

3.04 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.05 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.

C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

**END OF SECTION 053100**

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 SUMMARY

A. Section Includes:
   1. Pitched Roof Rafters.
   2. Exterior stud wall framing.
   3. Flat ceiling and attic floor joist framing.
   4. Collar ties.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of cold-formed steel framing product and accessory.

B. Shop Drawings:
   1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
   2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
   3. The design of the cold-formed steel framing shall be the responsibility of the contractor's fabricator. The sizes (depth) of the steel studs shall be as shown on the contract drawings. Unless specifically indicated on the construction documents, it shall be the responsibility of the design engineer to size the spacing and gauge of the element as well as the total depth of the member in the case of header and sill design.
   4. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   5. The contractor's fabricator shall provide a full set of engineering calculations as well as a complete set of shop drawings affixed with a New York State Professional Engineer's sign and seal. The design of the cold-formed steel elements shall be in conformance with the information shown on the contract documents and shall be in accordance with the 2020 Building Code of New York State.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Product Test Reports: From a qualified testing agency, unless otherwise stated, indicating that each of the following complies with requirements, based on evaluation of comprehensive tests for current products:
   1. Steel sheet.
   2. Expansion anchors.
   3. Power-actuated anchors.
   4. Mechanical fasteners.
   5. Vertical deflection clips.
   6. Horizontal drift deflection clips
   7. Miscellaneous structural clips and accessories.

D. Research Reports: For non-standard cold-formed steel framing, from ICC-ES.

1.05 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E329 to conduct the testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

C. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

D. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

E. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. ClarkDietrich Building Systems, LLC.
   2. MarinoWARE
   3. Or approved equal.

2.02 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
   1. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
      a. Interior Load-Bearing Wall Framing: Horizontal deflection of 1/360 of the wall height under a horizontal load of 5 lbf/sq. ft.

2.03 COLD-FORMED STEEL FRAMING, GENERAL

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of pre-consumer recycled content is not less than 25 percent.

B. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
   1. Grade: ST33H.
   2. Coating: G90 or equivalent.

C. Steel Sheet for Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:
   1. Grade: 50, Class 1 or 2.
   2. Coating: G90.

D. All studs and/or joists and accessories shall be the type, size, gage, and spacing shown on the plans. Studs, runners (track) bracing, and bridging shall be manufactured per ASTM C955.

E. All galvanized studs, joists, and accessories shall be formed from steel that conforms to the requirements of ASTM A653/A653M, as set forth in Section 1.02 of the AISI specification for design of cold-formed steel structural members.

F. All galvanized studs joists and accessories shall have a minimum G-60 coating.

G. Minimum steel gauges shall be 18 ga. for all structural elements subject to gravity and/or lateral wind forces.

H. Minimum steel gauge for interior elements subject to partition loadings shall be 20 ga..

I. All section properties shall be calculated in accordance with the AISI specification for the design of cold-formed steel structural members (latest edition).

J. Facing materials may not be substituted for bridging. Horizontal bridging must be installed prior to loading the wall and/or floor/roof joists.

K. The physical and structural properties published by approved supplier will be accepted; otherwise these properties must be substantiated by calculations for loading stresses and deflections of the designed framing sealed by a professional engineer licensed in the State of New York.

L. Prior to fabrication submit fabrication and erection drawings for review and approval by the architect/ engineer. Indicate component details, framing for openings, bearing anchorage, temporary bracing, welds or type and location of mechanical fasteners and accessories or items required of other work for complete installations. Included manufacturer's instructions for securing studs to tracks and for other framing connections.

2.04 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
   1. Supplementary framing.

2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Stud kickers and knee braces.
7. Hole reinforcing plates.
8. Backer plates.

2.05 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.

B. Anchor Bolts: ASTM F1554, Grade 36, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A153/A153M, Class C.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E488/E488M conducted by a qualified testing agency.

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
   1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

G. Column Flange Grip Clips: Pre-manufactured Column/Beam connectors for rapid installation of board type materials to Steel Column and Beam Flanges. ASTM A1003 A1003/A1003M Structural Grade 33 (230) Type H, ST33H (ST230H): 33ksi (230MPa) minimum yield strength, 45ksi (310MPa) minimum tensile strength, 27mil minimum thickness (22 gauge, 0.0283” design thickness) with ASTM A653/A653M G60 (Z180) hot dipped galvanized coating. Manufacturer: The steel Network, Inc. Unit connection box measures 1 inch deep, 2 inches wide and 2 1/2 inches long with a spring clip depth of 2.375 inches and a curved clip spring clearance of .2 inches.
   1. Install as indicated on the drawings. Maximum spacing 24" on center.

2.06 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A780/A780M.

B. Nonmetallic, Non-shrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, Portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C1107/C1107M, with fluid consistency and 30-minute working time.

C. Shims: Load bearing, high-density multimonomer plastic, and non-leaching; or of cold-formed steel of same grade and coating as framing members supported by shims.

D. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.07 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
   1. Fabricate framing assemblies using jigs or templates.
   2. Cut framing members by sawing or shearing; do not torch cut.
   3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
      a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
      b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.
   4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
   1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
   2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.03 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
   1. Cut framing members by sawing or shearing; do not torch cut.
   2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
      a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work. Welds may be butt, fillet, spot or groove type. The appropriateness of which shall be determined by and within the design calculations. All welds shall be touched-up using zinc -rich paint to galvanized members and paint similar to that used by the manufacturer for painted members.
      b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

D. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

E. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

F. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

G. Install insulation, specified in Section 072100 - ASPHALT SHINGLES in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

H. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

I. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
   1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

J. Wire tying in structural applications is not permitted.

3.04 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
   1. Stud Spacing: 16 inches unless indicated otherwise.

C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
   1. Install single-leg deflection tracks and anchor to building structure.
   2. Install double deep-leg deflection tracks and anchor outer track to building structure.
   3. Connect vertical deflection clips to infill studs and anchor to building structure.
   4. Connect drift clips to cold formed metal framing and anchor to building structure

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
   1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of flat, taut, steel sheet straps of width and thickness indicated and stud or stud-track solid blocking of width and thickness matching studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
      a. Install solid blocking at centers indicated on Shop Drawings.
   2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

## 3.05 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. All members shall be checked for proper alignment, bearing, completeness of attachments, proper placement and reinforcing.

D. Testing agency will report test results promptly and in writing to Contractor and Architect.

E. Remove and replace work where test results indicate that it does not comply with specified requirements.

F. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

## 3.06 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

## 3.07 TOLERANCES

A. Vertical alignment (plumbness) of studs shall be within 1/8 inch in 10.0 inches (3.175 mm in 3.048 m) of the span.

B. Horizontal alignment (levelness) of walls shall be within 1/8 inch in 10.0 inches of their respective lengths.

C. Spacing of studs shall not be more than +1/8 inch from the designed spacing providing that the cumulative error does not exceed the requirements of the finishing materials.

**END OF SECTION**

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Light gauge cold-formed steel roof trusses.

B. Anchorages, bracing, and bridging.

1.02 RELATED REQUIREMENTS

A. Section 054000 - Cold-Formed Metal Framing: Light gauge structural metal studs, joists, and rafters.

1.03 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2019a.

B. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2009 (Reapproved 2015).

C. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015, with Errata (2016).

D. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018.

E. CFSEI 5000 - Field Installation Guide for Cold-Formed Steel Roof Trusses; May 2000.

1.04 SUBMITTALS

A. Sec Section 013300 - Submittal Procesures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Span charts.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. Shop Drawings:
   1. Include detailed roof truss layout.
   2. Show member type, location, spacing, size and gauge, methods of attachment, and erection details. Indicate supplemental bracing, strapping, splices, bridging, and accessories.
   3. Include truss design drawings, signed and sealed by a qualified professional engineer registered in the State in which the Project is located, verifying ability of each truss design to meet applicable code and design requirements.
      a. Include the following:
         1) Design criteria.
         2) Member sizes and gauges.

1.05 QUALITY ASSURANCE

A. Designer Qualifications: Design trusses under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver trusses and other materials in manufacturer's unopened bundles or containers, each marked with manufacturer's name, brand, type, and grade. Exercise care to avoid damage during unloading, storing, and erection.

B. Store trusses on blocking, pallets, platforms, or other supports, off the ground and in an upright position, sufficiently braced to avoid damage from excessive bending. Gently slope stored trusses to avoid accumulation of water on interior of truss chord members.

C. Protect trusses and accessories from contact with earth, corrosion, deformation, mechanical damage, or other deterioration when stored at project site.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Cold-Formed Steel Trusses:
   1. Aegis Metal Framing, a Division of MiTek Industries; www.aegismetalframing.com/#sle.
   2. TrusSteel Division of Alpine Engineered products (alpineitw.com)
   3. Marino/WARE.
   4. Substitutions: See Section 016000 - Product Requirements.

2.02 TRUSS DESIGN REQUIREMENTS

A. Structural Performance: Design, engineer, fabricate, and erect trusses to withstand specified design loads for project conditions within required limits.
   1. Design Loads: As indicated.
   2. Deflections: Live load deflection meeting the following, unless otherwise indicated:
      a. Roofs: Maximum vertical deflection under live load of 1/360 of span.
   3. Design trusses to accommodate movement attributable to temperature changes within a range of 120 degrees F (67 degrees C) without damage or overstressing, sheathing failure, undue strain on fasteners and anchors, or other deleterious effects.

2.03 COMPONENTS

A. Trusses: Light gauge steel assemblies providing a complete horizontal framing system for locations indicated, ready for deck installation.
   1. Truss Type, Span, and Height: As indicated on drawings.
   2. Chord and Web Members: Fabricate required shapes from commercial quality galvanized steel sheet complying with ASTM A653/A653M, with minimum yield strength of 40,000 psi (275 MPa); minimum G60/Z180 coating; gauges as required for load conditions; all edges rolled or closed.

B. Fasteners: Self-drilling, self-tapping screw fasteners with corrosion-resistant plated finish, as recommended by steel truss manufacturer and marked for easy identification.
   1. Welding: Comply with applicable provisions of AWS D1.1/D1.1M and AWS D1.3/D1.3M.

C. Bracing, Bridging, and Blocking Members: Fabricate required shapes from commercial quality galvanized steel sheet complying with ASTM A653/A653M, with minimum yield strength of 33,000 psi (230 MPa); minimum G60/Z180 coating; gauges as required for load conditions.

2.04 FABRICATION

A. Factory fabricate cold-formed steel trusses plumb, square, true to line, and with secure connections, complying with manufacturer's recommendations and project requirements.
   1. Fabricate trusses using jig templates.
   2. Cut truss members by sawing, shearing, or plasma cutting.
   3. Fasten members in full compliance with instructions of manufacturer. Wire tying of framing members is not permitted.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine structure, substrates, and installation conditions. Notify Architect/Engineer of unsatisfactory preparation. Do not begin installation until substrates have been properly prepared and unsatisfactory conditions have been corrected.

B. Proceeding with installation indicates installer's acceptance of substrate conditions.

3.02 INSTALLATION

A. Install cold-formed steel trusses in strict accordance with manufacturer's instructions and approved shop drawings, using approved fastening methods.

B. Install temporary erection bracing and permanent bracing and bridging before application of any loads. Erect trusses with plane of truss webs vertical and parallel to each other, accurately located at spacing indicated. Anchor trusses securely at bearing points.

C. Adequately distribute applied loads to avoid exceeding the carrying capacity of any one joint, truss, or other component.

D. Exercise care to avoid damaging truss members during lifting and erection and to minimize horizontal bending of trusses.

E. Removal, cutting, or alteration of any truss chord, web, or bracing member in the field is prohibited, unless approved in advance by Architect/Engineer or the engineer of record and the truss manufacturer.

F. Repair or replace damaged members and complete trusses as directed and approved in writing by Architect/Engineer or the engineer of record and the truss manufacturer.

G. Galvanizing Repair: Touch up bare steel with zinc-rich paint in compliance with ASTM A780/A780M.

H. Roof Trusses:
   1. Comply with recommendations of CFSEI 5000.
   2. Align truss bottom chords with load-bearing studs or continuously reinforce track as required to transfer loads to structure.
   3. Install continuous bridging and permanent truss bracing as indicated.
   4. Install roof cross bracing and diagonal bracing as indicated.

3.03 FIELD QUALITY CONTROL

A. Owner will provide inspection service for inspection of field connections, in accordance with requirements of Section 014000 - Quality Requirements.

3.04 PROTECTION

A. Protect trusses from damage by subsequent construction activities.

B. Repair or replace damaged trusses, truss members, and bracing members; obtain approval in advance by Architect/Engineer or the engineer of record and the truss manufacturer for all cutting, repairs, and replacements.

**END OF SECTION 054400**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes but is no limited to the following:
   1. Loose bearing and leveling plates.
   2. Loose steel lintels.
   3. Shelf angles.
   4. Steel pipe sleeves.
   5. Steel framing and supports for mechanical and electrical equipment.
   6. Miscellaneous framing including hoist beam and supports for elevator and elevator equipment.
   7. Steel shapes for supporting elevator door sills.
   8. Steel framing and supports for applications where framing is not specified in other Sections.
   9. Slotted Channel Framing (Unistrut)
   10. Steel and galvanized steel pipe bollards.
   11. Galvanized overhead door jambs.
   12. Interior overhead door jamb extension plates.
   13. Miscellaneous plates located above overhead doors.
   14. Grate and frame for elevator sump pump pit.
   15. Recessed floor “D” rings and surface mounted wall “D” rings.
   16. Rope Tie Offs.
   17. Loose steel angles and steel angles bolted to concrete or masonry.
   18. Mezzanine edge angles.
   19. Stainless steel hooks for bunting.
   20. Beams located at training windows. See Drawing A470.
   21. Guard rails at interior training windows.
   22. Training Panel Anchors.
   23. Stainless Steel Face Shield Hooks.

1.03 RELATED SECTIONS INCLUDE THE FOLLOWING:

A. Section 031000 - Concrete Forming and Accessories for Apparatus Bay Floor Anchor Pots.

B. Section 033000 - Cast-In-Place Concrete

C. Section 036000 - Grouting

D. Section 040523 - Masonry Accessories

E. Section 042200 - Concrete Unit Masonry

F. Section 051200 - Structural Steel Framing

G. Section 055100 - Metal Stairs, Handrails and Railings

1.04 SUBMITTALS

A. Pursuant to Section 013300 - Submittal Procedures.

B. Pursuant to Section 016000 - Product Requirements.

C. Fabricator Qualifications: A firm experienced in producing metal fabrications like those indicated for this Project and with a record of successful in-service performance, as well as enough production capacity to produce required units.

D. Product Data:
   1. Shop paint primers.
   2. Galvanized Grating.
   3. Slotted Channel (Unistrut).

E. Shop Drawings: Detail fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
   1. Provide templates for anchors and bolts specified for installation under other Sections.
   2. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.
   3. Indicate finishes.

F. Welding Certificates: Copies of AWS certificates for welding procedures and personnel.

G. Manufacturer's Mill Certificates: Certify that Products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code--Steel".
   2. AWS D1.3/D1.3M, "Structural Welding Code--Sheet Steel".
   3. AWS D1.2/D1.2M, "Structural Welding Code-Aluminum".
   4. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.06 PROJECT CONDITIONS

A. Field Measurements: Where metal fabrications are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

B. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions. Allow for trimming and fitting.

1.07 COORDINATION

A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

B. Coordinate installation of steel weld plates (bearing plates) and angles for casting into concrete and/or bond beams that are specified in this Section but required for work of another Section. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.01 METALS, GENERAL

A. Metal Surfaces, General: For metal fabrications exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

B. Thermal Movements: Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, failure of connections, overstressing members and any other detrimental effect. Engineering calculations shall be based on surface temperatures of materials based on local maximum/minimum temperatures due to solar heat gain and nighttime heat loss.

C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

2.02 FERROUS METALS

A. Steel, Shapes and Bars: ASTM A 36/A 36M.

B. W-Shapes: ASTM A 992, Gr. 50.

C. Steel Plates, Shapes, and Bars: ASTM A36/A 36M.

D. Plates: ASTM A 283; gage to match existing where not indicated on Drawings.

E. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.

F. Steel Tubing: ASTM A500, cold-formed steel tubing.

G. Stainless-Steel Sheet, Strip and Plate: ASTM A 240/A 240M or ASTM A 366, Type 304.

H. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.

I. Bolts, Nuts, and Washers: ASTM A 325.

J. Cast-in-Place Anchors in Concrete: Anchors of type indicated below, fabricated from corrosion-resistant materials capable of sustaining, without failure, the load imposed within a safety factor of 4, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
   1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47 (ASTM A 47M) malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.

K. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

2.03 ALUMINUM

A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability
   1. Recycled Content: Give preference to aluminum with the highest recycled content feasible.

B. Extruded Structural Pipe: ASTM B 429/B 429M, Alloy 6063-T6.
   1. Provide Standard Weight (Schedule 40) pipe, unless otherwise indicated.

C. Extruded Aluminum: ASTM B221, Alloy 6063-T6

D. Drawn Seamless Tubing: ASTM B 210, Alloy 6063-T832.

E. Plate and Sheet: ASTM B 209, Alloy 6061-T6.

F. Die and Hand Forgings: ASTM B 247, Alloy 6061-T6.

G. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.

2.04 PAINT

A. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664; selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.

B. Galvanizing Repair Paint: High-zinc-dust-content paint for re-galvanizing welds in steel, complying with SSPC-Paint 20.

2.05 FASTENERS

A. Select and provide fasteners for fastening steel components to base materials, of type and size required to support loads, anchor components to substrates indicated, and develop proper friction, keying, and bonding.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts; ASTM A563; and, where indicated, flat and/or lock washers.
   1. Provide countersunk heads where indicated on Contract Drawings.

C. Stainless Steel fasteners; Type 304 or Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5 at exterior walls unless noted otherwise.
   1. Provide countersunk heads where indicated on Contract Drawings.

D. Plain Washers: Round, carbon steel, ASME B18.22.1 (ASME B18.22M). Use stainless-steel washers with stainless-steel fasteners.

E. Expansion anchors with countersunk heads as shown on contract drawings.

F. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated, with nuts, ASTM A 563; and where indicated, flat washers.
   1. Hot-dip galvanize where item being fastened is indicated to be galvanized.

G. Cast-in-Place Anchors in Concrete or Grouted Masonry: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

2.06 FABRICATION, GENERAL

A. Shop Assembly

1. Preassemble items in shop to greatest extent possible to minimize field splicing and assembly.
2. Disassemble units only as necessary for shipping and handling limitations.
3. Use connections that maintain structural value of joined pieces.
4. Clearly mark units for reassembly and coordinated installation.
5. Fabricate steel members in accordance with AISC Code of Standard Practice.

B. Material
1. Use material as specified. Use material of commercial quality and suitable for intended purpose for material that is not named or its standard of quality not specified.
2. Use material free of defects which could affect the appearance or service ability of the finished product.

C. Size:
1. Size and thickness of members as shown.
2. When size and thickness is not specified or shown for an individual item, use size and thickness not less than that used for the same component on similar standard commercial items or in accordance with established shop methods.

D. Cut, shear, drill and punch metals cleanly and accurately. Remove burrs and ease edges to radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

E. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

F. Weld corners and seams continuously to comply with the following:
1. Size and shape welds to develop the full design strength of the parts connected by welds and to transmit imposed stresses without permanent deformation or failure when subject to service loadings.
2. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
3. Obtain fusion without undercut or overlap.
4. Remove welding flux immediately.
5. 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.

G. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Fabricate joints that will be exposed to weather in a manner to exclude water or provide weep holes where water may accumulate.

J. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

K. Remove sharp or rough areas on exposed traffic surfaces.

L. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.

M. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

N. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6” embedment and 2” hook, not less than 8” from ends and corners of units and 24” o.c., unless otherwise indicated.

O. Galvanize and prime items as indicated herein and/or as shown on contract drawings. If not indicated all items shall be prime painted.

2.07 LOOSE STEEL LINTELS

A. Fabricate loose structural-steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated.

B. Weld adjoining members together to form a single unit where indicated.

C. Size loose lintels to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than 8 inches (200 mm), unless otherwise indicated.

D. Galvanize loose steel lintels located in exterior walls.

2.08 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction.
   1. Drill plates to scheduled to receive anchor bolts.
   2. Provide headed embedment studs where indicated.
   3. Plates scheduled to be galvanized shall be galvanized after fabrication.

2.09 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports that are not a part of structural-steel framework as necessary to complete the Work.

B. Fabricate units from structural-steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.

C. Galvanize miscellaneous framing and supports where indicated. All other miscellaneous framing and supports shall be prime painted.

2.10 PIPE BOLLARDS

A. Fabricate pipe bollards from Schedule 40 galvanized steel pipe. Provide galvanized steel domed caps for field welding.

2.11 FINISHES, GENERAL

A. Comply with NAAMM's “Metal Finishes Manual” for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

C. Aluminum: Clear Anodic Finish; AAMA 611, Class 1, AA-M12C22A41

2.12 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
   1. ASTM A 123/A 123M, for galvanizing steel and iron products.
   2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed metal fabrications:
   1. Exteriors (SSPC Zone 1B): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."

C. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.

2.13 BUNTING HOOKS

A. Provide 3/8” diameter Type 316 stainless steel hooks to support bunting. Provide hooks of sufficient length to penetrate into CMU back-up or solid wood blocking in exterior metal stud back-up a minimum of 2”. Epoxy hooks into CMU. Screw hooks into wood blocking. Locate hooks in brick masonry joints at locations as shown on the Contract Drawings.

2.14 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 18 inches o.c., unless otherwise shown.
   1. Provide mitered and welded units at inside and outside corners.
   2. Do not cross expansion and/or control joints. Create an open joint in shelf angle at each control/expansion joint 1-1/2 inches larger than expansion/control joint.
   3. Coordinate attachment of shelf angles thru continuous insulation.
   4. Shelf angles located in exterior wall assemblies shall be hot dip galvanized.

B. Furnish wedge-type concrete inserts, complete with corrosion resistant fasteners, to attach shelf angles to cast-in-place concrete

2.15 “D” RINGS

A. Floor mounted recessed “D” ring tie-offs where shown on Contract Documents.
   1. 10,000 lbs. Billet Aluminum D-Ring M-6061-10k from Mac’s Custom Tie-Downs, PO Box 1140, Sagle, ID 83860. Phone 800-666-1586.
   2. Provide six (6) 5/16” diameter stainless steel thru bolts anchoring the D-ring thru the mezzanine concrete slab and thru a ¼” x 12” x 12” galvanized templated plate located below the mezzanine deck. Secure with double nuts.

B. Wall mounted “D” ring tie-offs where shown on Contract Documents.
   1. 10,000 lb load capacity, super heavy-duty “D” ring tie-off pre-welded to a 6” x 6” x ¼” steel plate. On masonry surfaces, thru bolt (4) with stainless steel fasteners to two 6” x 1” x ¼” washer plates. Secure with double nuts. On steel surfaces, weld “D” ring plate to steel plate.

2. Gempler's item # 173155 or Architect approved equivalent.

2.16 SLOTTED CHANNEL FRAMING

A. Slotted Framing Channels: Cold-formed metal channels with continuous slot complying with MFMA-4.
   1. Acceptable Manufacturers:
      a. Flex-Strut Inc.
      b. Powerstrut.
      c. Unistrut.
   2. Material: Steel complying with ASTM A1011 Grade 33; or ASTM A1008/A1008M, commercial steel, Type B structural steel, Grade 33.
   3. Size of channels: As required by structural analysis or as shown on Contract Drawings, but not less than 1-5/8" by 1-5/8", 12 gauge.
   4. Finish: Hot Dip Galvanized unless indicated otherwise.

B. Slotted Framing Accessories:
   1. Provide manufacturer's accessories and fittings as required for a complete installation, including channel nuts, insets, end caps, swivel and swing fittings, supports, joiners, brackets and other accessories as required.
   2. Accessories Finish: Match slotted framing channel finish.

2.17 GALVANIZED STEEL GRATING

A. Pressure-Locked Galvanized Steel Grating: Fabricated by pressing rectangular flush-top crossbars into slotted bearing bars or swagging crossbars between bearing bars.
   1. Acceptable Manufacturers:
      a. Amico Grating.
      b. Indiana Gratings.
      c. Ohio Gratings, Inc.
   2. Bearing Bar Spacing: 11/16 inch o.c.
   3. Bearing Bar Depth: Minimum 1-1/2 inches and as required to comply with structural performance requirements.
   4. Bearing Bar Thickness: 3/16 inch.
   5. Crossbar Spacing: 4 inches o.c.
   6. Traffic Surface: Plain.
   7. Finish: Hot-dip galvanized, coating weight not less than 1.8 oz/sq.ft.

B. 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. Elevator sump grating covers do not require anchoring.

C. Fabricate cutouts in grating sections for penetrations. Arrange cut-outs to permit grating removal.

D. 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 and corners for perimeter angle frames. Cut, drill and tap units to receive hardware and similar items.
   1. Unless otherwise indicated, fabricate from same basic metal as gratings.
   2. Equip units indicated to be cast into concrete or built into masonry with integrally welded anchors. Unless otherwise indicated, space anchors 12 inches on center and provide minimum anchor units in the form of steel straps 1-1/4 inches wide by 1/4 inch thick by 6 inches long.

E. Separate dissimilar metals.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. Field Welding: Comply with the following requirements:
   1. Clean and strip primed steel items to bare metal where field welding is required.
   2. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   3. Obtain fusion without undercut or overlap.
   4. Remove welding flux immediately.
   5. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place masonry and/or concrete construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag bolts screws, and other connectors. Provide countersunk heads on fasteners where exposed in finish work.

G. Corrosion Protection: Coat concealed surfaces of aluminum that will come in contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

3.02 SETTING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
   1. Use nonshrink nonmetallic grout.
   2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.03 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings, if any.

B. Support steel on solid grouted masonry or concrete. Secure steel with anchor bolts embedded in grouted masonry or concrete.
   1. Where grout space under bearing plates is indicated at steel supported on concrete or masonry, install as specified above for setting and grouting bearing and leveling plates.

C. Overhead Door Jambs and Extension Plates
   1. Cover counter sunk stainless steel screw heads with epoxy metal filler. Finish smooth and level with door frame.

3.04 INSTALLING SLOTTED CHANNEL FRAMING

A. Install framing to comply with requirements of items being supported, including manufacturer's written instructions and requirements indicated on Shop Drawings.

B. Install shop or field fabricated, slotted channel framing and securely anchor to supporting structure, solid wood blocking or masonry construction with grouted cores.
   1. When attaching thru ceiling GWB to roof truss construction, slotted channel must connect to a minimum two roof trusses when truss spacing exceeds four (4) feet and to three (3) roof trusses when truss spacing is less than four feet. Coordinate with roof truss manufacturer for proper style and length of embedment of fastener.
   2. Install slotted channel framing and accessories plumb, square and true to line, and with connections securely fastened.

3.05 INSTALLING GALVANIZED PIPE BOLLARDS

A. Anchor bollards in place as shown on drawings. Support and brace bollards in position in footing excavations until concrete has been placed and cured.

B. Fill bollards solidly with concrete.

C. Field weld galvanized dome caps. Grind welds smooth. Fill any gaps with Bondo and finish smooth.

D. Repair all damaged galvanizing.

3.06 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed 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 (0.05-mm) dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

**END OF SECTION 055000**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual apply to work of this Section.

1.02 SUMMARY

A. This Section includes, but is not limited to, the following:
   1. Steel framed stairs and landings.
   2. Steel guard rails.
   3. Steel handrails.
   4. Mezzanine railings and gates.
   5. Sloped Corridor Railings.
   6. Railings at exterrior stairs.
   7. PE Stamped Shop Drawings.

B. Related Sections: The following Sections contain requirements that relate to this Section.
   1. Section 033000 - Cast-In-Place Concrete
   2. Section 036000 - Grouting
   3. Section 042200 - Concrete Unit Masonry
   4. Section 051200 - Structural Steel Framing
   5. Section 061000 - Rough Carpentry for blocking at railing attachment points
   6. Section 099100 - Painting

1.03 STANDARDS

A. All work of this section shall conform to CABO/ANSI, industry standards and manufacturer’s recommendations.

B. ASTM A500 "Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes".

C. ASTM A501 "Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing".

D. American Welding Society (AWS) applicable welding methods and standards.

E. Corps of Engineers CRD-C 621-83 "Specification for Nonshrink Grout".

F. FS TT-P-645A "Primer, Paint, Zinc Chromate, Alkyd Type".

G. National Association of Architectural Metal Manufacturers (NAAMM) Metal Finishes Manual.
   1. Metal Finishes Manual AMP 500
   2. Metal Stairs Manual AMP 510
   3. Pipe Railing Systems Manual AMP 521

1.04 SUBMITTALS

A. Pursuant to Section 013300 - Submittal Procedures.

B. Submit pursuant to Section 016000 - Product Requirements.

C. Shop drawings: Include plans, elevations, sections details and attachment to other work prepared by a qualified professional engineer licensed in the State of the project. Shop drawings shall be signed and sealed by the professional engineer.
   1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   2. Identify stairs in relation to floors and landing. Show details of construction, connections, and relation with handrails/guardrails.
   3. Identify location of railings and railing systems. Show railings and railing systems including splices and attachments. Show details and dimensions not governed by field conditions. Indicate railings and railing systems in related and dimensioned position, with elevations at 1/4 in. scale and details at 3 in. scale or larger.
   4. Indicate all required field measurements.

1.05 PERFORMANCE REQUIREMENTS

A. General: Engineer railing to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
   1. Aluminum: The lesser of minimum yield strength divided by 1.65 or minimum ultimate tensile strength divided by 1.95.
   2. Steel: 72 percent of minimum yield strength.

B. Structural Performance of Stairs: Provide metal stairs capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
   1. Uniform Load: 100lb/sq. ft.
   2. Concentrated Load: 300 lbf applied on an area of 4 sq. in.
   3. Uniform and Concentrated loads need not be assumed to act concurrently.
   4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
   5. Limit deflection of treads, platforms, and framing members to L/360 or ¼ inch, whichever is less.

C. Structural Performance of Railings: This term includes both guard rail systems and handrails. Provide railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
   1. Handrails and Guard Rail Systems:
      a. Uniform load of 50 lbf/ft. applied in any direction.
      b. Concentrated load of 200 lbf applied in any direction.
      c. Uniform and concentrated loads need not be assumed to act concurrently.

D. Seismic Performance: Provide metal stairs capable of withstanding the effects of earthquake motions determined according to ASCE/SEI 7, “Minimum Design Loads for Buildings and Other structures”: Section 9, “Earthquake Loads” and the State Building Code.
   1. Component Importance Factor is 1.5.

E. Thermal Movements: Provide exterior railings that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

F. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.06 QUALITY ASSURANCE

A. All work of this section shall be performed by experienced workers familiar with the work and according to manufacturer's recommendations and/or industry standards.

B. Handrail & Guard Rail design: Design guard rails and handrails and all joints and accessories for attaching to walls and other supports to be smooth and free of sharp edges or projections. Turn or otherwise treat handrails at ends in such a manner as to avoid projecting rail ends, catching of clothing and/or pinch points.

C. National Association of Architectural Metal Manufacturers (NAAMM) Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual", for Commercial Class, unless more stringent requirements are indicated.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Pursuant to manufacturers published instructions.

B. Protect against moisture exposure and damage.

C. Deliver materials to job site in good condition and properly protected against damage to finished surfaces.

D. Storage on site:
   1. Store material in a location and in a manner to avoid damage. Stack to prevent bending.
   2. Store aluminum, bronze, and stainless steel components and materials in clean, dry location, away from uncured concrete and masonry. Cover with waterproof paper, tarpaulin, or polyethylene sheeting and provide for circulation of air inside covering.

E. Keep handling on site to a minimum. Exercise particular care to avoid damage to finished materials.

PART 2 PRODUCTS

2.01 METALS

A. Steel and iron:
   1. Tubing: Cold-formed, ASTM A500; or hot-rolled, ASTM A501.
   2. Pipe, steel, black and hot-dip, zinc-coated: ASTM A53, Type E, Grade A and B, Type S, Grade A and B.

2.02 MISCELLANEOUS MATERIALS

A. Grout fill materials:
   1. Cementitious grout fills: See spec section 036000.

B. Filler metal and welding electrodes:
   1. Provide filler metal and electrodes that yield weld metal of same composition as base metal to be welded, pursuant to applicable AWS specifications, metal manufacturer's recommendations for color match, strength, and compatibility in fabricated items.
   2. Check compatibility and match of filler metal with base metal prior to start of continuous welding operations.

3. Store bare filler metal in dry and clean storage, pursuant to manufacturer's published instructions to avoid contamination.

C. Fasteners: Same basic metal as fastened metal. Do not use metals which are corrosive or incompatible with materials joined.
   1. Provide concealed fasteners for interconnection of handrail and railing components and for their attachment to other work except where exposed fasteners are unavoidable or are the standard fastening method for handrail and railing system indicated.

D. Anchors and inserts: Anchors of type, size, and material required for loading and installation condition shown, and recommended by manufacturer. Use nonferrous metal or hot-dipped galvanized anchors and inserts for exterior locations and elsewhere as required for corrosion resistance. Use expansion bolt devices for drilled-in-place anchors.

E. Primer paint for steel and iron: Manufacturer's standard rapid curing, rust-inhibiting primer; compatible with finish coats of paint. Coordinate selection of metal primer with finish paint requirements specified in Section 099100 - Painting.

2.03 RAILINGS/GUARDRAIL/HANDRAILS

A. Stair 104/201
   1. Railing/Guardrail/Handrail material: Steel, painted.
   2. Railing connections: Continuous butt welds ground smooth.
   3. Rail to post connections: Continuous fillet welds.
   4. Post mounting to sleeve anchors: Continuous fillet welds.
   5. Post mounting to stringers: Continuous fillet welds.
   6. Bracket for mounted handrails:
      a. Material: Match railing material and finish.
      b. Bracket anchorage: CMU and Guard Rail Posts
   7. Railing/Guardrail shapes, sizes
      a. Toprail: Round, tubular.
         1) Size 1 ½”
      b. Bottom rail: Round, tubular.
         1) Size 1 ½”
      c. Railing Insert:
         1) 8.5 gauge Woven wire mesh fabric with 2” x 2” diamond pattern, painted. Each termination of the woven wire mesh fabric shall be securely fastened to the steel U-channel for the entire perimeter of each panel. Contractor may either crimp the mesh into the U-channel or weld at every mesh end point.
   8. Post shapes, sizes:
      a. Round, tubular; 1-1/2 in.

B. Railings at Corridor Ramps:
   1. Handrail material: 1 - ½” diameter steel handrail.

C. Railings at Exterior Stair:
   1. Pipe: 1-1/2 inch Schedule 40 Aluminum pipe with 1.9 inch outside diameter.
   2. Handrail to run continuously throughout the whole length of handrail system.
   3. Mount to wall or other structure by utilizing mounting plates.
   4. No components shall be fastened via welding.
   5. Handrail will be installed at a height as shown on Contract Drawings.
   6. Clearance of a minimum 1-1/2 inch shall exist between the wall or post surface and the handrail.

7. Top and bottoms of handrail sections that stop at a landing, the handrail shall extend 12 inches horizontally beyond the top riser and 12 inches horizontally beyond the bottom tread.
8. Handrails shall return to a wall, guard or post as shown on the Contract Drawings.

2.04 FABRICATION

A. Form rail-to-end post connections and changes in rail direction.

B. Remove burrs from exposed cut edges.

C. Form elbow bends and wall returns to uniform radius, free from buckles and twists, with smooth finished surfaces, or use prefabricated bends.

D. Locate intermediate rails and balusters (pickets) pursuant to code.

E. Close exposed ends of pipe, tube and channel by welding metal closure in place or by use of approved prefabricated fittings.

F. For posts set in concrete, furnish matching sleeves or inserts not less than 5 in. long.

G. Welding:
1. Thoroughly fuse without undercutting or overlap.
2. Remove spatter, grind exposed welds where necessary,
   a. and contour surfaces to match those adjacent.
3. Discoloration of finished surfaces will not be acceptable.

H. Fabricate joints which will be exposed to the weather so as to exclude water or provide weep holes where water may accumulate.

I. Fabricate all-welded shop assemblies in as large sections as possible

2.05 STEEL-FRAMED STAIR

A. General: Construct stairs to conform to sizes and arrangements indicated. Join pieces together by welding, unless otherwise indicated. Provide complete stair assemblies, including metal framing, hangers, columns, handrails, railing systems, newels, balusters, struts, clips, brackets, bearing plates or other components necessary for the support of stairs and platforms, and as required to anchor and contain the stairs on the supporting structure.
1. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM "Metal Stair Manual" for class of stair designated, except where more stringent requirements are indicated.
   a. Commercial class, unless otherwise indicated.

B. Stair Framing: Fabricate stringers of structural steel channels and tubes as shown. Provide closures for exposed ends of stringers. Construct platforms of structural steel channel and/or tube headers and miscellaneous forming members. Bolt or weld headers to stringers; and bolt or weld newels and framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finish surfaces.

C. Metal Pan Risers, Sub-treads and Sub-platforms: Shape metal pans for risers and sub-treads 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.
1. Form metal pans of uncoated hot-rolled steel sheet, unless otherwise indicated.

2. Attach risers and sub-treads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting or bolting.
3. Provide sub-platforms of configuration and construction indicated; if not indicated, of same metal as risers and sub-treads, in thicknesses required to support design loading. Attach sub-platform to platform framing members with welds. Provide tube steel posts for support of platforms where shown on drawings.

D. Fillers: Provide steel sheet or plate fillers of thickness and size indicated or required to support structural loads of handrails where needed to transfer wall bracket loads through wall finish thicknesses. Size fillers to produce adequate bearing to prevent bracket rotation and over stressing of substrate.

E. For non-galvanized steel handrails and railing systems, provide non-galvanized ferrous metal fittings, brackets, fasteners and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.

2.06 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual" for recommendations for applying and designating finishes.

B. Preparation for Field Coating: Prepare uncoated ferrous metal surfaces to comply with minimum requirements indicated below for The Society for Protective Coatings (SSPC) surface preparation specifications and environmental exposure conditions of installed products:
1. Interior Stairs: SSPC-SP 3, "Power Tool Cleaning".
2. Exterior Stairs: SSPC-SP 6, "Commercial Blast Cleaning".

C. Zinc-Rich Shop Primer for Exterior Work: Product complying with SSPC-Paint 20:
1. Vehicle Type: Inorganic, Type 1.
2. Zinc Dust level: Level 2 (equal or greater than 77% and not more than 85%).
3. VOC Limits: Not more than 420 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Shop Primer (Interior Work): Rust-inhibitive, water based primer, emulsion type, anti-corrosive primer for interior or exterior ferrous metals exposed to mildly corrosive environments. Coating shall be resistant to flash rusting when applied to cleaned steel.
1. Vehicle Type: Acrylic.
2. VOC Limit: Not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Color: Manufacturer's standard light or medium gray.
4. Film Thickness: Minimum 3.5 mils dry film thickness.

PART 3 EXECUTION

3.01 PREPARATION

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions and directions for installing anchorages, including concrete inserts, weld plates and anchor bolts. Coordinate delivery of such items to Project site.

3.02 INSTALLATION

A. Anchor handrail and railing systems pursuant to ASTM E894.

B. Setting posts/grout:

1. Clean dust and foreign matter from sleeves.
2. Moisten interior of holes and surrounding surfaces with clean water.
3. Prepare and use specified grout fill pursuant to manufacturer's published instructions.
4. Place railing in position and brace until grout sets.
5. Pour mixture into annular space until it overflows the hole.
6. Wipe off excess and leave 1/8 in. build-up, sloped away from post.

C. Set posts plumb and aligned to within 1/4 in. in 12 ft.

D. Set rails horizontal or parallel to rake of steps or ramp to within 1/4 in. in 12 ft.

E. Support wall handrails on brackets spaced not more than 6 feet for steel and stainless steel sections.
   1. Handrail clearance at wall: The space between the wall side of a handrail and the wall surface, e.g., the rail clearance, shall be not less than 1-1/2 in. Handrail shall project no more than 3-1/2 in. into required stair width. Rail ends returned to wall shall terminate not more than 1/4 in. from wall.
   2. Handrail ends at top and bottom of stairs or ramps: The handrail at the upper and lower ends of stairs or ramps shall extend a horizontal distance of 12 in. beyond the intersection of the nosing line or ramp surface with the adjacent surface pursuant to ASTM E985.

3.03 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing steel stairs to in-place construction; include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts and other connectors as required.

B. Cutting, Fitting and Placement: Perform cutting, drilling and fitting required for installing steel stairs. Set units accurately in location, alignment and elevation; with edges and surfaces level, plumb, true and free of rack; and measured from established lines and levels.

C. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop-welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are intended for bolted field connections.

D. Field Welding: Comply with the following requirements:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

E. Stair Installation Tolerances:
   1. Maximum variation from plumb: 1/4 inch per story, noncumulative.
   2. Maximum offset from true alignment: 1/4 inch.

3.04 CLEANING AND TOUCH-UP PAINTING

A. Cleaning
   1. Immediately after erection, clean field welds, bolted connections, any and all areas showing any rust and areas where shop paint has been abraded. Clean all members of all mud, dirt and dust.

B. Touch-up Painting
   1. Immediately after cleaning, apply paint to all exposed areas where shop primer has been abraded, welds, bolted connections and cleaned areas of rusting using same materials as used for shop painting.
   2. Apply by brush or spray to provide minimum dry film thickness of 1.5 mils or thickness recommended by paint manufacturer.

**END OF SECTION 055100**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual apply to work of this Section.

1.02 SUMMARY

A. This Section includes, but is not limited to, the following:
   1. Elevator pit ladder.

B. Related Sections: The following Sections contain requirements that relate to this Section.
   1. Section 055000 - Metal Fabrications
   2. Section 061000 - Rough Carpentry
   3. Section 142410.13 - Hydraulic Passenger Elevator.

1.03 STANDARDS

A. All work of this section shall conform to CABO/ANSI, industry standards and manufacturer's recommendations.

B. ASTM B 209 "Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate".

C. American Welding Society (AWS) applicable welding methods and standards.

D. OSHA 1910.27 - Fixed Ladders.

E. FS TT-P-645A "Primer, Paint, Zinc Chromate, Alkyd Type".

F. NAAMM Metal Finishes Manual.

1.04 SUBMITTALS

A. Pursuant to Section 013300 - Submittal Procedures.

B. Submit pursuant to Section 016000 - Product Requirements.

C. Product Data: Manufacturer's data sheets on each product.

D. Shop Drawings:
   1. Detail fabrication and erection of each ladder indicated. Include plans, elevations, sections, and details of metal fabrication and their connections.
   2. Provide templates for anchors and bolts specified for installation under other Sections.
   3. Provide reaction loads for each hanger and bracket.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Competent and experienced firm capable of selecting fasteners and installing ladders to attain designed operational and structural performance.

B. Product Qualifications: Product design shall comply with OSHA 1910.27 minimum standards for ladders.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Pursuant to manufacturers published instructions.

B. Protect against moisture exposure and damage.

C. Deliver materials to job site in good condition and properly protected against damage to finished surfaces.

D. Storage on site:
   1. Store material in a location and in a manner to avoid damage. Stack to prevent bending.
   2. Store aluminum, bronze, and stainless-steel components and materials in clean, dry location, away from uncured concrete and masonry. Cover with waterproof paper, tarpaulin, or polyethylene sheeting and provide for circulation of air inside covering.

E. Keep handling on site to a minimum. Exercise care to avoid damage to finished materials.

PART 2 PRODUCTS

2.01 ELEVATOR PIT LADDER

A. Provide one elevator pit ladder in each elevator pit.

B. Ladder shall be of steel construction, prime painted, 18” wide and extend from bottom of pit to 4’-0” above floor level. Rungs shall be spaced 12” o.c.

C. Securely anchor ladder to floor and wall.

D. Coordinate ladder location and requirements with approved elevator manufacturer. Make minor adjustments in size of ladder to meet selected elevator supplier’s requirements.

2.02 MISCELLANEOUS MATERIALS

A. Fasteners: Same basic metal as fastened metal. Do not use metals which are corrosive or incompatible with materials joined.
   1. Provide concealed fasteners for interconnection of handrail and railing components and for their attachment to other work except where exposed fasteners are unavoidable or are the standard fastening method for handrail and railing system indicated.

B. Anchors and inserts: Anchors of type, size, and material required for loading and installation condition shown, and recommended by manufacturer. Use nonferrous metal or hot-dipped galvanized anchors and inserts for exterior locations and elsewhere as required for corrosion resistance. Use expansion bolt devices for drilled-in-place anchors.

C. Primer paint for steel and iron: Manufacturer's standard rapid curing, rust-inhibiting primer; compatible with finish coats of paint. Coordinate selection of metal primer with finish paint requirements specified in Section 099100 - Painting.

PART 3 EXECUTION

3.01 EXAMINATION

A. Coordinate anchorages. Furnish setting drawings, templates, and anchorage structural loads for fasteners resistance.

B. Do not begin installation until supporting structure is complete and ladder installation will not interfere with supporting structure work.

C. If supporting structure is the responsibility of another installer, notify Architect of unsatisfactory supporting work before proceeding.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions and in proper relationship with adjacent construction.

3.03 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

**END OF SECTION 055133**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Agreement, including General and Division 01 of the Project Manual apply to work of this Section.

1.02 SUMMARY

A. The work of this Section includes, but is not limited to, the following:
   1. Extruded aluminum safety nosings.

B. Related Sections: Other specification sections which directly relate to the work of this section include, but are not limited to, the following:
   1. Section 033000 – Cast-In-Place Concrete
   2. Section 033500 – Concrete Finishing
   3. Section 096513.23 – Resilient Stair Treads for interior rubber stair treads with integral nosings.

1.03 STANDARDS AND REFERENCES (LATEST EDITION)

A. Americans with Disabilities Act (ADA).

B. ASTM International (ASTM):
   1. ASTM B 30 – “Standard Specification for Copper Alloys in Ingot Form”.
   2. ASTM B221 – “Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes”.
   3. ASTM D 635 – “Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position”.
   4. ASTM D 3648 – “Standard Practices for the Measurement of Radioactivity”.
   5. ASTM D 4828 – “Standard Test Methods for Practical Washability of Organic Coatings”.

C. International Standards Organization (ISO): ISO 17398 – Safety colors and safety signs – Classification, performance and durability of safety signs.

D. SMP 800C: Toxic gas sampling and analytical procedures.

E. Military Specification: Mil-D-17951E; Deck Covering, Lightweight, Nonslip, Abrasive Particle Coated Fabric, Film, or Composite and Sealing Compound.

F. California Code of Regulations (CCR): California Title 24; Code for the Visually Impaired.

G. New York City Building Code Reference Standards: RS 6-1- Photoluminescent exit path markings.

1.04 SUBMITTALS

A. Submit pursuant to Section 013300 – Submittal Procedures.

B. Submit pursuant to Section 016000 – Product Requirements.

C. Product Data: Manufacturer’s data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Cleaning and maintenance instructions.

D. Shop Drawings: Provide shop drawings indicating details of construction and installation.

E. Selection Samples: Submit two sets of samples showing available colors, patterns, textures, and finishes.

F. Verification Samples: For each product specified, two samples approximately 3 inches long, representing actual materials.

1.05 QUALITY ASSURANCE

A. Manufacturer: Obtain stair nosing assemblies through one source from an approved Manufacturer.
   1. Manufacturer shall be ISO 9001 Certified or shall be an Approved Manufacturer for an ISO Certified Supplier.
      a. ISO 9001:2000 Certified Manufacturer shall have documented management and control of the processes that influence the quality of its products.
      b. Approved Manufacturer shall be approved by the Approved Supplier and shall have documented specifications that control their processes and influence the quality of its customer service.
   2. Manufacturer shall have a minimum of ten (10) years of experience in the fabrication of stair nosing systems.

B. Installer: Firm with not less than three (3) years of successful experience in the installation of systems similar to those required by this project and acceptable to the manufacturer of the system.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle materials and products in strict compliance with manufacturer's instructions and recommendations and industry standards. Protect from damage.

B. Store products in manufacturer's labeled packaging until ready for installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Balco, Inc., PO Box 17249, 2626 S. Sheridan, Wichita, KS 67217; Phone 800-767-0082.

B. Wooster Products, Inc., 1000 Spruce St., PO Box 6005; Wooster, OH 44691; Phone 800-321-4936; Basis of Specification.

C. Architect Approved Equivalent.

2.02 EXTRUDED ALUMINUM SAFETY TREADS AND NOSINGS

A. Type: 231 BF Supergrit® 3" wide, ¼" thickness, safety nosings for exterior stair treads.

B. Nosing base shall be type 6063-T5 extruded aluminum.

C. Anti-slip filler shall contain not less than 65% virgin grain Aluminum Oxide (AL2O3) abrasive.

D. Nosings shall have passed Fire Resistance Test (Federal Test Method Std. No. 501a, Method 6411).

E. Nosings shall terminate not more than 4” from ends of steps for poured concrete stairs.

F. Color shall extend uniformly throughout the filler. Color as selected by Architect from manufacturer’s standard colors.

G. Provide protective tape. Protective tape should be removed as soon as possible once installed.

H. Nosings shall finish flush with the top of the traffic surface.

I. Anchoring Hardware: Provide manufacturer’s recommended anchoring hardware to achieve best results for substrate and application.

PART 3 EXECUTION

3.01 EXAMINATION AND PREPARATION

A. If preparation is the responsibility of another installer, notify Architect in writing of deviations from manufacturer’s recommended installation tolerances and conditions.

B. Do no proceed with installation until substrates have been properly prepared and deviations from manufacturer’s recommended tolerances are corrected. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Commencement of installation constitutes acceptance of conditions.

3.02 INSTALLATION

A. Install in accordance with manufacturer’s written instructions and recommendations, including but not limited to the following.
   1. Schedule pours so as to install the metal safety nosings quickly before the initial set of the concrete occurs.
   2. Puddle the concrete and tamp safety nosing to insure proper concrete formation around the anchors.
   3. Remove protective tape upon completion of installation.
   4. Close area after pour; permit no use for 48 hours.

3.03 CLEANING AND PROTECTION

A. Cleaning: Clean treads and nosings as recommended by manufacturer. Remove scuff and heel marks prior to Substantial Completion.

B. Protection: Protect installed work from damage due to subsequent construction activity on the site including the application of sealer to the concrete stairs.

**END OF SECTION 055516**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This Section includes, but not limited to, the following:
   1. Wood grounds, nailers, furring and blocking.
   2. Rooftop equipment bases and support curbs.
   3. Exterior plywood sheathing/underlayment at roofing system, parapet walls, exterior stud walls and where shown on contract documents.
   4. Plywood backing panels.

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Section 073113.11 - Composite Shingles.
   2. Section 075323.11 - Self-Adhering EPDM Roofing System.
   3. Section 084113 - Aluminum Framed Entrances and Storefronts.
   4. Section 085213 - Aluminum Clad Wood Windows for Related Nailers, Furring, and Blocking.
   5. Section 092116 - Gypsum Board Assemblies for Related Nailers, Furring, and Blocking.
   6. Division 10 - Specialties for items requiring blocking.
   7. Division 11 - Equipment for Items requiring blocking.
   8. Division 12 - Furnishings for items requiring blocking.
   9. Division 23 - Heating, Ventilating, and Air Conditioning for rooftop equipment bases and support curbs.

1.03 REFERENCES

A. Standards: Comply with the following unless otherwise specified or indicated on the Drawings:
   1. Lumber: American Softwood Lumber Standard PS 20 by the U.S. Department of Commerce. Comply with applicable provisions for each indicated use.
   2. Plywood: Product Standard PS 1 for Softwood Plywood, Construction and Industrial by the U.S. Department of Commerce.
   3. Plywood Installation: APA Design/Construction Guide, Residential & Commercial by the American Plywood Association (APA).
   4. Grading Rules:
      a. Douglas Fir, Hem-Fir, Idaho White Pine, and other Western Woods: Western Wood Products Association (WWPA) or West Coast Lumber Inspection Bureau (WCLIB).
      b. Southern Pine: Southern Pine Inspection Bureau (SPIB).
      c. Redwood: Redwood Inspection Service (RIS).
      d. Spruce-Pine-Fir: National Lumber Grades Authority (NLGA).
   5. Preservative Treatment: American Wood Preservers' Association (AWPA) and American Wood Preservers Bureau (AWPB) Standards, quality control methods, and inspection requirements.
   6. Fire-Retardant Treatment: American Wood Preservers' Association (AWPA) Standards.
   7. Framing Installation: American Forest and Paper Association (AFPA).

1.04 SUBMITTALS

A. Submit following pursuant to Section 013300 - Submittal Procedures.

B. Submit pursuant to Section 016000 - Product Requirements.

C. Quality Control Submittals:
   1. Certificates: Certification for the following wood treatments:
      a. Dip Treatment: Certification by treating plant stating chemical solutions used, submersion period, and conformance with applicable standards.
      b. Pressure Treatment: Certification by treating plant stating chemicals and process used, net amount of chemical preservative retained, and conformance with specified standards.
      c. Waterborne Preservatives: Certified written statement that moisture content of treated materials was reduced to a maximum of 19 percent prior to shipment to Project site.
      d. Fire-Retardant Treatment: Certification by treating plant stating treated material complies with specified standards and treatment will not bleed through specified finishes.

1.05 QUALITY ASSURANCE

A. Experienced workers familiar with the work and according to manufacturer's recommendations and/or industry standards shall perform all work of this Section.

B. Mill and Producers Mark: Each piece of lumber and plywood shall be grade-stamped indicating type, grade, mill, and grading agency certified by the Board of Review of the American Lumber Standards Committee. Mark shall appear on unfinished surface or ends of pieces with finished surfaces.
   1. Pressure Preservative Treated Material: Accredited agency quality mark on each piece of wood indicating treatment.
   2. Fire-Retardant Treated Material: Accredited testing agency mark on each piece of wood indicating compliance with the fire hazard classification. The mark must identify the name and location of the treating plant and show the material complies with AWPA standards and has been dried after treatment.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Pursuant to manufacturers published instructions.

B. Protect against moisture exposure and damage.

C. Keep lumber and plywood dry by elevating above dampness, so that air can circulate, and warping will not occur, and by covering with waterproof film that permits circulation of air to all parts of each pile.
   1. Provide spacers between each bundle to promote air circulation.

D. Do not stack any lumber in direct contact with the ground.

1.07 DEFINITIONS

A. Abbreviations:
   1. PPT: Pressure preservative treated.
   2. E: Modulus of elasticity.
   3. Fb: Extreme fiber stress in bending.
   4. RFS: Rough full sawn.
   5. S4S: Surfaced four sides.

B. Association Abbreviations:
   1. ALSC - American Lumber Standard Committee
   2. APA - The Engineered Wood Association

3. AWPA - American Wood Protection Association
4. FSC - Forest Stewardship Council US
5. NFPA - National Fire Protection Association

1.08 WARRANTY

A. Fire Retardant Plywood
   1. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under the Contract Documents.

PART 2 PRODUCTS

2.01 WOOD PRODUCTS - GENERAL

A. Lumber: American Softwood Lumber Standard PS 20 and applicable rules of grading agencies indicated. If no grading agency is specified, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
   1. Factory mark each piece of lumber with grade stamp of grading agency.
   2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
   3. Provide dressed lumber, S4S, unless otherwise indicated.

2.02 DIMENSION LUMBER AND BOARDS

A. Qualities: Provide following species, product class, and grade for lumber up to 4 in. thick which is not in contact either with earth or concrete, is not above roof deck, and is not exposed to weather or moist environment. Grade stamp each piece except Appearance grade.
   1. Framing, except studs:
      a. Species: Southern Pine or Douglas Fir - Larch.
      b. Product class: Structural Joists & Planks.
      c. Stress grade: No. 2.
      d. Moisture content: 19% maximum. Bring down to 19% after treatment.
   2. Studs and plates:
      a. Species: Southern Pine or Douglas Fir - Larch.
      b. Product class: Light Framing and Studs.
      c. Grade: Stud or Construction.
      d. Moisture content: 19% maximum.
   3. Blocking and lumber for supporting and fastening of other work, including such items as frames, nailers, curbs, and bases:
      a. Species: Southern Pine or Western Woods.
      b. Product class: Structural Joists & Planks or Light Framing.
      c. Stress grade: No. 2 or Construction.
      d. Moisture content: 19% maximum. Bring down to 19% after treatment.
      e. Pressure preservative treatment: see Article 2.04 (Non-treated blocking & furring for cabinets).
      f. Fire Treatment: All blocking in fire rated walls must be fire-treated wood blocking.
   4. Furring, grounds, bracing, and other board lumber:
      a. Species: Southern Pine or Western Woods.
      b. Product class: Boards.
      c. Grade: No. 3 or Standard.

d. Moisture content: 19% maximum.
e. Pressure preservative treatment: see Article 2.04.

B. Referenced Standards:
1. Lumber: PS 20.

C. Inspection agencies whose ALSC-certified rules shall be used for lumber in this Work: NeLMA, NH&PMA, NLGA- SPIB, WCLIB, or WWPA.

2.03 PLYWOOD

A. Qualities: Veneer-face composite or plywood panels, with 15% maximum moisture content, except 18% allowed after re-drying from pressure preservative treatment.
1. Vertical Applications - Exposed:
a. Thickness: 5/8 in. unless otherwise shown.
b. Grade: APA AB, Group 1.
c. Exposure durability class: Exposure 1.
d. Fasteners: Hot-dip zinc coated galvanized steel, heavy duty (.265" thread diameter) screws or manufacturer's recommendation for application.
e. Fastener spacing: 6 in. o.c. at edges; 12 in. o.c. at intermediate supports.
2. Vertical Applications (Not Exposed to View):
a. Thickness: 5/8 in. unless otherwise shown.
b. Grade: APA CDX, Group 1.
c. Exposure durability class: Exposure 1.
d. Fasteners: hot-dip galvanized steel, heavy duty (.265 thread diameter) screws or manufacturers recommendation for application.
e. Fastener spacing: 6 in. o.c. at edges; 12 in. o.c. at intermediate supports.
3. Roof Applications:
a. Thickness: 3/4 in. fire-retardant.
b. Grade: APA CDX, Group 1.
c. Exposure durability class: Exposure 1.
d. Fasteners: Hot-dip zinc coated galvanized steel (ASTM A153-Class C) or stainless-steel (Type 316) #8 countersunk screw long enough to penetrate bottom flute of metal decking by 3/4". Screw pull out strength in metal deck must be 500 lbs. or greater.
e. Fastener spacing: 8 in. o.c. at 4-foot edge; 16" o.c. at perpendicular edges and 12" o.c. in the field. Minimum 29 fasteners per 4' x 8' sheet.
f. H-clips: As required or shown on the Drawings.
g. Plywood must meet or exceed span and load requirements.
1) 40 lb. snow load minimum or greater if indicated on Structural Drawings Design Load Tables.
2) 24" o.c. span unless otherwise indicated on the Drawings.

B. Exterior Wall Sheathing:
1. Thickness: 3/4 in. unless otherwise shown.
2. Grade: APA CDX, Group 1.
3. Exposure durability class: Exposure 1.
4. Fasteners: Hot-dip zinc coated galvanized steel (ASTM A153-Class C) or stainless-steel (Type 316) #8 countersunk flat head screw.
5. Fastener spacing: 8 in. o.c. vertically at each stud, 8 in. o.c. horizontally at top and bottom track, door headers, window and louver headers and sills.

C. Plywood equipment mounting panels.
1. Minimum nominal thickness using glues without urea formaldehyde.
2. Grade: APA C-C PLUGGED, Group 1, Exposure 1.

3. Fire resistive treatment.

2.04 PRESERVATIVE TREATMENT

A. Treat lumber and plywood where indicated and as specified. Comply with applicable AWPA Standards and quality control and inspection requirements.
   1. Fasteners and anchoring devices to be used with wood treated with waterborne preservatives shall be hot-dip galvanized or stainless steel.

B. Complete fabrication to the greatest extent possible prior to treatment of items to be treated. Where items must be cut after treatment, coat cut surfaces with heavy brush coat of the same chemical used for treatment or other solution recommended by AWPA Standards for the treatment.

C. Inspect wood after treating and drying. Discard warped or twisted items.

D. Pressure Treatment (Above Ground Use): Treat the following wood items with waterborne preservatives for above ground use, complying with AWPA Standard C2 for lumber and timbers and AWPA Standard C9 for plywood. A retention requirement of 4.0 kg/m3 (0.25 pcf). Redry wood to a maximum moisture content of 19 percent after treatment.
   1. Nailers, blocking, cants, shim stock, and similar members used in conjunction with roofing (including related flashings, trim and vapor barrier), coping, and waterproofing.
   2. Nailers, blocking, furring, stripping, and similar concealed members in contact with exterior masonry and concrete (including interior width of exterior walls), and all sills for framing.
   3. Wood items indicated or shown on the Contract Drawings to be preservative treated.

E. Pressure Treatment (Ground Contact Use): Treat the following wood items with waterborne preservatives for below ground use, complying with AWPA Standard C2 for lumber and timbers and AWPA Standard C9 for plywood. A retention requirement of 6.4 kg/m3 (0.40pcf):
   1. Wood members placed in the ground.
   2. Wood members immersed in fresh water.

2.05 FIRE RETARDANT TREATMENT

A. Furnish “FR-S” lumber where indicated, complying with AWPA Standards for pressure impregnation with fire-retardant chemicals to achieve a flame spread rating of 25 or less, when tested in accordance with UL Test 723, ASTM E84 or NFPA Test 255.
   1. Where treated items are indicated to receive a transparent or paint finish, use a fire-retardant treatment which will not bleed through or adversely affect bond of finish.
   2. In exterior applications or applications of exterior sheathing and blocking other than roof sheathing use FRX fire retardant lumber.
   3. Provide UL label or identifying mark on each piece of fire-retardant lumber.
   4. Redry treated items to maximum moisture content of 19% for lumber and 15% for plywood.

B. Fire Retardant Plywood Roof Sheathing
   1. Manufacturer: Arch Wood Protection, 3941 Bonsal Road, Conley, GA 30288; Telephone: (404) 362-3970.
   2. Product Treatment: Dricon FRT is produced by licensed treatment plants. Fire Retardant chemical shall provide protection against termites and fungal decay, shall be registered for use as a wood preservative by the U.S. Environmental Protection Agency (EPA), shall comply with formulation FR-1 of the current edition of AWPA Standard P17, and shall be free of halogens, sulfates and ammonium phosphate. Treated wood shall have a flame spread of less than 25 when tested in an extended 30-minute tunnel test in accordance with ASTM E 84, NFPA 255 or UL 723.

a. Corrosion Properties: Fire retardant treated wood in contact with carbon steel, galvanized steel, aluminum, copper and red brass shall exhibit corrosion rates less than 1 mil (0.025 mm) per year when tested in accordance with Fed. Spec. MIL-L-19140, Paragraph 4.6.5.2.
b. Testing: Testing on fire performance, strength, and corrosion properties of fire retardant treated wood shall be recognized by issuance of a National Evaluation Services Report.

3. Fire Retardant Treatment: Manufacturer's solution for fire retardant treatment of wood.
   a. Plywood Treatment Standard: Comply with AWPA Standard C27, current edition, and Appendix H of AWPA Use Category System.
4. Warranty
   a. Warranty Period: 40-year roof warranty against heat degradation commencing on Date of Substantial Completion.

2.06 FRAMING HARDWARE

A. Fasteners and Anchoring Devices: Select and furnish items of type, size, style, grade, and class as required for secure installation of the Work. Items shall be hot-dip zinc coated galvanized steel (ASTM A153-Class C) or stainless-steel (Type 316) for exterior use. Unless shown or specified otherwise, comply with the following:
   1. Nails and Staples: FS FF-N-105.
   2. Wood Screws: FS FF-S-111.
   3. Bolts and Studs: FS FF-B-575.
   4. Nuts: FS FF-N-836.
   5. Washers: FS FF-W-92.
   6. Lag Bolts or Lag Screws: FS FF-B-561.
   7. Masonry Anchoring Devices: Expansion shields, masonry nails and drive screws: FS FF-S-325.
   8. Toggle Bolts: FS FF-B-588.
   9. Bar or Strap Anchors: ASTM A575 carbon steel bars.
   10. Wall Plugs: Corrugated type, galvanized steel, 24 USS gage min, not less than 2 inches wide x 2-1/2 inches deep.
   11. Cross Bridging: Nailable type, galvanized steel, 16 USS gage min, by 3/4 inch wide.
   12. Metal Hangers and Framing Anchors: Size and type for intended use, galvanized finish, manufacturer's recommended fasteners.
   13. Buck Anchors: Corrugated type, galvanized steel not lighter than 12 USS gage min, 4 inches wide (except where partitions are less than 4 inches thick) by 8 inches long, punched for two 5/16-inch carriage bolts at buck end.
   14. Sleeper Anchors: Approved type, galvanized steel not lighter than 20 USS gage min, not less than 1-1/4 inches wide, designed to anchor into concrete not less than 1-1/2 inches and permit height adjustment of sleeper.

PART 3 EXECUTION

3.01 FRAMING

A. Frame the Work according to NFPA Manual for Wood Frame Construction.

B. Cut pieces for full wood-to-wood fit at connections. Do not splice freestanding members.

C. Examine each piece of lumber before setting in place. Set the soundest pieces in positions of greatest stress. Select clearest pieces for exposed use. Discard pieces which have defects that impair their structural function.

D. Set members plumb, level, or to slope shown.

E. Do not cope or notch horizontal members more than 1/6 their depth in center third of span, nor more than ¼ joist depth at end thirds. Drill joists for passage of lines in end thirds only. Drilled holes shall be no more than 1/3 joist depth and shall leave a full 2 in. of wood top or bottom.

3.02 FASTENERS AND FASTENER SPACING

A. For work above roof, all other exterior locations or in damp locations, use hot-dip zinc coated galvanized steel (ASTM A153-Class C) or stainless steel (Type 316) common nails, screws, bolts, nuts and washers.

B. Drive nails or screws full depth, drilling hard or brittle woods first to prevent splitting. Leave no hammer marks in exposed work. In beams, headers and trimmers built up from 2x lumber, nail 16 in. o.c. minimum, staggered top and bottom.

C. Nail according to NFPA Manual for Wood Frame Construction Table 11, except as more stringently specified herein or shown on Contract Drawings.

3.03 CEILING FRAMING

A. Provide ceiling framing members of sizes and spacing as shown, with double headers and trimmers. Set on double plates at stud walls.

B. Connect and bridge ceiling framing as for floor framing.

3.04 FURRING AND GROUNDS

A. Provide PPT furring at exterior walls and in damp locations.

B. Terminate vertical furring with horizontal firestop strip at floor, opening, and ceiling lines, positioned to provide fastening for edges of wall finish material and base and cove trim.

C. Execute furring at openings to serve as grounds for finish work. Shim furring and grounds to make finish work plane and flush with opening frames. Bevel plaster grounds to form key.

D. Space 1 x 3 or 1 x 2 furring at 16 in. o.c. for all finishes, except that 1 x 3 furring spaced 24 in. o.c. shall be provided for plywood paneling 3/8 in. or thicker.

E. Do not use furring strips with knots or missing knots where nail or screw fastening of plywood finish will be employed.

F. Provide furring at inside jamb of exterior windows to adjust G.W.B. return to meet finished edge of provided window or to meet provided window trim. Furring configuration at this location must be included with window submittals. See Section 085213 - Aluminum Clad Wood Windows.

3.05 BLOCKING AND OTHER SUPPORT MEMBERS

A. Select sound lumber for blocking, nailers, sleepers, cants, deck edges, curbs, frames, bases, and ledgers. See Article 3.06 for locations where PPT blocking is to be used. Blocking in fire rated walls must be fire-treated wood blocking.

B. Provide quality and size of fasteners that will support live and dead loads. Recess bolts and nuts as necessary to avoid conflict with roofing and other adjoining or covering work. Provide washers where bolt heads and nuts bear against wood.

C. Furnish and install blocking and ledgers for support of all wall-hung construction including, but not limited to fixtures, cabinets, countertops, recessed equipment, shelving, railings, toilet

partitions, shower rods, towel hooks, shower seats, lockers, door wall bumpers, coat racks, light fixtures, drinking fountains and mirror brackets.

D. Furnish and install blocking in all drywall ceilings and soffits for support of all ceiling hung construction including, but not limited to, light fixtures, air drops, cord reels, speakers and projector screens.

3.06 EXTENT AND INSTALLATION OF PRESERVATIVE TREATED WOOD

A. Provide PPT lumber at locations indicated on drawings:

B. Install PPT lumber with galvanized steel or stainless-steel fasteners and connectors that do not react with the particular treatment salt that has been used.

C. Apply a heavily brushed touchup coat to cuts, holes, and abraded or dented areas of each piece of treated lumber using specified chemical.

3.07 FIRE RETARDANT PLYWOOD ROOF SHEATHING, PARAPET CAPS AND/OR EXTERIOR PLYWOOD SHEATHING

A. Store and install in accordance with manufacturer’s recommendations.

B. Provide 1/8" spacing between adjacent sheets of plywood.

C. Installed plywood must be covered with either permanent or temporary coverings at the end of each day's work.

**END OF SECTION 061000**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Gypsum sheathing in exterior cavity wall construction.
   2. Gypsum sheathing at roof side of parapets.
   3. Sheathing in areas of vertical EPDM roofing.

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Section 054000 - Cold Formed Metal Framing
   2. Section 061000 - Rough Carpentry

1.03 STANDARDS

A. All work of this section shall conform to industry standards and/or manufacturer’s recommendations.

B. ASTM C 954 "Standard Specification for Steel Drill Screws for the Application of Gypsum Panel products or Metal Plaster Bases to Steel Studs from 0.033 inch to 0.112 inch Thickness".

C. ASTM C 1177 "Standard Specification for Glass Mat Gypsum - Substrate for use as Sheathing".

D. ASTM C 1280 "Standard Specification for Application of Gypsum Sheathing".

E. ASTM C 1396 "Standard Specification for Gypsum Board".

F. GA-253 "Recommended Specifications for the Application of Gypsum Sheathing".

1.04 SUBMITTALS

A. Pursuant to Section 013300 - Submittal Procedures.

B. Pursuant to Section 016000 - Product Requirements.

C. Product Data:
   1. Submit manufacturer's product data for each type of exterior gypsum sheathing indicating where each type will be used.
   2. Submit fastener data as recommended by exterior gypsum sheathing manufacturer and as specified herein.

1.05 QUALITY ASSURANCE

A. Experienced workers familiar with the work and according to manufacturer’s recommendations and/or industry standards shall perform all work of this section.

B. Single-Source Responsibility for Panel Products: Obtain each type of gypsum board and other panel products from a single manufacturer.

C. Fire-Test-Response Characteristics: Where fire-rated gypsum board assemblies are indicated, provide gypsum board assemblies that comply with the following requirements:

1. Fire Resistance Ratings: As indicated by reference to GA File Numbers in GA-600 “Fire Resistance Design Manual” or design designations in UL “Fire Resistance Directory” or in the listing of another testing and inspecting agency acceptable to authorities having jurisdiction.
2. Gypsum board assemblies indicated are identical to assemblies tested for fire resistance according to ASTM E119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
3. Deflection and Firestop Track: Top runner provided in fire-resistance-rated assemblies indicated is labeled and listed by UL, Warnock Hersey, or another testing and inspecting agency acceptable to authorities having jurisdiction.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturers published instructions.

B. All materials shall be delivered in their original unopened packages and stored in an enclosed shelter providing protection from damage and exposure to the elements.

C. Neatly stack gypsum panels flat to prevent sagging.

1.07 WARRANTY

A. Provide products that offer twelve months of coverage against in-place exposure damage (delamination, deterioration and decay).

B. Manufacturer’s Warranty:
1. Five years against manufacturing defects.

PART 2 PRODUCTS

2.01 MATERIALS

A. Gypsum Sheathing - Cavity Wall
1. Glass-Mat Gypsum Board: Gypsum board designed as an exterior substrate for a weather barrier, consisting of a noncombustible water-resistant core, essentially gypsum, surfaced with glass mats on face and back, partially or completely embedded in core, and with unsurfaced square edges. Comply with ASTM C 1177 and requirements below.
   a. Type: X
   b. Thickness: 5/8 inch
2. Products: Subject to compliance with requirements, gypsum sheathing boards that may be incorporated in the Work include, but are not limited to, the following:
   a. Dens-Glass® Gold Exterior Sheathing; Georgia-Pacific Gypsum LLC
   b. GlasRoc® Sheathing; CertainTeed
   c. Fiberock® Aqua-Tough Sheathing; U.S. Gypsum Company
3. Sheathing fasteners: ASTM C 954, steel drill screws, Type S-12 fluted tip, a minimum of 1 ¼ inches long with organic polymer coating or other corrosion-protective coating.

B. Gypsum Sheathing to receive roofing material:
1. On the roof side of framed parapets and other vertically framed areas where sheathing will be covered by roofing materials use fiberglass-mat faced gypsum roof board.
   a. Thickness: 5/8 inch
   b. Weight: 2.55 psf.
   c. Surfacing: Fiberglass mat with non-asphaltic coating.
   d. Flexural Strength, Parallel (ASTM C 473): 100 lbf, minimum
   e. Flute Span (ASTM E 661) 8 INCHES.
   f. Permeance (ASTM E 96): Not more than 32 perms

g. R-Value (ASTM C 518): Not less than 0.67
h. Water absorption (ASTM C 1177): Less than 10 percent of weight.
i. Compressive Strength (Applicable Sections of ASTM C 472): 500 to 900 pounds per square inch.
j. Surface Water Absorption (ASTM C 473): Not more than 2 grams.
k. Acceptable products:
   1) DensDeck Prime, Georgia-Pacific Gypsum.
   2) Architect approved equivalent

2. Sheathing fasteners: ASTM C 954, steel drill screws, Type S-12 fluted tip, a minimum of 1 ¼ inches long with organic polymer coating or other corrosion-protective coating.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.

C. Coordinate wall sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

D. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

3.02 SHEATHING INSTALLATION

A. Comply with ASTM C 1280, GA-253 and manufacturer's written instructions. Erect gypsum sheathing pursuant to GA-216 and fasten at 6" o.c. along panel edge locations and 12" o.c. field locations with 1 ¼" S #6 screws.
   1. Fasten sheathing to cold-formed metal framing with screws.
   2. Install boards with a 3/8-inch gap where non-load bearing construction abuts structural elements.
   3. Install boards with a ¼ inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing boards but do not cut into facing.

C. Horizontal Installation: Abut ends of boards over centers of studs, and stagger end joints of adjacent boards not less than one stud spacing. Attach boards at perimeter and within field of board to each stud.
   1. Space fasteners approximately 6 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.
   2. For sheathing under stucco cladding, boards may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

D. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.
   1. Space fasteners approximately 6 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.

2. For sheathing under stucco cladding, boards may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

E. Do not bridge building expansion joints; cut and space edges of gypsum sheathing to match spacing of structural support elements.

3.03 PROTECTION

A. Protect gypsum sheathing and gypsum roof board until covered.

B. Replace broken or damaged sheathing.

C. Apply permanent or temporary covering within manufacturer's stated exposure limits.

**END OF SECTION 061643**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This Section includes, but not limited to, the following:
   1. Cellular PVC trim boards for frieze boards, rake boards, louver/door/window trim and other trim boards as shown on the Contract Drawings.
   2. Cellular PVC trim boards at interior GWB ceiling/CMU wall intersections..
   3. Cellular PVC Skirtboards.
   4. Cellular PVC trim boards for window sills, jambs, and heads where indicated on Contract Drawings.

1.03 SUBMITTALS

A. Submit following pursuant to Section 013300 - Submittal Procedures.

B. Submit pursuant to Section 016000 - Product Requirements.

C. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation instructions and methods.
   4. Code compliance reports.

D. Samples:
   1. For each product specified, two (2) samples, minimum size 6 inches long, representing actual product, color and finish.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Class A (Class 1) Flame Spread Classification.
   2. Meet ICC and CCMC code requirements.

B. Allowable Tolerances:
   1. Variation in component length: Minus 0.00/+1.00.
   2. Variation in component width: ± 1/16".
   3. Variation in component thickness: ± 1/16"
   4. Variation in component edge cut: ±2 degrees.
   5. Variation in Density: -0% + 10%

C. Workmanship, Finish, and Appearance:
   1. Free foam cellular pvc that is homogeneous and free of voids, holes, cracks, and foreign inclusions and other defects. Edges must be square, and top and bottom surfaces shall be flat with no convex or concave deviation.
   2. Uniform surface free from cupping, warping and twisting.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Trim materials should be stored on a flat and level surface on a full shipping pallet. Handle materials to prevent damage to product edges and corners. Store materials under a protective covering to prevent jobsite dirt and residue form collecting on the boards.

1.06 WARRANTY

A. Provide manufacturer's 20 year warranty against defects in manufacturing that cause the products to rot, corrode, delaminate, or excessively swell from moisture.

PART 2 PRODUCTS

2.01 MATERIALS

A. Acceptable products:
   1. AZEK® Trimboards manufactured by The Azek® Company, 5215 Old Orchard Rd., Skokie, IL, 60077, Phone: (877) 275-2935.
   2. CERAMATRIM® Cellular PVC Trimboards by CertainTeed Corporation, 20 Moores Road, Malvern, PA 19355.
   3. VERSATEX, 400 Steel St., Aliquippa, PA 15001. Phone: 724-857-1111.
   4. Architect approved equivalent.

2.02 MATERIAL

A. Free foam cellular PVC material with a small-cell microstructure.
   1. Density: 0.55 grams/cubic centimeter when tested in accordance with ASTM D792.
   2. Water Absorption: Less then 0.50 percent when tested in accordance with ASTM D570.
   3. Tensile Strength: 3582 psi when tested in accordance with ASTM D 638.

2.03 SIMULATED WOOD TRIM

A. PVC Trimboards: Trimboards with sealed edge, designed with a natural appearance.
   1. Size: Width and thickness as shown on Contract Drawings.
   2. Finish: Reversible with Traditional (Smooth)/ Woodgrain finish.

B. PVC Sheet Board: For use as sheet materials to create patterns, surrounds, backplates, etc. as shown on the Contract Documents.
   1. Size: Width and Thickness as shown on Contract Drawings.
   2. Finish: Reversible with Traditional (Smooth)/ Woodgrain finish.

C. PVC Cornerboard: Folded, 90-degree, rabbeted with 3/4" pocket, one-piece assembly.
   1. Size: Width and Thickness as shown on Contract Drawings.
   2. Finish: Reversible with Traditional (Smooth)/ Woodgrain finish.

D. PVC Skirtboard: Use at base of all fiber cement siding, also serves as siding starter.
   1. Size: 5/4 x 10".
   2. Grained exterior surface.

2.04 ACCESSORY PRODUCTS

A. Fasteners:
   1. Use fasteners designed for cellular PVC trim and wood siding (thinner shank, blunt point, full round head).
   2. Use stainless steel fasteners.

3. Staples, small brads and wire nails must not be used as fastening members.
4. The fasteners should be long enough to penetrate the substrate a minimum of 1 1/2". All fasteners must be countersunk.
5. Use 2 fasteners per framing member for trim board applications.
6. Fasteners must be installed no more than 2" form the end of each board.
7. PVC Cellular Trim products should be fastened into a flat, solid substrate. Fastening PVC Cellular Trim products into hollow or uneven areas must be avoided.

B. Adhesives:
1. Glue all PVC Cellular Trim products to PVC Cellular Trim product joints such as window surrounds, long fascia runs, etc. with cellular PVC cement approved by the PVC Cellular product manufacturer, to prevent joint separation.
2. The glue joint should be secured with a fastener and/or fastened on each side of the joint to allow adequate bonding time.
3. Surfaces to be glued should be smooth, clean and in complete contact with each other.
4. To bond PVC Cellular Trim products to other substrates, various adhesives may be used. Consult adhesive manufacturer to determine suitability.

C. Sealants:
1. Use urethane, polyurethane or acrylic based sealants without silicone.

2.05 FINISHES

A. Install PVC Cellular Trim products with grained surface exposed.

B. Countersunk nail holes must be filled with a prefabricated plug, polyurethane or acrylic based caulk. Plug or caulk color to match trim board color.

PART 3 EXECUTION

3.01 INSTALLATION

A. Manufacturer's instructions:
1. Comply with manufacturer's product catalog installation instructions and product technical bulletin instructions.

B. Radius Applications
1. Heat form PVC trim where radius applications are required at arched windows and doorways.

C. Fastener Location
1. Use 2 fasteners per every framing member for trim board applications.
2. Use additional fasteners for trimboards 8 inches and wider.
3. Fasteners must be installed no more than 2" from the end of each board.

D. Thermal Expansion and Contraction
1. PVC Cellular products expand and contract with changes in temperature.
2. Properly fastening PVC Cellular Trim material along its entire length will minimize expansion and contraction.
3. When properly fastened, allow for 1/8" per 18 foot of PVC Cellular Trim products for expansion and contraction.
4. Joints between pieces of PVC Cellular Trim products should be glued to eliminate joint separation. When gaps are glued on a long run of PVC Cellular Trim product, allow expansion and contraction at ends of the run.

E. Finishes

1. Install Cellular PVC products with grained surface exposed.
2. Countersunk nail holes must be filled with a prefabricated plug, polyurethane or acrylic based caulk. Plug or caulk color to match trim board color.

3.02 CLEANING

A. Clean simulated wood trim with mild detergent and water.

B. Products with pumice, such as Soft Scrub, may be applied with a nylon brush.

C. For more stubborn stains use a mild household cleaner and degreaser like Clorox Cleanup, Clorox Outdoors, Denatured Alcohol, Bleach, Mr Clean Magic Eraser or Corte Clean with a nylon brush. Always test a small area prior to wide spread use.

3.03 PROTECTION

A. Protect installed products until completion of the project.

B. Touch-up, repair, or replace damaged products before Substantial Completion.

**END OF SECTION 066000**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual apply to work of this Section.

1.02 SUMMARY

A. This Section includes Cementitious Waterproofing applied to the following surfaces:
   1. Exterior and interior below-grade surfaces of concrete foundation walls and footings at elevator pit.
   2. Other below grade surfaces of existing building foundation walls and footers, and new foundations and footers as shown on the Contract Drawings.

1.03 SUBMITTALS

A. Submit pursuant to Section 013300 - Submittal Procedures

B. Submit pursuant to Section 016000 - Product Requirements

C. Product Data: Include substrate preparation, technical data, and recommendations for method of application, primer, number of coats and coverage or thickness.

D. Material Certificates: For each product, signed by manufacturers.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain primary waterproofing materials and primers through one source from a single manufacturer.

1.05 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecast weather conditions permit waterproofing to be performed according to manufacturers' written instructions.

B. Ventilation: Provide adequate ventilation during application of waterproofing in enclosed spaces. Maintain ventilation until waterproofing has thoroughly cured.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Five Star Products, Inc.
   2. Sika Corporation
   3. W. R. Meadows, Inc.

2.02 CEMENTITIOUS WATERPROOFING

A. Two component, self-curing cementitious waterproofing system, suitable for both negative and positive side waterproofing.
   1. Five Star® Waterproofing (Basis of Specification)

2. SikaTop® Seal 107
3. CEM-KOTE™ FLEX ST

B. Compressive Strength (ASTM C109)
1. 4 hours 3000 psi
2. 28 days 7000 psi

C. Bond Strength (ASTM C882)
1. 7 days 2400 psi

D. Permeability (CRD-C 48)
1. 1/8” thickness: 7.16x10-13 cm/sec (negative side)
7.16x10-14 cm/sec (positive side)

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, with Applicator present, for compliance with requirements for surface smoothness and other conditions affecting performance of work.
1. Begin waterproofing application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Protection of Other Work: Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with waterproofing. Prevent waterproofing materials from entering and clogging weep holes and drains.

B. Clean substrates of projections and substances detrimental to work; fill voids, seal joints, and apply bond breakers if any, as recommended by waterproofing manufacturer.

3.03 APPLICATION, GENERAL

A. Comply with manufacturer's written recommendations unless more stringent requirements are indicated or required by Project conditions to ensure satisfactory performance of waterproofing.
1. Apply additional coats if recommended by manufacturer or required to achieve coverages indicated.
2. Allow each coat of waterproofing to cure 24 hours before applying subsequent coats.

B. Apply waterproofing to footings and foundation walls of elevator pit as shown on Drawing.
1. Trowel apply to 1/8” thickness.
2. Apply from finished-grade line to top of footing, extend over top of footing, and down a minimum of 6 inches (150 mm) over outside face of footing.
3. Extend 12 inches (300 mm) onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.

3.04 CLEANING

A. Remove waterproofing materials from surfaces not intended to receive waterproofing.

**END OF SECTION 071116**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This Section includes but not limited to the following:
   1. Insulation under slabs-on-grade.
   2. Rigid perimeter foundation wall insulation.
   3. Board-type cavity wall insulation.

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Section 042200 - Concrete Unit Masonry for board insulation installed in cavity walls.
   2. Section 072116 - Blanket Insulation
   3. Section 072129 - Sprayed Insulation
   4. Section 075323.11 - Self-Adhering EPDM Roofing System for board insulation under EPDM roofing.
   5. Section 079200 - Sealants for spray foam sealant.
   6. Division 22 - Plumbing for pipe insulation
   7. Division 23 - HVAC for duct, pipe and equipment insulation

1.03 STANDARDS

A. All work of this section shall conform to industry standards and/or manufacturer’s recommendations.

B. ASTM C578 "Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation".

C. ASTM E84 “Standard Test Method for Surface Burning Characteristics of Building Materials”.

D. ASTM E119 “Standard Test Methods for Fire Tests of Building Construction and Materials”.

E. ASTM E136 “Standard Test Method for Behavior of Materials in A Vertical Tube Furnace At 750 degrees C.”

1.04 SUBMITTALS

A. Submit pursuant to Section 013300 - Submittal Procedures.

B. Submit pursuant to Section 016000 - Product Requirements.

C. Product test reports from and based on tests performed by qualified independent testing laboratory evidencing compliance of insulation products with requirements including r-values (aged values for plastic foam insulation), fire performance characteristics, perm ratings, water absorption ratings, and other properties, based on comprehensive testing of current products.

1.05 QUALITY ASSURANCE

A. Experienced workers familiar with the work and according to manufacturer’s recommendations and/or industry standards shall perform all work of this Section.

B. Fire Performance Characteristics: Provide insulation materials identical to those whose indicated fire performance characteristics have been determined per the ASTM test method

indicated below, by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing and inspecting organization.
1. Surface Burning Characteristic: ASTM E84.
2. Fire resistance Ratings: ASTM E119.

C. Single-Source Responsibility for Insulation Products: Obtain each type of building insulation from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

D. Allowable Thickness Variations: Manufacturer's standard units that vary slightly from the thickness indicated may be acceptable, SUBJECT TO THE APPROVAL OF THE ARCHITECT.

E. Thermal Resistance: The thicknesses shown are for the thermal resistance (R-Value in accordance with ASTM C177 or ASTM C518) specified for each material. The R-Values specified are minimum acceptable. Provide adjusted thicknesses as directed for the use of material having a different thermal resistance.

F. Certification: Affidavit by the polystyrene thermal manufacturer, certifying that the insulation was manufactured with CFC-free blowing agents.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's recommendations for handling, storage, and protection during installation.

B. Protect plastic insulation as follows:
1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver plastic insulating materials to project site ahead of installation time.
3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide insulation products of one of the following unless otherwise noted:
1. Dow Building Solutions: The Dow Chemical Company
2. Kingspan Insulation LLC
3. Owens Corning Foam Insulation, LLC.

2.02 INSULATING MATERIALS

A. Extruded Polystyrene Board (XPS) and Polyisocyanurate Insulation:
1. Provide thickness to meet R-value shown on the drawings.
2. Use Foil Faced Polyisocyanurate Insulation: Thermax or Architect approved equal where shown on Drawings.
3. Use extruded polystyrene (XPS) board where shown in contact with soil or in exterior wall construction. Insulation shall have a compressive strength of 25 PSI and R-Value of R-5 per inch of thickness.
4. Use extruded polystyrene (XPS) board in joints between interior and exterior slabs.

5. Use scored extruded polystyrene where shown in masonry cavity walls. Insulation shall have a compressive strength of 25 PSI and R-Value of R-5 per inch of thickness.
   a. Joint tape as recommended by insulation manufacturer.

2.03 AUXILIARY INSULATING MATERIALS

A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation or mechanical anchors securely to substrates indicated without damaging or corroding insulation, anchors, or substrates.

B. Fastening Components
   1. Nails or Staples: Steel wire; galvanized, type and size to suit application.
   2. Tape: type and size to suit application.
   3. Spindle Fasteners: Galvanized wire spindle on flat metal base; self-adhering backing.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adjacent materials are dry and ready to receive insulation.

B. Do not proceed with installation of insulation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install insulation in accordance with manufacturer's published instructions.

B. Butt insulation tight. Leave no gaps or voids.

C. No voids in the insulation will be permitted.
   1. Insulation shall be slit or neatly placed around conduits, pipes, boxes or any other pieces in walls, cavities or below slab grades.
   2. Insulation shall not be compressed when placed.
   3. Tape all insulation joints in cavity wall insulation.

D. Any holes, voids and/or spaces between heated and unheated spaces shall be sealed with foamed in place insulation/sealant.
   1. Voids are not acceptable.

E. Joints between dissimilar exterior materials shall be filled with insulation.
   1. Compatible foamed in place insulation shall be used where insulation cannot be installed.
   2. Sealant and backer rod are required regardless of insulation or foamed in place insulation.

F. Provide Rigid Extruded Polystyrene Board Insulation at all new exterior foundation walls and/or grade beams. Extend insulation vertically down face of foundation wall or grade beam. See Contract Drawings for required depths and thickness of foundation insulation. Protect insulation from damage during concrete work and backfilling.

3.03 WASTE MANAGEMENT

A. Plan and coordinate insulation work to minimize generation of off-cuts and waste. Sequence work to maximize use of insulation off-cuts and waste.

3.04 PROTECTION

A. General: Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

**END OF SECTION 072113**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This Section includes but not limited to the following:
   1. Building insulation in batt or blanket form.
   2. Sound attenuating fire batt insulation.
   3. Eave vent baffles
   4. Sill sealer

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Section 054000 - Cold Formed Metal Framing for thermal insulation installed as part of metal-framed wall assemblies.
   2. Section 072113 - Board Insulation
   3. Section 072129 - Sprayed Insulation
   4. Section 075323.11 - Self-Adhering EPDM Roofing System for roof insulation specified as part of the roofing construction.
   5. Section 078400 - Firestopping for semi-refractory fiber insulation.
   6. Section 079200 - Sealants
   7. Section 092116 - Gypsum Board Assemblies for thermal insulation and sound attenuation insulation installed as part of metal-framed wall and partition assemblies.
   8. Division 22 - Plumbing for pipe insulation.
   9. Division 23 - HVAC for duct, pipe, and equipment insulation.

1.03 STANDARDS

A. All work of this section shall conform to industry standards and/or manufacturer's recommendations.

B. ASTM C553 "Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications".

C. ASTM C612 "Standard Specification for Mineral Fiber Block and Board Thermal Insulation".

D. ASTM C665 "Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing".

E. ASTM E84 "Standard Test Method for Surface Burning Characteristics of Building Materials".

F. ASTM E119 "Standard Test Methods for Fire Tests of Building Construction and Materials".

G. ASTM E136 "Standard Test Method for Behavior of Materials In A Vertical Tube Furnace At 750 degrees C."

1.04 SUBMITTALS

A. Submit pursuant to Section 013300 - Submittal Procedures.

B. Submit pursuant to Section 016000 - Product Requirements.

C. Submit product data for each type of insulation, sill sealer, and eave bent baffle if of a pre-manufactured style.

D. Product test reports from and based on tests performed by qualified independent testing laboratory evidencing compliance of insulation products with requirements including R-values, fire performance characteristics, perm ratings, water absorption ratings, and other properties, based on comprehensive testing of current products.

1.05 QUALITY ASSURANCE

A. Experienced workers familiar with the work and according to manufacturer's recommendations and/or industry standards shall perform all work of this Section.

B. Fire Performance Characteristics: Provide insulation materials identical to those whose indicated fire performance characteristics have been determined per the ASTM test method indicated below, by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing and inspecting organization.
   1. Surface Burning Characteristic: ASTM E84.
   2. Fire resistance Ratings: ASTM E119.

C. Single-Source Responsibility for Insulation Products: Obtain each type of building insulation from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

D. Allowable Thickness Variations: Manufacturer's standard units that vary slightly from the thickness indicated may be acceptable, SUBJECT TO THE APPROVAL OF THE ARCHITECT.

E. Thermal Resistance: The thicknesses shown are for the thermal resistance (R-Value in accordance with ASTM C177 or ASTM C518) specified for each material. The R-Values specified are minimum acceptable. Provide adjusted thicknesses as directed for the use of material having a different thermal resistance.

F. Certification: Affidavit by the polystyrene thermal manufacturer, certifying that the blanket insulation was manufactured with CFC-free blowing agents.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's recommendations for handling, storage, and protection during installation.

PART 2 PRODUCTS

2.01 INSULATING MATERIALS - GENERAL

A. General: Provide insulating materials that comply with requirements and with referenced standards.
   1. Preformed Units: Sizes to fit applications indicated; selected from manufacturer's standard thicknesses, widths, and lengths.

2.02 FORMALDEHYDE-FREE BATT INSULATION

A. Manufacturers:
   1. Johns-Manville International Inc.

2. Knauf Insulation
3. Owens Corning Eco Touch

B. Glass Fiber Insulation Batts:
1. Description: flexible, lightweight, thermal, formaldehyde-free insulation made of long, resilient glass fibers bonded with anon-toxic acrylic thermosetting resin binder.
2. Unfaced, rated non-combustible pursuant to ASTM E84, E119 and E136.
3. Thermal resistance (R-value) as shown on drawings.
4. Width of batts shall completely fill space between framing members. Where framing member spacing exceeds available batt width, provide multiple batts to completely fill space between framing members.
   a. No voids will be tolerated.

2.03 SOUND ATTENUATION FIRE BATT INSULATION (MINERAL WOOL)

A. Manufacturers:
1. Johns Manville
   a. Mineral Wool Sound Attenuation Fire Batts (SAFB)
2. Owens Corning, Thermafiber
   a. Thermafiber® SAFB™
3. Rockwool
   a. AFB evo™

B. Type: Sound Attenuation Fire Blanket (SAFB)
1. R-Value: 3.7 per inch
2. Facing: Unfaced only
3. Density: 4.0pcf (nominal) for 1” thick material
4. Density: 2.5pcf (nominal) for thickness greater than 1”.
5. Surface Burning Characteristics: Unfaced-Flame spread 0 and Smoke Developed 0
6. Minimum Recycle content: 70% (pre-consumer)
7. Formaldehyde-Free product

C. 3” thickness in 3-5/8” cavities and 6” thickness in 6” or larger cavities (see drawings for wall thickness) Sound Attenuation Fire Batts (SAFB), 16” or 24” wide.

D. Ceiling: 3” thick x 24” wide Sound Attenuation Fire Batts.

E. Used in both rated and non-rated interior walls and ceilings wherever sound attenuation is shown on the Contract Drawings.

2.04 AUXILIARY INSULATING MATERIALS

A. Adhesive for Bonding Insulation: product with demonstrated capability to bond insulation or mechanical anchors securely to substrates indicated without damaging or corroding insulation, anchors, or substrates.

B. Adhesively Attached Pin Anchors: Perforated plate, 2-inches square, welded to projecting pin, with self-locking washer, complying with the following requirements:
1. Plate: Zinc-plated steel, 0.106-inch thick.
2. Pin: Copper-coated low carbon steel, fully annealed, 0.106-inches in diameter, length to suit depth of insulation indicated and, with washer in place to hold insulation tightly to substrate behind insulation.
3. Self-Locking washer: Mild steel, 0.016-inch thick, sizes as required to hold insulation securely.

a. Where spindles will be exposed to human contact after installation, project ends with capped self-locking washers.

C. SILL SEALER
1. Install high-density Polyethylene foam sill sealer at all exterior stud walls under all bottom tracks (not just at top of foundation wall).

D. FASTENING COMPONENTS
1. Nails or Staples: Steel wire; galvanized, type and size to suit application.
2. Tape: type and size to suit application.
3. Spindle Fasteners: Galvanized wire spindle on flat metal base; self-adhering backing.

E. WIRE-UP INSTALLATION
1. Wire Mesh: galvanized steel, hexagonal wire mesh.
a. 16 Gauge Wire at 24" o.c. min.

F. INSULATION EAVE VENT BAFFLES 24" TRUSS SPACING
1. Manufacturers: DCI Products, 415 South Penn St., Clifton Heights, PA, 19018; Phone: 800-622-4455 or Architect Approved Equivalent.
2. Material: 1/8" minimum thickness corrugated plastic compatible with spray foam insulation.
a. Must provide 2" minimum airflow between trusses.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adjacent materials are dry and ready to receive insulation.

B. Verify mechanical and electrical services within walls have been installed and inspected.

C. Do not proceed with installation of insulation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean substrates of substances harmful to insulation or vapor retarders, including removal of projections that might puncture vapor retarders.

B. Verify that adjacent materials are dry and ready to receive the insulation.

3.03 INSTALLATION

A. Install insulation in accordance with manufacturer’s published instructions.

B. Butt insulation tight.

C. Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within plane of insulation. Leave no gaps or voids.

D. Fasten in place at maximum 6 in. on center, tape in place, or retain in place with spindle fasteners or retain in place with mesh secured to framing members as required by manufacturer’s published instructions. Tape seal butt ends and lapped side flanges. Tape seal tears or cuts in membrane with material compatible with membrane, on an insulation that bears a facing.

E. All spaces around windows, doors and other penetrations shall be filled or foamed with insulation, with no voids.

F. In exterior stud walls and insulated interior stud walls, all cavities within studs placed adjacent to each other shall be filled with insulation as stud assemblies are built. Likewise, all cavities in headers shall be filled with insulation.

G. No voids in the insulation will be permitted.
   1. Insulation shall be slit or placed around conduits, pipes, boxes or any other pieces in walls or roof.
   2. Insulation shall not be compressed when placed, except where indicated to be stuffed.

H. Any holes, voids or spaces between heated and unheated spaces shall be sealed with foamed in place insulation.
   1. Voids are not acceptable.

I. Joints between dissimilar exterior materials shall be filled with batt insulation.
   1. Foamed in place insulation shall be used where batt insulation cannot be installed.
   2. Sealant and backer rod are required regardless of insulation or foamed in place insulation.

J. Do not place insulation over or within 3-inches of recessed lighting fixtures, unless fixtures are rated for insulation contact.

K. Where two layers of insulation are indicated or required, run second layer perpendicular to first layer.

L. Apply sound attenuating fire batts; friction-fit in all partitions indicated by the wall type and/or keynote on the floor plans and under built-up ramps as shown. Use metal clips or wire as required to ensure that the blankets remain in place in the wall and ramps assembly. Install the insulation consistently on one side of the partition filling the cavity to the full height of the wall. Leave no voids.

M. Install eve vent baffles between roof trusses at all vented eaves. Secure baffles to top chord of truss or bottom of roof deck with pan head screws 8" o.c.

3.04 WASTE MANAGEMENT

A. Plan and coordinate insulation work to minimize generation of off-cuts and waste. Sequences work to maximize use of insulation cut-offs and waste,

3.05 PROTECTION

A. General: Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation

**END OF SECTION 072116**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Supplementary Conditions, and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. The work of this section includes, but is not limited to, the following:
   1. Closed cell spray foam insulation.
   2. Temporary UV protection for spray foam insulation.
   3. Ignition barrier applied to spray foam insulation where required by AHJ.

B. Related Sections: Other specification sections which directly relate to the work of this section include, but are not limited to, the following:
   1. Section 042200 - Concrete Unit Masonry
   2. Section 054000 - Cold Formed Metal Framing
   3. Section 072713 - Air/Vapor Barriers
   4. Section 079200 - Sealants
   5. Section 092116 - Gypsum Board Assemblies

1.03 STANDARDS AND REFERENCES

A. The following standards and publications (latest edition) are applicable to the extent referenced in the text.
   1. ASTM C 518 - "Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus".
   2. ASTM C 177 - "Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus".
   3. ASTM C 1338 - "Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings".
   4. ASTM E 84 - "Standard Test Method for Surface Burning Characteristics of Building Materials".
   5. ASTM E 96 - "Standard Test Methods for Water Vapor Transmission of Materials".
   6. ASTM E 283 - "Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen".
   7. ASTM E 2178 - "Standard Test Method for Air permeance of Building Materials".
   8. ASTM D 1621 - "Standard Test Method for Compressive Properties of Rigid Cellular Plastics".
   9. ASTM D 1622 - "Standard Test Method for Apparent Density of Rigid Cellular Plastics".
   10. ASTM D 1623 - "Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics".
   11. ASTM D 2126 - "Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging".
   12. ASTM D 2842 - "Standard Test Method for Water Absorption of Rigid Cellular Plastics".

1.04 SUBMITTALS

A. Submit pursuant to Section 013300 - Submittal Procedures.

B. Submit pursuant to Section 016000 - Product Requirements

C. Product Data:
   1. Provide spray foam manufacturer's:

a. Product data for type of insulation specified.
b. Test Reports performed by a qualified third-party testing agency evidencing compliance of insulation products with specified requirements.
c. Installation Instructions.
d. Use Limitations and Recommendations.
e. Sample Warranty.

2. Provide product data for temporary UV blocking coverings to be utilized if spray foam exposure exceeds 90 days.

D. Certifications:
1. Manufacturer's years of experience in manufacture of materials of this Section.
2. Copy of Applicator current certificate issued by spray foam manufacturer.
3. Insulation installer shall provide a certification listing the type, manufacturer and R value of insulation installed in each element of the building thermal envelope. Certification shall indicate the initial installed thickness and installed density for each element of the building thermal envelope. The insulation installer shall provide two signed and dated copies of the certification. One copy shall be submitted to the Architect and the other copy shall be posted in a conspicuous location on the project site.

1.05 QUALITY ASSURANCE

A. Single Source Responsibility: Single source products from one manufacturer.

B. Installer: A firm which has at least 5 years experience in spray foam insulating and has been trained and approved by the spray foam manufacturer in the art of applying spray foam insulation.

C. Pre-Installation Conference: A pre-installation conference shall be held prior to commencement of field operations to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Agenda for the meeting shall include but is not limited to review of special details, the cleaning requirements for masonry anchors, and overspray control.

D. A copy of the manufacturer's published installation instructions must be available at all times on the project during installation.

E. Spray foam must be applied to the sample masonry panel.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials and products in manufacturer's original sealed containers clearly labeled with manufacturer's name, product identification, safety information, lot numbers if applicable, net weight of contents, and expiration date.

B. Store and handle in strict compliance with manufacturer's instructions, recommendations and material safety data sheets. Store in accordance with local fire and safety codes. Protect from damage from sunlight, weather, excessive temperatures and construction operations.

C. Empty containers must be removed from site on a daily basis.

1.07 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

B. Do not apply insulation when substrate temperatures are less than 50 degrees F prior to installation or as recommended by spray foam manufacturer.

C. Surfaces must be dry prior to application of spray foam. Installer must measure substrate moisture content before applying spray foam. Record moisture readings and their respective locations and submit to Architect for record. Excess humidity may cause poor adhesion, and result in product failure.

D. To avoid overspray, product should not be applied when conditions are windy.

E. Protect adjacent surfaces: windows; flashings; masonry anchors; door frames; floors; soffits; fascia; equipment; etc. from damage of overspray. Immediately remove all overspray from adjacent surfaces.

F. Spray foam on exterior walls and other areas subject to UV exposure shall not be left exposed more than 90 days. If permanent veneer/siding covering cannot be installed within 90 days, provide temporary UV blocking coverings. If it is known permanent covering will not occur within 90 day time limit, cover spray foam insulation within seven (7) days of application. Maintain temporary UV blocking coverings until installation of the permanent veneer/siding covering.

1.08 WARRANTY

A. Provide manufacturer's Limited Lifetime Warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Accella Polyurethane Systems, 2400 Spring Stuebner Road, Spring, TX 77389 Phone: 800-221-3626.

B. BASF Corporation, 1703 Crosspoint Ave., Houston, TX 77054 Phone: 800-706-0712.

C. Demilec, 3315 E. Division St., Arlington, TX 76011 Phone: (888) 224-1533.

D. Icynene Inc., 6747 Campobello Road, Mississauga, Ontario L5N 2L7 Canada Phone: 800-758-7325.

E. Johns Manville, 717 17th Street, Denver, CO 80202 Phone: 309-978-2434.

F. NCFI Polyurethanes, Division of BMC, PO Box 1528, Mount Airy, NC 27030 Phone: 800-346-8229.

2.02 MATERIALS

A. Closed Cell Spray Foam Insulation
   1. Spray applied Rigid Polyurethane Foam Insulation System
   2. Products:
      a. Bayseal® CCX/XP manufactured by Accella Polyurethane Systems.
      b. SPRAYTITE® 178 Series manufactured by BASF Corporation.
      c. Heatlok® XT manufactured by DEMILEC USA.
      d. Icynene ProSeal™ manufactured by Icynene Inc.
      e. JM Corbond III® manufactured by Johns Manville.
      f. InsulBloc® manufactured by NCFI Polyurethanes
   3. Physical Properties:

| Property | Test Method | Typical Value |
|---|---|---|
| Density | ASTM D 1622 | 1.9 – 2.2 lbs/cubic foot |
| Aged Thermal Resistance 180 days @ 23 degrees C, 1” | ASTM C 518 | 6.6 - 7.1 (ft2hdegrees F)/BTU. |
| Air Permeance @75 Pa, 1” | ASTM E 283 | less than 0.02 L/sm squared |
| Compressive Strength | ASTM D 1621 | 15 - 40 psi |
| Tensile Strength | ASTM D 1623 | 40 - 65 psi |
| Water Vapor Transmission, 1”, Vapor Barrier (<1 perm) @ 1-1/4” | ASTM E 96 | 1.2 – 1.4 perms |
| Off Gassing Tests (VOC Emissions) | CGSB 51.23-92 | Pass (No toxic vapors) |
| Surface Burning Characteristics 3” Flame Spread Index Smoke Development | ASTM E 84 | Class 1 25 max. 450 max. |
| Closed Cell Content | ASTM D 2856 | >90% |

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Ensure that penetrating work by other trades is in place and complete.

C. Verify that all exterior and interior wall, partition, and floor/ceiling assembly construction has been completed to the point where the insulation may correctly be installed.

D. Verify that substrate and cavities are dry by checking surface for moisture with Moisture Detection Paper strips or other moisture detection system acceptable to the Architect. Record location of all readings and results and submit to Architect for record.

E. Verify substrate is free from any foreign material that will impede application and/or adhesion.

F. Verify that mechanical and electrical services in ceilings, walls and floors have been installed and tested and, if appropriate, verify that adjacent materials are dry and ready to receive insulation.

G. Verify transition flashings and sealants are in place and are compatible with the spray foam insulation.

H. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces by brushing, scrubbing, scraping, grinding or compressed air to remove loose mortar, dust, oil, grease, oxidation, mill scale, rust and other contaminants which will affect adhesion of the closed cell spray foam insulation. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Mask and protect adjacent surfaces from overspray or dusting.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions. Product must be installed according to local code and must be applied by a qualified applicator.

B. Equipment used to apply the foam insulation shall have fixed ratio positive displacement pumps and approved by the foam manufacturer.

C. Apply insulation by spray method, to uniform monolithic density without voids. Apply in consecutive passes as recommended by manufacture to thickness as indicated on the drawings or required to meet R values. Comply with manufacturer’s recommended cooling times between passes. Apply additional insulation to any area not meeting design thickness.

D. Apply insulation to seal voids at truss ends to prevent wind scouring of ceiling insulation.

E. Seal plumbing stacks, electrical wiring and other penetrations into attic to control air leakage.

F. Apply insulation to fill voids around doors, windows, and louvers. Apply insulation to fill voids around accessible service and equipment penetrations.

G. Do not install spray foam insulation in areas where it will be in contact with equipment or materials with operating temperatures of 180 degrees F (82 degrees C) or greater.

H. Clean all exposed masonry eyelets and/or anchor parts that extend thru the spray foam. Cleaning method shall not damage or bend masonry anchors.

I. Apply sealant to joints between structural assemblies as specified in Division 07.

J. Patch damaged areas just prior to permanent veneer covering.

K. Trim, as required, any excess thickness that would interfere with the application of cladding/covering systems by other trades or restrict the open cavity required in veneer masonry construction.

L. Full payment for spray foam work cannot be made until all masonry anchors and/or anchor parts have been cleaned and all areas of overspray have been rectified.

3.04 PROTECTION

A. Protect installed spray foam until spray foam is covered by a finish product. Provide temporary coverings where spray foam insulation is subject to abuse.

B. Provide temporary UV protection of installed foam if spray foam will be exposed more than 90 days.

C. Touch-up, repair or replace damaged spray foam before covering with finish product.

**END OF SECTION 072129**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This section includes, but is not limited to, the following:
   1. Infiltration Barrier (Weather Resistive Barrier).
   2. Window, Door, Louver & Transition Flashing
   3. Air Barriers.
   4. Vapor Retarders.
   5. Sill Sealer.
   6. Foam Closure Strip at Metal Roof Decking.

B. Related Sections: The following sections contain requirements that relate to this section:
   1. Section 031000 - Concrete Forming and Accessories for vapor barrier/insulation under interior slabs on grade.
   2. Section 053100 - Steel Decking.
   3. Section 054000 - Cold Formed Metal Framing.
   4. Section 074646 - Fiber Cement Siding - Hardie.
   5. Section 075323.11 - Self-Adhering EPDM Roofing System for vapor retarder specified as part of the EPDM Roofing System.
   6. Section 076200 - Sheet Metal Flashing and Trim.
   7. Section 079200 - Sealants.

1.03 STANDARDS AND REFERENCES

A. ASTM International
   1. ASTM D 882; "Standard Test Method for Tensile Properties of Thin Plastic Sheeting".
   2. ASTM D 1117; "Standard Guide for Evaluating Non-woven Fabrics".
   3. ASTM E 84; "Standard Test Method for Surface Burning Characteristics of Building Materials".
   4. ASTM E 96; "Standard Test Methods for Water Vapor Transmission of Materials".
   5. ASTM E 1643; " Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs".
   6. ASTM E 1677; "Standard Specification for Air Barrier (AB) Material or Assemblies for Low-Rise Framed Building Walls".
   7. ASTM E 2178; "Standard Test Method for Air Permeance of Building Materials".
   8. ASTM E 2357; "Standard Test Method of Determining Air Leakage Rate of Air Barrier Assemblies".

B. AATCC - American Association of Textile Chemists & Colorists
   1. Test Method TM127; "Test Method for Water Resistance: Hydrostatic Pressure".

C. TAPPI - Technical Association of the Pulp and Paper Industry
   1. Test Method T-460; "Air Resistance of Paper (Gurley Method)".

1.04 SUBMITTALS

A. Submit pursuant to Section 013300 - Submittal Procedures.

B. Submit pursuant to Section 016000 - Product Requirements.

C. Product Data: Submit manufacturer's product data, installation instructions, use limitations and recommendations.

D. Manufacturer's field service reports for infiltration barrier: Provide pre-installation conference and site reports from authorized field service representative, indicating observation of infiltration barrier assembly installation.

E. Infiltration Barrier Warranty: Manufacturer's executed warranty form with authorized signatures and endorsements indicating date of Substantial Completion:
   1. Warranty Period: 10-year limited product and labor warranty.

1.05 PRE-INSTALLATION MEETING

A. Hold a pre-installation conference, two weeks prior to start of infiltration barrier installation. Attendees shall include Contractor, Architect, installer, Owner's Representative, and infiltration barrier manufacturer's designated representative.

B. Review all related project requirements and submittals, status of substrate work and Preparation, areas of potential conflict and interference, availability of infiltration barrier assembly materials and components, installer's training requirements, equipment, facilities and scaffolding, and coordination of methods, procedures and sequencing requirements for full and proper installation, integration and protection.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver materials and components in manufacturer's original, unopened, undamaged containers with identification labels intact.

B. Store materials as recommended by manufacturer.

PART 2 PRODUCT

2.01 VAPOR RETARDER

A. Wall and Roof
   1. Vapor Retarder shall be six (6) mil. polyethylene for wall and warm side of attic/roof construction.

B. Under slab on grade
   1. See Section 031000 - Concrete Forming and Accessories

2.02 INFILTRATION BARRIER

A. Infiltration barrier DuPont™ Tyvek® DrainWrap™ or an Architect Approved Equivalent shall be installed over all exterior wall sheathing.
   1. Air Penetration: .004 cfm/ft2 at 75 Pa maximum when tested in accordance with ASTM E2178. Type 1 when tested in accordance with ASTM E-1677.
   2. Water Vapor Transmission: 36 perms, when tested in accordance with ASTM E96, Method A
   3. Water Penetration Resistance: 210 cm when tested in accordance with AATCC Test Method 127.
   4. Basis Weight: 2.1-oz/yd2 min., when tested in accordance with TAPPI Test Method T-410.
   5. Surface Burning Characteristics: Class A, when tested in accordance with ASTM E84. Flame Spread: 5, Smoke Developed: 25.

6. Infiltration Barrier to be made of spunbonded polyolefin, non-woven, non-perforated infiltration barrier (weather barrier).
   a. Infiltration barrier to be covered within four (4) months of installation.

B. Tape: 3” wide pressure sensitive tape of type recommended by manufacturer for sealing joints and penetrations in infiltration barrier.

C. Fasteners: DuPont Tyvek Wrap Cap Screws, as distributed by DuPont: 1-5/8” rust resistant screw with 2” diameter plastic cap or manufacturer approved equivalent.

2.03 WINDOW, DOOR, LOUVER AND TRANSITION FLASHING (WDLT FLASHING)

A. Self adhering membrane consisting of an SBS rubberized asphalt compound integrally laminated to an engineered film.
   1. Thickness: 35 mils minimum
   2. Primer: As recommended by manufacturer.
   3. Manufacturer: Henry Company Blueskin WB or Architect approved equivalent.
   4. Termination Bar: 1/8” x 1”, 304 stainless steel, continuous, fastened at 16” o.c.

2.04 AUXILIARY SEALING MATERIALS

A. SILL SEALER
   1. Install high-density Polyethylene foam sill sealer under bottom track at all exterior stud walls. Sealer to be full width of track.

B. FOAM CLOSURE STRIPS
   1. Provide top and bottom void strip foam closures by Metal Deck.com or Architect approved equivalent.
   2. Foam Closure Strips to be manufactured to match the profile of the roof deck.
   3. Install in top and bottom flutes of all roof decking at perimeter envelope insulation as shown on Contract Drawings.

PART 3 EXECUTION

3.01 VAPOR TIGHTNESS

A. No tears or gaps in the vapor retarder and infiltration barrier will be allowed. Repair any tears or punctures in barriers immediately BEFORE CONCEALMENT by other work. Cover tape or add another layer of vapor/infiltration barrier.

B. Vapor retarders are to be installed over all exterior batt insulation, uninterrupted from slab to roof deck or as detailed on Contract Drawings.
   1. Firmly attach vapor retarders to substrates with mechanical fasteners or adhesives as recommended by vapor retarder manufacturer.
   2. Overlap joints a minimum of 24”.
   3. Overlapped joints shall be completely covered with adhesives or tape per vapor barrier/retarder manufacturer’s printed directions. Locate all joints over framing members or other solid substrates.

C. The joint between the exterior wall Gypsum Wall Board and the roof deck shall be sealed against air infiltration. The exterior wall Gypsum Wall Board shall overlay the bottom plate. Use foam closure strips specified above in both top and bottom flutes behind the exterior wall gypsum sheathing.

3.02 AIR TIGHTNESS

A. Infiltration Barrier
   1. All joints in the infiltration barrier will be lapped a minimum of six (6) inches and sealed with an approved construction tape. Overlap infiltration barrier at exterior corners a minimum of 12 inches.
   2. The infiltration barrier shall be neatly folded into each building opening in a manner to eliminate any gaps in the continuous airtight surface.
   3. Any terminating edges of the infiltration barrier, such as at the top or bottom of the wall shall be sealed with caulk.
   4. All penetrations shall be fully sealed per manufacturer's recommendations.
   5. Seal any tears or cuts as recommended by infiltration barrier manufacturer.
   6. Notify manufacturer's designated representative to obtain required periodic observations of infiltration barrier installation.

B. It is intended that the building be as airtight as practical.
   1. It is incumbent upon the contractor to notify the Architect of any conflict or problem, so the Architect may make revisions or modifications to the work.
   2. Notify Architect and allow 48 hours (minimum) for inspection of the insulation and vapor barrier prior to covering or sealing of the work.

3.03 WINDOW, DOOR, LOUVER AND TRANSITION FLASHING (WDLT FLASHING)

A. Surface Preparation
   1. All surfaces must be clean of oil, dust and excess mortar. Strike masonry joints flush.
   2. Prime all surfaces to receive flashing in accordance with manufacturer's recommendations.

B. Installation
   1. Lap flashing a minimum of 2" on both side and end laps. Orient laps shingle fashion to shed water. Seal joints in accordance with manufacturer's recommendations.
   2. Membrane applied to the underside of the substrate (i.e. ceilings) requires mechanical fastening with termination bars.
   3. Install termination bar where shown on the contract documents or required to insure permanent adhesion to substrate.
   4. Where spanning a change in substrates, beam, column, brace, etc., flashing shall extend onto each surface a minimum of 4" on each side of the discontinuity.

C. Locations
   1. Install at all window, door, louver, duct, pipe, conduit penetrations of the exterior gypsum/wood sheathing or exterior CMU back-up masonry.
   2. Install at all inside and outside corners of exterior gypsum/wood sheathing.
   3. Transition flashing shall span any discontinuity between exterior wall back-up materials. These can be vertical, horizontal and/or diagonal. Examples are:
      a. Gypsum/wood sheathing terminates at start of exterior CMU back-up with both materials in the same plane.
      b. Gypsum/wood sheathing overlaps exterior CMU back-up and terminates.
      c. Exterior CMU back-up wall is not continuous due to a steel column, beam and/or brace.
      d. Exterior gypsum/wood sheathing is not continuous due to a steel column, beam and/or brace.
   4. At all other locations shown on Contract Drawings.

3.04 PROTECTION

A. General: Protect installed insulation, infiltration barriers, WDLT flashings and vapor barriers from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

B. Protect WDLT flashings from sunlight as quickly as possible. Exposure to sunlight shall be limited to six weeks or as recommended by manufacturer in writing.

**END OF SECTION 072713**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This section includes, but not limited to, the following:
   1. Installation of a fluid-applied air and water-resistive barrier via spray application to exterior CMU back-up walls where indciated

B. Related Sections: The following sections contain requirements that relate to this section:
   1. Section 040523 - Masonry Accessories
   2. Section 042200 - Concrete Unit Masonry for requirement that backup masonry joints are flush and completely filled with mortar, and that excess mortar on brick ties will be removed; requirement for gap at deflection joints and fillers; coordination with sequencing of through-wall flashing.

1.03 PERFORMANCE REQUIREMENTS

A. Material Performance: Provide materials which have an air permeance not to exceed 0.004 cubic feet per minute per square foot under a pressure differential of 0.3 in. water (1.57 psf) (0.02L/m2 @ 75 Pa.) when tested according to ASTM E 2178.

B. Connections to Adjacent Materials: Provide connections to prevent air leakage and vapor migration at the following locations:
   1. Foundation and walls, including penetrations, ties and anchors.
   2. Walls, windows, curtain walls, storefronts, louvers or doors.
   3. Different wall assemblies and fixed openings within those assemblies.
   4. Wall and roof connections and penetrations.
   5. Expansion joints,
   6. All other leakage pathways in the building envelope.

1.04 SUBMITTALS

A. Submit pursuant to Section 013300 - Submittal Procedures

B. Submit pursuant to Section 016000 - Product Requirements.

C. Product Data: Submit manufacturer’s product data, installation instructions and manufacturer’s printed instructions for evaluation, preparing and treating substrate, temperature and other limitations of installation conditions, technical data and tested physical and performance properties.
   1. Submit letter from primary materials manufacturer indicating approval of products not manufactured by primary manufacturer.
   2. Include statement that materials are compatible with adjacent materials proposed for use.

D. Compatibility: Submit letter from manufacturer stating that materials proposed for use are permanently chemically compatible and adhesively compatible with adjacent materials proposed for use. Submit letter from manufacturer stating that cleaning materials used during installation are chemically compatible with each of the adjacent materials proposed for use.

1.05 QUALITY ASSURANCE

A. Manufacturer: Obtain primary materials from a single manufacturer regularly engaged in manufacturing air and vapor barrier membranes. Obtain secondary materials from a source acceptable to the primary materials manufacturer

B. VOC Regulations: Provide products which comply with applicable regulations controlling the use of volatile organic compounds.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product, date of manufacture, and directions for storage.

B. Store materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air and vapor barrier membrane manufacturer. Protect stored materials from direct sunlight.

C. Handle materials in accordance with manufacturer's recommendations.

1.07 PROJECT CONDITIONS

A. Temperature: Install air and vapor barrier within range of ambient and substrate temperatures recommended by air and vapor barrier manufacturer.

B. Field Conditions: Do not install air and vapor barrier in snow, rain, fog or mist without temporary protection and supplemental heat as required. Do not install air and vapor barrier when the temperature of substrate surfaces and surrounding air temperatures are below those recommended by the manufacturer. Apply membrane to a surface dry substrate, or in accordance with manufacturer's recommendations.

1.08 WARRANTY

A. Material warranty: Provide manufacturer's standard product warranty, for a minimum of 3 years from date of Substantial Completion.

B. Installation Warranty: Provide installer's 2-year warranty form date of Substantial Completion, including all components of the air and vapor barrier assembly, against failures including loss of air tight seal, loss of watertight seal, loss of adhesion, loss of cohesion, failure to cure properly.

PART 2 PRODUCT

2.01 MATERIALS

A. Fluid-Applied Air and Vapor Barrier: Fluid-applied proprietary materials as specified. Use regular or low-temperature formulation depending on site conditions, within temperature ranges specified by manufacturer. Provide related accessories including primer, seam tape, mastic, fluid and sealant recommended by manufacturer. Subject to compliance with requirements, provide one of the following:
   1. Carlisle Coatings and Waterproofing:
      a. Fluid-Applied Air and Vapor Barrier: Barriseal, 40 mils thick (dry)
      b. Water-Based Primer: CCW-AWP Water-Based Primer.
      c. Solvent-Based Primer: CCW-702 Solvent-Based Primer.
      d. Solvent-Based Aerosol Primer: CAV-GRIP

e. Mastic: CCW-704 Solvent-Based Rubberized Asphalt Mastic
f. Sealants: CCW-703 Vertical Grade Liquiseal membrane or CCW-201 two component polyurethane sealant.
g. Counterflashing for Masonry Through-Wall Flashings: CCW-705.
h. Website: www.carlisle-ccw.com

2. Grace Construction Products:
   a. Fluid-Applied Air and Vapor Barrier: Perm-A-Barrier Liquid, 60 mils thick (wet).
   b. Water-Based Primer: Perm-A-Barrier WB Primer.
   c. Solvent-Based Primer: Bituthene Primer B2 and Bituthene Primer B2 LVC.
   d. Through-Wall Flashings or Shelf Angle Flashings: Perm-A-Barrier Wall Flashing.
   e. Mastics, Adhesive and Tapes: As recommended by Grace Construction Products.
   f. Transition Strip: Perm-A-Barrier Detail Membrane and Perm-A-Barrier Wall Flashing.
   g. Transition Strip: Bituthene Primer B02
   h. Termination Mastic: Bituthene Liquid Membrane and as recommended by Grace Construction Products.
   i. Window Flashings and Detail Membrane: Perm-A-Barrier Detail Membrane and Perm-A-Barrier Wall Flashing.
   j. Website: www.na.graceconstruction.com
3. Tremco, Inc.: www.tremcosealants.com
   a. Fluid-Applied Air and Vapor Barrier: ExoAir 120SP (spray-applied) and ExoAir 120R (roller-grade), 60 mils (wet) (25 square feet per gallon for sheathing panels and 20 square feet per gallon for unparged masonry walls).
   b. Water-Based Primer: ExoAir WB Primer
   c. Solvent-Based Primer: ExoAir Primer or GM Primer or ExoAir 10 Primer as recommended.
   d. Counterflashing for Masonry Through-Wall Flashings: ExoAir TWF.
   e. Mastics, Adhesives and Tapes: As recommended by manufacturer.
4. Sto Corp: www.stocorp.com
   a. Primary Air Barrier Material: StoGuard VaporSeal - ready-mixed flexible spray or roller applied waterproof air barrier and vapor barrier membrane material.
   b. Accessory Materials
      1) Joint and Rough Opening Treatments
         (a) Sto Gold Fill® with StoGuard Mesh: ready-mixed flexible trowel or spray applied air barrier material.
         (b) StoGuard Rapid Seal™ with StoGuard Mesh: moisture cure elastomeric waterproof air barrier material (mesh not required at rough openings).
         (c) Sto VaporSeal with StoGuard Fabric: flexible waterproof air barrier and vapor barrier membrane material.
         (d) StoGuard Tape: self-adhering rubberized asphalt tape with polyester fabric facing (for rough openings only).
      2) Joint Reinforcements
         (a) StoGuard Mesh: nominal 4.2 oz/yd2 self-adhesive, flexible, symmetrical, interlaced glass fiber reinforcing mesh, with alkaline resistant coating for compatibility with Sto materials.
         (b) StoGuard Fabric: non-woven integrally reinforced cloth reinforcement.
         (c) StoGuard RediCorner™: non-woven integrally reinforced pre-formed cloth.
      3) Transition Membranes
         (a) Sto Gold Fill with StoGuard Mesh: ready-mixed flexible trowel or spray applied air barrier material with treated glass fiber reinforcing mesh.
         (b) StoGuard RapidSeal or StoGuard RapidSeal with StoGuard Mesh: moisture cure elastomeric waterproof air barrier material with treated glass fiber reinforcing mesh (where applicable).
         (c) Sto VaporSeal with StoGuard Fabric: flexible waterproof air barrier membrane material with non-woven integrally reinforced cloth.

(d) StoGuard Tape: self-adhering rubberized asphalt tape with polyester fabric facing.

4) Primers

(a) StoGuard Primer: rubber resin emulsion primer for use with StoGuard Tape to enhance adhesion and allow installation down to 35° F.

5. Architect Approved Equivalent.

2.02 AUXILIARY MATERIALS

A. Sealant at Transitions in Substrate and Connections to Adjacent Elements: Low-modulus pre-cured silicone extrusion and sealant for bonding extrusions to substrates; Tremco Silicone Extruded Sheet by Tremco, Spectrem EZ Seal by Tremco or Bondaflex Silbridge 300 by May National Associates.

B. Transition Membrane between Air and Vapor Barrier Membrane and Roofing and Other Adjacent Materials: Comply with both air and vapor barrier manufacturer's recommendations and roofing material manufacturer's recommendations.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas and conditions under which air and vapor barrier assemblies will be applied, with Installer present, for compliance with requirements.
1. Verify that surfaces and conditions are suitable prior to commencing work of this section. Do not proceed with installation until unsatisfactory conditions have been corrected.
2. Do not proceed with installation until after minimum concrete curing period recommended by air and vapor barrier manufacturer.
3. Ensure that the following conditions are met:
a. Surfaces are sound, dry, even, and free of oil, grease, dirt, excess mortar or other contaminants.
b. Concrete surfaces are cured and dry, smooth and without large voids, spalled areas or sharp protrusions.
c. Masonry joints are flush and completely filled with mortar, and all excess mortar sitting on masonry ties has been removed.
4. Verify substrate is surface dry. Test for capillary moisture by plastic sheet method according to ASTM D 4263 and take suitable measures until substrate passes moisture test. Surface dry is an acceptable substrate condition if acceptable to the manufacturer.
5. Verify sealants used in sheathing are compatible with membrane proposed for use. Perform field peel-adhesion test on materials to which sealants are adhered.
6. Notify Architect in writing of anticipated problems using air and vapor barrier over substrate prior to proceeding.

3.02 SURFACE PREPARATION

A. Clean, prepare and treat substrate according to manufacturer's written instructions. Mask off adjoining surfaces to prevent overspray and spillage.

B. Prime substrate for application of sheet membrane transition strips as recommended by manufacturer and as follows:
1. Prime masonry, concrete substrates with conditioning primer.
2. Prime glass-fiber surfaced gypsum sheathing an adequate number of coats to achieve required bond, with adequate drying time between coats.
3. Prime wood, metal and painted substrates with primer.

4. Prepare, treat and seal vertical and horizontal surfaces at terminations and penetrations through air and vapor barrier and at protrusions.

C. Prime substrate for application of fluid-applied air and vapor barrier if recommended by manufacturer based on project conditions and as follows.

3.03 INSTALLATION

A. Air and Vapor Barrier Installation: Install transition strip materials and fluid-applied air and vapor barrier to provide continuity throughout the building envelope. Install materials in accordance with manufacturer's recommendations and as follows, unless manufacturer recommends other procedures in writing based on project conditions or requirements of their recommended materials:
   1. Apply primer for transition strips at rate recommended by manufacturer. Allow primer to dry completely before transition strip application. Apply as many coats as necessary for proper adhesion.
   2. Apply primer for fluid-applied air and vapor barrier as recommended by fluid-applied air and vapor barrier manufacturer. Based on manufacturer's recommendation, no primer may be required for the fluid-applied materials.
   3. Apply fluid-applied air and vapor barrier using equipment and methods recommended by manufacturer, to achieve a dry film thickness as recommended by the manufacturer.
   4. Apply fluid-applied air and vapor barrier and transition strips to shed water naturally without interception by a sheet edge, unless that edge is sealed with permanently flexible termination mastic.
   5. Position subsequent sheets of transition strips applied above so that membrane overlaps the membrane sheet below by a minimum of 2 inches (50mm), unless greater overlap is recommended by manufacturer. Roll into place with roller.
   6. Overlap horizontally adjacent pieces of transition strips a minimum of 2 inches (50mm), unless greater overlap is recommended by manufacturer. Roll seams with roller.
   7. Seal around all penetrations with termination mastic, extruded silicone sealant, membrane counterflashing or other procedure in accordance with manufacturer's recommendations.
   8. Connect air and vapor barrier in exterior wall assembly continuously to the air barrier of the roof, to concrete below-grade structures, to windows, curtain wall, storefront, louvers, exterior doors and other intersection conditions and perform sealing penetrations, using accessory materials and in accordance with the manufacturer's recommendations.
   9. At changes in substrate plane, provide transition material (bead of sealant, mastic, extruded silicone sealant, membrane counterflashing or other material recommended by manufacturer) under membrane to eliminate all sharp 90 degree inside corners and to make a smooth transition from one plane to another.
   10. Provide mechanically fastened non-corrosive metal sheet to span gaps in substrate plane and to make a smooth transition from one plane to another. Membrane shall be continuously supported by substrate or as recommended by the manufacturer.
   11. At through-wall flashings, provide an additional 6-inch-wide strip of manufacturer's recommended membrane counterflashing to seal top of through-wall flashing to membrane or as recommended by manufacturer. Seal exposed top edge of strip with bead of mastic or as recommended by manufacturer.
   12. At deflection and control joints, provide backup for the membrane to accommodate anticipated movement.
   13. At expansion and seismic joints provide transition to the joint assemblies.
   14. Apply a bead or trowel coat of mastic along membrane seams at reverse lapped seams, rough cuts and as recommended by the manufacturer.
   15. At end of each working day, seal top edge of membrane to substrate with termination mastic.
   16. Do not allow materials to come in contact with chemically incompatible materials.
   17. Do not expose membrane to sunlight longer than is recommended by the manufacturer.

18. Inspect installation prior to enclosing assembly and repair punctures, damaged areas and inadequately lapped seams with a patch of membrane lapped as recommended by manufacturer.

3.04 FIELD QUALITY CONTROL

A. Owner's Inspection and Testing: Cooperate with Owner's testing agency. Allow access to work areas and staging. Notify Owner's testing agency in writing of schedule of Work of this Section to allow sufficient time for testing and inspection. Daily inspection and testing may be required. Do not cover Work of this Section until testing and inspection is accepted.

3.05 PROTECTING AND CLEANING

A. Protect air and vapor barrier assemblies from damage during application and remainder of construction period, according to manufacturer's written instructions.
   1. Coordinate with installation of materials which cover air and vapor membrane, to ensure exposure period does not exceed that recommended by the air and vapor barrier manufacturer.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction and acceptable to the primary material manufacturer.

**END OF SECTION 072726**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Composite Shingles
   2. Self-Adhering roof underlayment
   3. Ridge Vent

B. Related Sections: The following sections contain requirements that relate to this section:
   1. Section 061000 - Rough Carpentry.
   2. Section 076200 - Sheet Metal Flashing and Trim.
   3. Section 077253 - Snow Guards.
   4. Division 22 - Plumbing work projecting through roof.
   5. Division 23 - HVAC work projecting through roof.
   6. Division 26 - Electrical work projecting through roof.

1.03 STANDARDS

A. All work of this section shall conform to industry standards and/or manufacturer's recommendations.

B. ASTM D226 "Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing".

C. SMACNA "Architectural Sheet Metal Manual, Seventh Edition".

D. ASTM D1970 "Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection".

E. ASTM D3462 "Standard Specification for Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules".

F. ASTM E108 "Standard Test Methods for Fire Tests of Roof Coverings".

G. ASTM D3018 "Standard Specification for Class A Asphalt Shingles Surfaced with Mineral Granules".

H. ASTM D3161 "Standard Test Method for Wind-Resistance of Asphalt Shingles (Fan-Induced Method)".

I. ASTM D4586 "Standard Specification for Asphalt Roof Cement, Asbestos - Free".

J. UL 790 "Standard for Tests for Fire Resistance of Roof Covering Materials".

K. UL 997 "Standard for Wind Resistance of Prepared Roof Covering Materials".

1.04 SUBMITTALS

A. Submit following pursuant to Section 013300 - Submittal Procedures.

1. Manufacturer's Literature for all specified products: Technical product data, installation instructions, and recommendations, including data that materials comply with requirements.
2. Installer Qualifications including written certification from manufacturer indicating installer is qualified and an authorized installer for enhanced warranties specified.
3. Sample Warranty for roof shingle system meeting specified warranty requirements.
4. Initial Selection Samples: Two complete shingle boards with different colored shingles being the main feature on each board and showing small samples representing manufacturer's full range of available colors and patterns.
5. Final Shingle Color Samples: Submit three (3) full size shingles in two different colors selected by the Architect from initial color boards for final color selection.

B. Submit pursuant to Section 016000 - Product Requirements.

1.05 QUALITY ASSURANCE

A. All work of this section shall be performed by experienced workers familiar with the work and according to manufacturer's recommendations and/or industry standards.

B. Uplift resistance: Provide labeled materials which have been tested pursuant to UL or ASTM standard criteria for wind uplift indicated for each shingle type required.

C. Manufacturer Qualifications: Company specializing in manufacturing the roofing systems products specified in this section, with minimum of 25 years experience.

D. Installer Qualifications: Certified by shingle manufacturer for steep slope installation, certified to install enhanced warranty projects.

1.06 DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturers published instructions.

B. Protect against moisture exposure and damage.

C. Deliver material in manufacturer's undamaged, unopened, labeled bundles, rolls or containers.

D. Store materials to avoid water damage, and store rolled goods on end. Comply with manufacturer's recommendations for job-site storage and protection.

E. Remove damaged or unsuitable materials.

1.07 PROJECT/SITE CONDITIONS

A. Substrate: Proceed with shingle work only after substrate construction and penetrating work have been completed.

B. Weather Conditions: Proceed with shingle work only when weather conditions follow manufacturer's published recommendations and when substrate is dry.

1.08 EXTRA MATERIALS

A. Furnish extra shingles that match products installed and that are packaged in original un-opened packages and identified with labels describing content.
   1. Composite Shingles: Provide four (4) unbroken bundles.

1.09 WARRANTY

A. Provide shingle manufacturer's standard shingle and accessory 40-year limited warranty for non-residential construction with the first twenty (20) years non-prorated.

B. Wind-Speed Warranty: Composite Shingles will resist blow-off or damage caused by wind speeds up to 130mph.

PART 2 PRODUCTS

2.01 SHINGLE MANUFACTURERS

A. Subject to compliance with requirements, provide products from one of following:
   1. CertainTeed (Basis of Specification)
   2. GAF (Basis of Specification)

2.02 SHINGLE MATERIALS

A. GAF Timberline HDZ or CertainTeed Landmark®.

B. Hip and Ridge Shingles:
   1. GAF Timbertex® Premium Hip and Ridge Cap Shingles.
   2. CertainTeed Cedar Crest® Hip and Ridge Cap Shingles.
   3. Hip and Ridge Cap Shingles shall be from same manufacturer as roof shingles and as recommended by manufacturer to fulfill warranty requirements.

C. Color: As selected by Architect from manufacturer's standard colors.

D. Starter Strip: Self sealing starter shingle designed for roof shingles.
   1. WeatherBlocker™ Eave/rake starter strip by GAF.
   2. Starter shingle shall be from same manufacturer as roof shingles and as recommended by manufacturer to fulfill warranty requirements.

2.03 UNDERLAYMENT MATERIAL AND FASTENERS

A. Self-adhering roof underlayment: Self-adhering, self-sealing, rubberized asphalt sheet membrane, complying with ASTM D1970, with manufacturer's primer for concrete, masonry, and DensGlass Gold surfaces. Also use primer if adhesion to other substrates is found to be marginal. See Item below where self-adhering roof underlayment material is required to overlap EPDM roofing.
   1. Acceptable Products:
      a. StormGuard Leak Barrier® by GAF.
      b. Certainteed WinterGuard® Granular Waterproofing Shingle Underlayment.

B. Self-adhering roof underlayment in contact with EPDM roofing material: Self-adhering, self-sealing, composed of two waterproofing materials-an aggressive butyl rubber-based adhesive backed by a layer of high density cross laminated polyethylene with manufacturer's primer for concrete, masonry, and DensGlass Gold surfaces. Also use primer if adhesion to other substrates is found to be marginal.
   1. Acceptable Products:
      a. Grace Ultra" by W.R. Grace Co., 62 Whittemore Ave., Cambridge, MA. 02140, (800) 354-5414.
      b. Architect approved equivalent product that states in writing it is compatible to be applied directly to EPDM and TPO roofing.

C. Nails: Standard round wire shingle type of hot-dipped zinc-coated steel; 3/8 to 7/16-inch head diameter; 10 to 12 gage, barbed or deformed shank; of sufficient length to penetrate through roof sheathing by at least 1/8".

D. Roofing Cement:
   1. Asphalt Plastic Roofing Cement meeting the requirements of ASTM D 4586, Type I or II.

E. Roofing Sealant:
   1. Commercial grade roofing sealant that provides a 100% watertight seal that keeps water out at the most vulnerable areas of roof (roof protrusions, step flashings, skylights, chimneys, vents, gutters, etc.) and comes with a twenty (20) year limited warranty against leaks caused by manufacturing defects. Meets the performance criteria of ASTM D 412, ASTM D 2196, ASTM D 1475 and ASTM D 1644, Flexseal™ Roofing Sealant, by GAF-ELK.

2.04 FLASHING MATERIALS AND FASTENERS

A. See Section 076200 - Sheet Metal Flashing and Trim.

B. Nails: Standard round wire roofing type of material same as flashing material; minimum 19/64 in. head diameter and 0.104 in. shank diameter; of sufficient length to penetrate through roof sheathing by at least 1/8 inch.

2.05 RIDGE VENT

A. GAF Cobra Snow Country Rigid Exhaust Vent with GAF Timbertex Premium Ridge Cap shingles matching roof shingles.

B. CertainTeed 12" Filtered Ridge Vent with CertainTeed Cedar Crest Ridge Cap Shingles matching roof shingles.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until roof deck has been properly prepared.

B. If roof deck preparation is the responsibility of another installer, notify Construction Manager of unsatisfactory preparation before proceeding.

3.02 PREPARATION OF SUBSTRATE

A. Clean substrate of any projections and substances detrimental to shingling work. Cover knotholes or other minor voids in substrate with sheet metal flashing secured with galvanized roofing nails.

B. At areas to receive eave protection membrane, fill knot holes and cracks with latex filler.

C. Coordinate installation of shingles with flashing and other adjoining work to ensure proper sequencing. Do not install shingle roofing until all vent stacks and other penetrations through roofing have been installed and are securely fastened against movement.

3.03 STANDARDS APPLICATION

A. Citing of SMACNA or NRCA drawings and text is intended as a direction to construction solution for inclusion in the Work.

B. Information depicted within these Specifications and on Drawings takes precedence over SMACNA and NRCA.

3.04 FLASHING

A. Plumbing vent stacks and other roof projections: Provide aluminum / neoprene manufactured standard flashing units. Separate dissimilar pipe and flashing metals by using No. 15 asphalt-saturated organic felts.

3.05 SELF-ADHERING ROOF UNDERLAYMENT (MEMBRANE)

A. Installing self-adhering roof underlayment (membrane): Install self adhering roof underlayment over entire roof surface. In any locations where the underlayment is in contact with EPDM roofing, Grace Ultra, GAF Underroof HT or equivalent product compatible with EPDM must be utilized.
   1. At vertical walls, install membrane extending at least 12 inches up the wall and 12 inches onto the roof surface lapping over roof deck underlayment or as shown on the contract drawings.
   2. At roof curbs, install membrane from under the built-in counter flashing and 12 inches on to the roof surface lapping over roof deck underlayment.
   3. Follow the manufacturer's installation instructions. Unsealed lap joints and holes which will allow the passage of moisture will not be allowed.
   4. Install the concealed membrane so that the flow of water is not against the edges of the sheets. Lap edges and ends a minimum of 6 inches.
   5. Broom the surface of the sheets to ensure that the membrane is firmly attached to the substrate and that all lap joints are sealed.
   6. Repair punctures and other defects immediately.
   7. Membrane shall be covered as soon as possible and within the manufacturer's limits for exposure.

3.06 COMPOSITE SHINGLE INSTALLATION

A. Install composite shingles according to manufacturer's written instructions, recommendations in ARMA's "Residential Asphalt Roofing Manual", and composite shingle recommendations in NRCA's "The NRCA Roofing and Waterproofing Manual".

B. Install starter strip along lowest roof edge, consisting of a composite shingle strip at least 7 inches wide with self-sealing strip face up at roof edge.
   1. Extend composite shingles 3/8" over fascia at eaves and flush at rakes.

C. Install first and remaining courses of composite shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.

D. Fasten composite shingle strips with a minimum of six (6) roofing nails located according to manufacturer's written instruction.
   1. Nails must be driven flush with the shingle surface. Do not overdrive or under drive the nails.

E. Ridge Cap Shingles: Maintain same exposure of cap shingles as roofing shingle exposure. Lap cap shingles at ridge to shed water away from direction of prevailing winds. Fasten with roofing nails of sufficient length to penetrate sheathing.

F. Valley conditions
   1. Open Metal Valleys: Lap shingles over the metal valley flashing 5 inches. Lay the shingles so that the exposed portion of the valley at the top is 5 inches wide on each side of the valley centerline and increases in width 1/8 inch per ft towards the eaves. Cut off one inch of the upper outside corner of each shingle. Set the portion of the shingle that overlaps the valley in plastic cement.

3.07 PROTECTION

A. Protect installed products until completion of the project.

B. Any roof areas that are not completed by the end of the work day are to be protected from moisture and contaminates.

**END OF SECTION 073113.11**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SECTION INCLUDES

A. Factory-finished fiber cement lap siding , trim and accessories.

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Section 054000 - Cold Formed Metal Framing
   2. Section 061000 - Rough Carpentry
   3. Section 066000 - Plastic Fabrications
   4. Section 072713 - Air Barrier/Vapor Retarder
   5. Section 079200 - Sealants

1.03 REFERENCES

A. ASTM C 1185 - Standard Test Methods for Sampling and Testing Non-Asbestos Fiber-Cement Flat Sheet, Roofing and Siding Shingles, and Clapboards.

B. ASTM C 1186 - Standard Specification for Flat Non-Asbestos Fiber Cement Sheets.

C. ASTM D3359 - Standard Test Method for Measuring Adhesion by Tape Test, Tool and Tape.

D. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

E. ASTM E 96 - Standard Test Methods for Water Vapor Transmission of Materials.

F. ASTM E 136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C.

1.04 SUBMITTALS

A. Submit pursuant to Section 013300 - Submittal Procedures.

B. Submit pursuant to Section 016000 - Product Requirements.

C. Product Data: Manufacturer’s data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods, including nailing patterns.
   4. Applicable model code authority evaluation report (ICC, CCMC, etc.)

D. Selection Samples: For each finished product specified, two complete sets of color samples representing manufacturer’s full range of available colors, textures and patterns.

E. Verification Samples: For each product selected provide two six inch long samples representing actual size, texture, color and profile.

F. Maintenance and periodic inspection recommendations.

G. Manufacturer’s Certificates: Certify products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Provide installer with not less than three years of experience with products similar to those specified.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer’s unopened packaging until ready for installation.

B. Store products off the ground, on a flat surface, and under a roof or separate waterproof covering. Protect edges and corners from chipping.

C. Carry fiber cement boards by holding the narrow edge.

1.07 WARRANTY

A. Provide HardiePlank HZ5 lap siding 30 year limited, non-pro-rated product warranty.

B. Finish Warranty: Limited product warranty against manufacturing finish defects.
   1. When used for its intended purpose, properly installed and maintained according to James Hardie's published installation instructions, James Hardie's ColorPlus finish with ColorPlus Technology, for a period of 15 years from the date of purchase: will not peel; will not crack; and will not chip. Finish warranty includes the coverage for labor and material.

C. Register manufacturer’s warranty, made out in Owner’s name, with original to Owner.

D. Workmanship Warranty: Application limited warranty for two (2) years.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Acceptable Manufacturer: James Hardie Building Products, Inc., 26300 La Alameda Suite 400 ; Mission Viejo, CA 92691; Toll Free Tel: 866-274-3464; Tel: 949-367-4980; Fax: 949-367-4981; Email: request info (info@jameshardie.com); Web: www.jameshardiecommercial.com

B. Architect Approved Equivalent matching color, size and profile.

2.02 SIDING

A. HardiePlank HZ5 lap siding requirement for Materials:
   1. Fiber-cement Siding - complies with ASTM C 1186 Type A Grade II.
   2. Fiber-cement Siding - complies with ASTM E 136 as a noncombustible material.
   3. Fiber-cement Siding - complies with ˜STM E 84 Flame Spread Index = 0, Smoke Developed Index = 5.
   4. CAL-FIRE, Fire Engineering Division Building Materials Listing - Wildland Urban Interface (WUI) Listed Product.
   5. National Evaluation Report No. NER 405 (BOCA, ICBO, SBCCI, IBC, IRC).
   6. City of Los Angeles, Research Report No. 24862.
   7. Miami Dade County, Florida Notice of Acceptance 07-0418.04.
   8. US Department of Housing and Urban Development Materials Release 1263d.
   9. California DSA PA-019.
   10. City of New York M EA 223-93-M.
   11. Florida State Product Approval FL889.

12. Texas Department of Insurance Product Evaluation EC-23.

B. Lap Siding: HardiePlank HZ5 Lap siding with a sloped top, beveled drip edge and nailing line as manufactured by James Hardie Building Products, Inc.
   1. Type: Select Cedarmill 7-1/4 inches (184 mm) with 6 inches (152 mm) exposure.

2.03 FASTENERS

A. Metal Framing:
   1. Metal Framing: 1-1/4 inches (32 mm) No. 8-18 by 0.375 inch (9.5 mm) head self-drilling, corrosion resistant S-12 ribbed buglehead screws.
   2. Metal Framing: 1-5/8 inches (41 mm) No. 8-18 by 0.323 inch (8.2 mm) head self-drilling, corrosion resistant S-12 ribbed buglehead screws.d
   3. Metal Framing: 1 inch (25 mm) No. 8-18 by 0.323 inch (8.2 mm) head self-drilling, corrosion resistant ribbed buglehead screws.
   4. Metal Framing: 1 inch (25 mm) No. 8-18 by 0.311 inch (7.9 mm) head self-drilling, corrosion resistant S-12 ribbed buglehead screws.
   5. Metal Framing: 1.5 inch (38mm) [AGS-100] .100 inches by 25 inches (2540 mm by 635 mm) ET&F Pin or equivalent pneumatic fastener.

2.04 FINISHES

A. Factory Finish: ColorPlus Technology by James Hardie
   1. Definition: Factory applied finish; defined as a finish applied in the same facility and company that manufactures the siding substrate.
   2. Process:
      a. Factory applied finish by fiber cement manufacturer in a controlled environment within the fiber cement manufacturer’s own facility utilizing a multi-coat, heat cured finish within one manufacturing process.
      b. Each finish color color must have documented color match to delta E of 0.5 or better between product lines, manufacturing lots or product runs as measured by photospectrometer and verified by an independent third party
   3. Protection: Factory applied finish protection such as plastic laminate that is removed once siding is installed.
   4. Accessories: Complete finishing system includes pre-packaged touch-up kit provided by fiber cement manufacturer. Provide quantities as recommended by manufacturer.

B. Factory Finish Color: As selected by Architect from manufacturer's standard colors.

2.05 ACCESSORIES

A. Color-Plus Technology Touch-Up Kits and Touch-Up Pens

B. Flat Tabs

C. Corner Tabs

D. Seam Tape: HardieWrap ® Seam Tape

E. Starter Strips: Create by ripping 1-1/4” pieces of HardiePlank siding.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If framing preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Minimum 20 gauge, 3-5/8 inch (92 mm) C-Stud 16 inches maximum on center or 16 gauge, 3-5/8 inches (92 mm) C-Stud, 24 inches (610 mm) maximum on center metal framing complying with local building codes, including the use of water-resistive barriers and/or vapor barriers where indicated. Minimum 1-1/2 inches (38 mm) face and straight, true, of uniform dimensions and properly aligned.
   1. Install water-resistive barriers and claddings to dry surfaces.
   2. Repair any punctures or tears in the water-resistive barrier prior to the installation of the siding.
   3. Protect siding from other trades and incidental damage.

### 3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Install a water-resistive barrier in accordance with local building code requirements.

D. The water-resistive barrier must be appropriately installed with penetration and junction flashing in accordance with local building code requirements.

E. Install HardieWrap ® flashing, and HardieWrap ® Flex Flashing

### 3.03 INSTALLATION - LAP SIDING

A. Install materials in strict accordance with manufacturer's installation instructions.

B. Starting: Install a minimum 1/4 inch (6 mm) thick starter strip at the bottom course of the wall. Apply planks horizontally with minimum 1-1/4 inches (32 mm) wide laps at the top. The bottom edge of the first plank overlaps the starter strip.

C. Allow minimum vertical clearance between the edge of siding and any other material in strict accordance with the manufacturer's installation instructions.

D. Align vertical joints of the planks over framing members.

E. Maintain clearance between siding and adjacent finished grade.

F. Locate splices at least one stud cavity away from window and door openings.

G. Wind Resistance: Where a specified level of wind resistance is required Hardieplank lap siding is installed to framing members and secured with fasteners described in Table No. 2 in National Evaluation Service Report No. NER-405.H.

H. Touch-up all field cut edges before installing.

I. Pre-drill nail holes if necessary to prevent breakage.

3.04 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion

**END OF SECTION 074646**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General Division 01 of the Project Manual, apply to work of this Section.

B. Section 061000 – Rough Carpentry

C. Section 076200 - Sheet Metal Flashing and Trim

D. Division 22 – Plumbing Vents and Roof Drains

1.02 GENERAL NOTES

A. Preceding job start up, contractor shall decide to his satisfaction that all specifications contained herein are workable.

B. Contractor will perform all work by competent, trained, and properly equipped personnel in strict accordance with good roofing practices and applicable industry standards.

C. Contractor will observe all published safety prevention policies and practices relating to application of roofing system and related work. All federal, state, and local codes shall be followed.

D. Contractor will follow application, safety, etc. information as published in the most current edition of the manufacturer's Roofing System Technical Specifications.

1.03 SCOPE

A. Work under this section covers the installation of a new SELF ADHERED EPDM ROOFING SYSTEM. Installation to provide for a warranty with a maximum wind speed of 90 mph. In addition, contractor shall include all related items of work as noted herein or indicated on the drawings or otherwise required to complete the specified elements of work and provide the necessary warranties for this work.

B. Disposal of construction waste is the responsibility of the Contractor. Perform disposal in a manner complying with all Federal, State and Local requirements.

1.04 REFERENCES

A. Referenced Standards: These standards (latest edition) form part of this specification only to the extent they are referenced as specification requirements.
   1. ASTM C 1177/C 1177M – "Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing".
   2. ASTM C 1289 – "Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board".
   3. ASTM D 3273 – "Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber".
   4. ASTM D 4637 – "Standard Specification for EPDM Sheet used in Single-Ply Roof Membrane".
   5. ASTM D 4811 – "Standard Specification for Nonvulcanized (Uncured) Rubber Sheet Used as Roof Flashing".
   6. ASTM E 84 – "Standard Test Method for Surface Burning Characteristics of Building Materials".

7. ASTM E 136 – “Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C”.
8. FM 1-28 – “Design Wind Loads; Factory Mutual System”.
9. FM 1-29 – “Roof Deck Securement and Above Deck Roof Components; Factory Mutual System”.
10. FM 4470 – “Approval Standard - Class I Roof Covers”, current version.
11. PS 1 - Construction and Industrial Plywood.
12. PS 20 - American Softwood Lumber Standard.
13. SPRI ES-1 – “Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems”. (ANSI/SPRI ES-1).

1.05 SUBMITTALS

A. Pursuant to Section 013300 – Submittal Procedures.

B. Pursuant to Section 016000 – Product Requirements.

1.06 SHOP DRAWINGS:

A. Furnish shop drawings to include the following:
   1. Roof Plan drawn to scale.
   2. Roof drain locations. (If required)
   3. All other roof penetrations.
   4. Roof insulation layout.
   5. Roof flashing, edges and pertinent details.

B. Large scale (3” =1’0”) drawings showing all standards and special details as required for this project by membrane manufacturer.

C. Samples of membrane roofing, flashing, insulation and metal flashing, etc. if requested by the Architect.

D. Copies of manufacturer’s specifications, installation instructions and sample warranty and one (1) copy of Material Safety Data Sheets (MSDS).

E. Certification:
   1. Submit letter from Manufacturer certifying applicator’s license.
   2. Certification that total system complies with specified requirements of regulatory agencies listed in this specification (UL and/or factory mutual) and New York State building code.

F. Contract Closeout Submittals
   1. Warranty: Warranties as specified.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery: Deliver materials to the site in the manufacturer’s labeled, unbroken containers.

B. Storage and Handling: Store materials in a dry, well-ventilated place protected from the weather.
   1. Volatile liquids shall be stored in a separate storage building or trailer or removed from the site at the end of each workday.
   2. Store volatile liquids at temperatures recommended by the manufacturer.
   3. Store adhesives at temperatures between 60 degrees F and 80 degrees F.

C. Damaged materials shall be replaced at roofing contractor’s expense.

1.08 JOB CONDITIONS

A. Proceed with roofing work when existing and forecast weather conditions permit work to be performed in accordance with manufacturer's recommendations and warranty requirements.

B. Do not allow oil-based products (petroleum, grease, oil, solvents, mineral oil, animal fat etc.), or direct steam vents to come in contact with EPDM membrane.
   1. Abide by manufacturer's instructions for protection and cleaning.

C. Coordinate roofing work with other trades.

D. All surfaces to receive roofing shall be thoroughly dry and free of dew or frost.

1.09 DEFINITIONS

A. Roofing Terminology: Refer to ASTM D1079 for definition of terms related to roofing work not otherwise defined in the section.

B. American Society for Testing and Materials (ASTM): 1916 Race St., Philadelphia, PA 19103

1.10 SYSTEM DESCRIPTION

A. 0.060 Standard elastomeric sheet roofing that is self-adhering to acceptable substrate.

1.11 QUALITY ASSURANCE

A. Manufacturer:
   1. Company specializing in manufacturing the roofing membrane specified in this Section with ten years of manufacturing experience.
   2. System supplier must have ISO 9002 certification.
   3. Manufacturer must be able to provide the project with the membrane and Isocyanurate insulation that is produced in their facilities.

B. Applicator:
   1. Shall be a current contractor who has achieved Master Contractor status and certified by the approved roofing manufacturer.
   2. Shall have a fully staffed office within 100 miles of the job site.
   3. Shall have experience in installing specified system.

1.12 REGULATORY REQUIREMENTS

A. Conform to applicable local building code requirements.

B. Underwriters Laboratories, Inc. (UL): Class A Fire Hazard Classification.

C. Factory Mutual Corporation (FM): Roof Assembly Classification, FM Construction Bulletin 1-28, and 1-29 meeting minimum requirements of FM 1-90.

1.13 QUALITY INSPECTION/OBSERVATION

A. Inspection by Manufacturer: Provide an interim and final inspection of the roofing system by a Technical Representative employed by roofing system manufacturer.
   1. Technical representative shall not perform any sales functions.
   2. Technical representative shall issue a written report of each inspection.

3. Contractor shall complete any necessary repairs required for issuance of warranty.

1.14 PRE-INSTALLATION CONFERENCE

A. Before start of roofing work, attend a conference to discuss the proper installation of materials. Attendees shall include all parties directly affecting work of this Section.

1.15 WARRANTY

A. Type/Term:
   1. Provide 20-year Firestone Red Shield Roofing System Limited Warranty (Red Shield Warranty). Warranty shall include membrane, roof insulation, membrane accessories, and metal edging and coping.
   2. Provide a separate Firestone ISO 95+ Insulation Warranty (Insulation Warranty term shall coincide with Red Shield Warranty.)

B. Coverage:
   1. Red Shield Warranty:
      a. Limit of liability: No Dollar Limitation
      b. Scope of coverage: Repair any leak in the Firestone EPDM Roofing System caused by the ordinary wear and tear of the elements, manufacturing defect in Firestone brand materials, damage due to winds up to 90 mph. and the workmanship used to install these materials.

C. Special Project Warranty
   1. Submit roof installer's warranty, signed by installer, covering Work of this Section, including all components of the membrane roofing system such as roofing membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, and walkway pads, for the following warranty period:
      a. Warranty Period: Two years from date of Substantial Completion

1.16 RESTRICTED WORK PERIOD

A. Do not perform the roofing and related Work between December 1st and April 1st unless approved otherwise, in writing, by the Architect. During this period, clear the roof of materials, equipment, and debris. Maintain the roof in a watertight condition.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Firestone: Firestone Building Products Co., Headquarters, 250 West 96th Street, Indianapolis, IN 46260, Phone: 800-428-4442. (Basis of Specification)

B. Carlisle Syntec Incorporated, PO Box 7000, Carlisle, PA 17013-0925

C. Manufacturer of Insulation and Cover Board: Same manufacturer as roof membrane.

2.02 ROOFING SYSTEM DESCRIPTION

A. Roofing System:
   1. Membrane: Ethylene propylene diene monomer (EPDM).
   2. Thickness: As specified elsewhere.
   3. Membrane Attachment: Fully adhered.

4. Slope: If deck is sloped, but not enough to provide positive drainage to meet local building codes, provide additional slope to achieve 1/4 inch per foot (1:48) or as shown on Contract Drawings by means of tapered insulation.
5. Comply with applicable local building code requirements.
6. Provide assembly having Underwriters Laboratories, Inc. (UL) Class A, B, C, Fire Hazard Classification.
7. Provide assembly complying with Factory Mutual Corporation (FM) Roof Assembly Classification, FM DS 1-28 and 1-29, and meeting minimum requirements of FM 1-90 wind uplift rating.

B. Vapor Barrier over deck/deck cover:
1. Membrane: High density polyethylene sheet with SBS modified bitumen adhesive.
2. Attachment: Self adhering

C. Insulation:
1. Total System R Value: as shown on Contract Drawings
2. Maximum Board Thickness: 4 inches (50 mm); use as many layers as necessary; stagger joints in adjacent layers.
3. Base and Intermediate (if any) Layers: Polyisocyanurate foam board, non-composite.
   a. Attachment: Mechanical fastening.
4. Top Layer: Polyisocyanurate foam board, non-composite.
   a. Attachment: Mechanical fastening.

D. Cover Board: DensDeck® Prime Roof Board with EONIC™ Technology or Architect approved equivalent.
1. Thickness: 5/8 inch.
2. Type: X
3. R-Value: .67.
4. Attachment: Mechanical Fastening

2.03 EPDM MEMBRANE MATERIALS

A. Roofing and Flashing Membrane: Black cured synthetic single-ply membrane composed of ethylene propylene diene terpolymer (EPDM) with the following properties:
1. Thickness: 0.060 inch (1.5 mm).
2. Reinforcement: Non-reinforced
3. Nominal Thickness Tolerance: Plus/minus 10 percent.
4. Sheet Width: Provide the widest available sheets to minimize field seaming.
5. Adhesive:
6. Factory applied from edge to edge
7. Acceptable Product: FullForce™ EPDM Membrane with Secure Bond Technology by Firestone.

B. Membrane Fasteners: Type and size as required by roof membrane manufacturer for roofing system and warranty to be provided; use only fasteners furnished by roof membrane manufacturer.

C. Flashing Membrane: Self-curing, non-reinforced membrane composed of nonvulcanized EPDM rubber, complying with ASTM D 4811 Type II, and with the following properties:
1. Thickness: 0.055 inch (1.4 mm).
2. Color: Same as field membrane
3. Acceptable Product: RubberGard EPDM FormFlash by Firestone.

D. Self-Adhesive Flashing Membrane: Semi-cured 45 mil EPDM membrane laminated to 35 mil (0.9 mm) EPDM tape adhesive; QuickSeam Flashing by Firestone.

E. Pre-Molded Pipe Flashings: EPDM, molded for quick adaptation to different sized pipes; Firestone EPDM Pipe Flashing.

F. Adhesive Primer: Synthetic rubber based primer formulated for compatibility with EPDM membrane and tape adhesive, with VOC content less than 2.1 lb/gal (250 g/L); QuickPrime Plus LVOC by Firestone.

G. Seam Edge Treatment: EPDM rubber-based sealant, formulated for sealing exposed edges of membrane at seams; FullForce™ Sealant by Firestone.

H. Pourable Sealer: Two-part polyurethane, two-color for reliable mixing; Pourable Sealer by Firestone.

I. Water Block Seal: Butyl rubber sealant for use between two surfaces, not exposed; Water Block Seal by Firestone.

J. Metal Plates and Strips Used for Fastening Membrane and Insulation: Steel with Galvalume coating; corrosion-resistance meeting FM 4470 criteria.
   1. Termination Bars: Aluminum bars with integral caulk ledge; 1.3 inches (33 mm) wide by 0.10 inch (2.5 mm) thick; Firestone Termination Bar by Firestone.

K. Roof Walkway Pads: EPDM, 0.30 inch (7.6 mm) thick by 30 by 30 inches (760 by 760 mm) with EPDM tape adhesive strips laminated to the bottom; QuickSeam Walkway Pads by Firestone.

L. Yellow Safety Strip: To designate areas of caution on the roof or around rooftop objects. 5.5 inches wide (140 mm) by 100 feet long (30 m) strip and nominal 30 mil (0.76 mm) thick yellow TPO membrane laminated to a white, cured, seam tape. Compatible with TPO and EPDM; QuickSeam Yellow Safety Strip by Firestone.

2.04 ROOF INSULATION AND COVER BOARDS

A. Polyisocyanurate Board Insulation: Closed cell polyisocyanurate foam with black glass reinforced mat laminated to faces, complying with ASTM C 1289 Type II Class 1, with the following additional characteristics:
   1. Thickness: As indicated on drawings.
   2. Size: 48 inches (1220 mm) by 96 inches (2440 mm), nominal.
   3. Exception: Insulation to be attached using adhesive or asphalt may be no larger than 48 inches (1220 mm) by 48 inches (1220 mm), nominal.
   4. R-Value (LTTR): 1.0 inch (25 mm) Thickness: 5.7 R, minimum.
   5. Compressive Strength: 20 psi (138 kPa) when tested in accordance with ASTM C 1289.
   6. Ozone Depletion Potential: Zero; made without CFC or HCFC blowing agents.
   7. Recycled Content: 19 percent post-consumer and 15 percent post-industrial, average.
   8. Acceptable Product: ISO 95+ polyiso board insulation by Firestone

B. Gypsum-Based Cover Board: Non-combustible, water resistant gypsum core with embedded glass mat facers, complying with ASTM C 1177/C 1177M or C 1278 and with the following additional characteristics:
   1. Size: 48 inches (1220 mm) by 96 inches (2440 mm), nominal.
      a. Exception: Board to be attached using adhesive or asphalt may be no larger than 48 inches (1220 mm) by 48 inches (1220 mm), nominal.
   2. Thickness: 5/8”.
   3. Surface Water Absorption: 1.0 g, maximum, when tested in accordance with ASTM C473.
   4. Spanning Capability: As recommended by manufacturer for maximum flute spans.

5. Surface Burning Characteristics: Flame spread of 0, smoke developed of 0, when tested in accordance with ASTM E 84.
6. Combustibility: Non-combustible, when tested in accordance with ASTM E 136.
7. Factory Mutual approved for use with FM 1-60 and 1-90 rated roofing assemblies.
8. Mold Growth Resistance: Zero growth, when tested in accordance with ASTM D 3273 for minimum of 4 weeks.

C. Insulation Fasteners: Type and size as required by roof membrane manufacturer for roofing system and warranty to be provided; use only fasteners furnished by roof membrane manufacturer.

D. Insulation Adhesive: Type as required by roof membrane manufacturer for roofing system and warranty to be provided; use only adhesive furnished by roof membrane manufacturer.

2.05 VAPOR BARRIER

A. Vapor Barrier Membrane: Comprised of SBS modified bitumen adhesive, factory-laminated to a tri-laminate woven, high-density polyethylene top surface. Release liner protecting adhesive.
1. Intended for use as a direct to deck air/vapor barrier in roofing systems and may be used as a temporary roof membrane for up to ninety (90) days.
2. Thickness: 0.0325" (0.826 mm) minimum, when tested in accordance with ASTM D 5147.
3. Max Load at Break at 73 °F (23 °C): 64 lbf/in, MD (11 kN/m) 88 lbf/in, XMD (15 kN/m) when tested in accordance with ASTM D 5147.
4. Low Temperature Flexibility: -30 °F (-34 °C) when tested in accordance with ASTM D 5147.
5. Moisture Vapor Permeance, 0.02 Perms (0.92 Ng/Pa•s•m2) maximum, when tested in accordance with ASTM E 96.
6. Air Permeability: 0.00114 ft3/min•ft2 (0.007 L/sec•m2) maximum, when tested in accordance with ASTM E 2178.

B. Acceptable Product: V-Force Vapor Barrier Membrane by Firestone or Architect approved equivalent.

2.06 ACCESSORIES

A. Gas piping supports shall be set in place by the roofing contractor.
1. Coordinate with plumbing contractor for number required for installation & spacing.
2. Supports shall be supplied by plumbing contractor.

PART 3 INSTALLATION

3.01 GENERAL

A. Install roofing, insulation, flashings, and accessories in accordance with roofing manufacturer's published instructions and recommendations for the specified roofing system. Where manufacturer provides no instructions or recommendations, follow good roofing practices and industry standards. Comply with federal, state, and local regulations.

B. Obtain all relevant instructions and maintain copies at project site for duration of installation period.

C. Do not start work until Pre-Installation Notice has been submitted to manufacturer as notification that this project requires a manufacturer's warranty.

D. Perform work using competent and properly equipped personnel.

E. Temporary closures, which ensure that moisture does not damage any completed section of the new roofing system, are the responsibility of the applicator. Completion of flashings, terminations, and temporary closures shall be completed as required to provide a watertight condition.

F. Install self-adhering roofing membrane only when surfaces are clean, dry, smooth and free of snow or ice; do not apply roofing membrane during inclement weather or when ambient conditions will not allow proper application; consult manufacturer for recommended procedures during cold weather. Do not work with sealants and adhesives when material temperature is outside the range of 60 to 80 degrees F (16 to 27 degrees C).

G. Protect adjacent construction, property, vehicles, and persons from damage related to roofing work; repair or restore damage caused by roofing work.
   1. Protect from spills and overspray from bitumen, adhesives, sealants and coatings.
   2. Particularly protect metal, glass, plastic, and painted surfaces from bitumen, adhesives, and sealants within the range of wind-borne overspray.
   3. Protect finished areas of the roofing system from roofing related work traffic and traffic by other trades.

H. Until ready for use, keep materials in their original containers as labeled by the manufacturer.

I. Consult membrane manufacturer's instructions, container labels, and Safety Data Sheets (SDS) for specific safety instructions. Keep all adhesives, sealants, primers and cleaning materials away from all sources of ignition.

3.02 EXAMINATION

A. Examine roof deck to determine that it is sufficiently rigid to support installers and their mechanical equipment, and that deflection will not strain or rupture roof components or deform deck.

B. Verify that surfaces and site conditions are ready to receive work. Correct defects in the substrate before commencing with roofing work.

C. Examine roof substrate to verify that it is properly sloped to drains.

D. Verify that the specifications and drawing details are workable and not in conflict with the roofing manufacturer's recommendations and instructions; start of work constitutes acceptable of project conditions and requirements.

3.03 PREPARATION

A. Prior to proceeding, prepare roof surface so that it is clean, dry, and smooth, and free of sharp edges, fins, roughened surfaces, loose or foreign materials, oil, grease and other materials that may damage the membrane.

B. Fill all surface voids in the immediate substrate that are greater than 1/4 inch (6 mm) wide with fill material acceptable insulation to membrane manufacturer.

3.04 WOOD NAILER LOCATION AND INSTALLATION

A. Total wood nailer height shall match the total thickness of insulation being used and shall be installed with a 1/8” gap between each length and at each change of direction.

B. Wood nailers shall be firmly fastened to the deck. Mechanically fasten wood nailers to resist a force of 200 lbs. per linear foot.

3.05 VAPOR BARRIER INSTALLATION

A. All deck/deck cover substrates (except metal decks) must be primed prior to application. Use only primer supplied by membrane manufacturer.

B. Expanded Polystyrene, Extruded Polystyrene, Common Polyisocyanurate, Fiberglass, Wood Fiber, Perlite and existing single-ply roofs are not acceptable substrates for SBS bitumen adhesive.

C. Application can be made at ambient temperatures as low as 25 °F (-4 °C) as long as membrane has been stored in a heated area so that it will be between 50 °F (10 °C) and 100 °F (38 °C) at the time of application.

D. Install with minimum 3" (76.2 mm) side laps and 6" (152.4 mm) end laps.

E. Roll in with a 75 lb (34 kg) roller to fully mate each roll to substrate, including all lap areas.

3.06 INSULATION AND COVER BOARD INSTALLATION

A. Install insulation in configuration and with attachment method(s) specified in PART 2, under Roofing System.

B. Install only as much insulation as can be covered with the completed roofing system before the end of the day's work or before the onset of inclement weather.

C. Lay roof insulation in courses parallel to roof edges.

D. Neatly and tightly fit insulation to all penetrations, projections, and nailers, with gaps not greater than 1/4 inch (6 mm). Fill gaps greater than 1/4 inch (6 mm) with acceptable insulation. Do not leave the roofing membrane unsupported over a space greater than 1/4 inch (6 mm).

E. Mechanical Fastening: Using specified fasteners and insulation plates, engage fasteners through insulation into deck to depth and in pattern required by Factory Mutual for FM Class specified in PART 2 and membrane manufacturer, whichever is more stringent.

3.07 SELF ADHERING SINGLE-PLY MEMBRANE INSTALLATION

A. General: A foreman trained and certified by the company issuing the EPDM system warranty shall be present at all times that EPDM is being installed.
   1. Install only as much material as can be made watertight at the end of each day’s work.
   2. At all times have a contingency plan for making the roof watertight should weather conditions require that the work be suspended on short notice.

B. Substrates must be clean, dry and free of foreign material which could inhibit adhesion.
   1. Install Firestone FullForce EPDM membrane with Secure Bond™ technology only when ambient and substrate temperatures are 20 °F (-7 °C) minimum and rising. Do not install Firestone FullForce EPDM below this minimum temperature.

C. Lay out the membrane pieces so that field and flashing splices are installed to shed water. Install membrane without wrinkles and without gaps or fishmouths in seams; bond and test seams and laps in accordance with membrane manufacturer's instructions and details. Note: All

seams must be primed for proper adhesion and finished using FullForce Lap Sealant as required by the manufacturer's application guide and details.

1. Once the membrane has relaxed in place a minimum of 30 minutes (longer in colder weather), and the seam positions are aligned, carefully fold back the leading edge of the FullForce EPDM membrane at one end to expose the release liner. Do not fold the length of the roll in half to remove the liner.
2. Starting from the center split of the exposed release liner, remove the liner at a 45° angle from the center of the sheet back beyond the membrane edge. Be sure to pull enough of the release liner to hold below the membrane. Remove at least 5' of release liner from one end of the sheet and adhere it to the substrate. The removed liner should extend at a 45° angle beyond the edges of the membrane. Do not remove the 4" (102 mm) strip or release liner along the seam edge at this time.
3. Keeping the membrane flat and secured, and the seam overlap aligned, continue removing the release liner at a 45° angle along the entire length of the sheet (up to 100'). Pulling the release liner at an alternate angle can cause the sheet to move and may trap air. The two halves of the release liner should be pulled out at the same time by two people. Keep the release liner as close to the roof surface as possible during removal. NOTE: Removal of the liner and any handling of the exposed SA adhesive should be completed by two persons minimum.
4. To initiate adhesion, use a stiff bristled broom and apply downward pressure across the installed membrane. Broom the membrane from the center of the sheet working toward the edge. Repeat the process on the other half of the sheet.
5. Remove the 4" (102mm strip of release liner from the edge overlapping the lower sheet of EPDM. Peel the liner at a 45° angle to the seam edge and then along the length of the seam, making sure there is sufficient contact between the two membranes layers.
6. Use a 1 ½" to 2" (38mm to 51mm) wide silicone roller to roll the entire seam at a right angle toward the outer seam and then along the length of the seam.
7. Roll the installed membrane with a weighted roller (5 lb per lineal inch) across the width of the sheet to ensure full contact with the substrate. NOTE: Do not roll membrane in place with a weighted roller if installed over ISOGARD™ HD or ISOGARD CG

D. Fold back the remaining half of membrane and repeat the preceding steps.

E. Edge Securement
   1. Secure membrane at all locations where membrane terminates or goes through an angle change greater than 2 in 12 inches (1:6 ) using mechanically fastened reinforced perimeter fastening strips, plates, or metal edging as indicated or as recommended by roofing manufacturer.
      a. Exceptions: Round pipe penetrations less than 18 inches (460 mm) in diameter and square penetrations less than 4 inches (200 mm) square.
      b. Metal edging is not merely decorative; ensure anchorage of membrane as intended by roofing manufacturer.

3.08 FLASHING AND ACCESSORIES INSTALLATION

A. Install flashings, including laps, splices, joints, bonding, adhesion, and attachment, as required by membrane manufacturer's recommendations and details.

B. Metal Accessories: Install metal edgings, gravel stops, and copings in locations indicated on the drawings, with horizontal leg of edge member over membrane and flashing over metal onto membrane.
   1. Follow roofing manufacturer's instructions.
   2. Remove protective plastic surface film immediately before installation.
   3. Install water block sealant under the membrane anchorage leg.
   4. Flash with manufacturer's recommended flashing sheet unless otherwise indicated.

5. Where single application of flashing will not completely cover the metal flange, install additional piece of flashing to cover the metal edge.
6. If the roof edge includes a gravel stop and sealant is not applied between the laps in the metal edging, install an additional piece of self-adhesive flashing membrane over the metal lap to the top of the gravel stop; apply seam edge treatment at the intersections of the two flashing sections.
7. When the roof slope is greater than 1:12, apply seam edge treatment along the back edge of the flashing.

C. Scuppers: Set in sealant and secure to structure; flash as recommended by manufacturer.

D. Roofing Expansion Joints: Install as shown on drawings and as recommended by roofing manufacturer.

E. Flashing at Walls, Curbs, and Other Vertical and Sloped Surfaces: Install weathertight flashing at all walls, curbs, parapets, curbs, skylights, and other vertical and sloped surfaces that the roofing membrane abuts to; extend flashing at least 8 inches (200 mm) high above membrane surface.
1. Use the longest practical flashing pieces.
2. Evaluate the substrate and overlay and adjust installation procedure in accordance with membrane manufacturer's recommendations.
3. Complete the splice between flashing and the main roof sheet with specified splice adhesive before adhering flashing to the vertical surface.
4. Provide termination directly to the vertical substrate as shown on roof drawings.

F. Roof Drains:
1. Taper insulation around drain to provide smooth transition from roof surface to drain. Use specified pre-manufactured tapered insulation with facer or suitable bonding surface to achieve slope; slope not to exceed manufacturer's recommendations.
2. Position membrane, then cut a hole for roof drain to allow 1/2 to 3/4 inch (12 to 19 mm) of membrane to extend inside clamping ring past drain bolts.
3. Make round holes in membrane to align with clamping bolts; do not cut membrane back to bolt holes.
4. Apply sealant on top of drain bowl where clamping ring seats below the membrane
5. Install roof drain clamping ring and clamping bolts; tighten clamping bolts to achieve constant compression.

G. Flashing at Penetrations: Flash all penetrations passing through the membrane; make flashing seals directly to the penetration.
1. Pipes, Round Supports, and Similar Items: Flash with specified pre-molded pipe flashings wherever practical; otherwise use specified self-curing elastomeric flashing.
2. Pipe Clusters and Unusual Shaped Penetrations: Provide penetration pocket at least 2 inches (50 mm) deep, with at least 1 inch (25 mm) clearance from penetration, sloped to shed water.
3. Structural Steel Tubing: If corner radii are greater than 1/4 inch (6 mm) and longest side of tube does not exceed 12 inches (305 mm), flash as for pipes; otherwise, provide a standard curb with flashing.
4. Flexible and Moving Penetrations: Provide weathertight gooseneck set in sealant and secured to deck, flashed as recommended by manufacturer.

## 3.09 FINISHING AND WALKWAY INSTALLATION

A. Install walkways at access points to the roof, around rooftop equipment that may require maintenance, and where indicated on the drawings.

B. Walkway Pads: Adhere to the roofing membrane, spacing each pad at minimum of 1.0 inch (25 mm) and maximum of 3.0 inches (75 mm) from each other to allow for drainage.
   1. If installation of walkway pads over field fabricated splices or within 6 inches (150 mm) of a splice edge cannot be avoided, adhere another layer of flashing over the splice and extending beyond the walkway pad a minimum of 6 inches (150 mm) on either side.
   2. Prime the membrane, remove the release paper on the pad, press in place, and walk on pad to ensure proper adhesion.

3.10 FIELD QUALITY CONTROL

A. Manufacturer's requirements and recommendations shall be followed in all respects for installation of membrane materials. In addition to membrane manufacturer's requirements, the following standards and remedial actions are specified for installation of membrane materials as part of the work:
   1. Miscellaneous Mechanical Fasteners: Mechanical fasteners for securing insulation to roof decking shall in all cases be driven tight. Loose, overdriven, or backed out fasteners will not be acceptable. If a straightedge Is placed over a fastener and that fastener is greater than 1/8 inch above the surface of the surrounding membrane, that fastener shall be considered to be backed out. Loose, overdriven, or backed out fasteners will be repaired in accordance with specification TS 18 in the ARMA/NRCA/SPRI Repair Manual for Low-Slope Roof Systems. Each such repair shall be considered a patch.
   2. Field Lap Seams: Field lap seams and seam cover tape shall be installed along straight lines. A four-foot straightedge shall be placed along any given section of lap seam or seam cover tape; a variance of more than ¼ inch in either direction, or a total of ¼ inch in both directions, shall constitute failure to meet the standards of good workmanship. Sections of membrane with seams not complying with this standard shall be removed and replaced.
   3. Wrinkles in Membrane: Field membrane shall be adhered with a minimum of wrinkling. Wrinkles greater than 24 inches in length, or groups of wrinkles which contain a total of 30 inches, shall constitute failure to meet the standards of good workmanship. Wrinkles not complying with this standard shall be repaired in accordance with specification TS 7 in the ARMA/NRCA/SPRI Repair Manual for Low-Slope Roof Systems. Each such repair shall be considered a patch.
   4. Cuts and Holes: All cuts and holes in the membrane shall be repaired in accordance with specification TS 3 or 5, as applicable, in the ARMA/NRCA/SPRI Repair Manual for Low-Slope Roof Systems. Each such repair shall be considered a patch.
   5. Replacement of Deficient Field Membrane: Areas of roof membrane containing more than 3 patches in any area of 100 square feet shall be considered defective and shall be removed and replaced at the direction of the Architect.

B. Inspection by Manufacturer: Provide final inspection of the roofing system by a Technical Representative employed by roofing system manufacturer specifically to inspect installation for warranty purposes (i.e. not a sales person).

C. Perform all corrections necessary for issuance of warranty.

3.11 CLEANING

A. Clean all contaminants generated by roofing work from building and surrounding areas, including bitumen, adhesives, sealants, and coatings.

B. Repair or replace building components and finished surfaces damaged or defaced due to the work of this section; comply with recommendations of manufacturers of components and surfaces.

C. Remove leftover materials, trash, debris, equipment from project site and surrounding areas.

3.12 PROTECTION

A. Where construction traffic must continue over finished roof membrane, provide durable protection and replace or repair damaged roofing to original condition.

**END OF SECTION 075323.11**

**PAGE INTENTIONALLY BLANK**

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual apply to Work of this Section.

1.02 SUMMARY

A. Furnish all labor, material, tools equipment, and services for all preformed roofing as indicated, in accord with the provisions of the Contract Documents. The Metal Roofing Manufacturer will provide all components required for a complete metal roofing system to include straight and curved ridge, closures, sealants, fillers, and any other required items.

B. Completely coordinate with work of all other trades.

C. Related Sections:
1. Section 061000 – Rough Carpentry.
2. Section 075323.11 – Self-Adhering EPDM Roofing System.
3. Section 076200 – Sheet Metal Flashing and Trim.
4. Section 077123 – Manufactured Gutters and Downspouts.
5. Section 077253 – Snow Guards.
6. Division 26 – Electrical (for grounding requirements).

1.03 REFERENCE STANDARDS

A. AAMA 2605 – “Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels”.
B. ASTM C1177 –” Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing”.
C. ASTM C1289 – “Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board”.
D. ASTM D1970 – “Standard Specification for Self-adhering Polymer Modified Bituminous Sheet Materials Used as steep Roofing Underlayment for Ice Dam Protection”.
E. ASTM E1514 – “Standard Specification for Structural Standing Seam Steel Roof Panel Systems”.
F. ASTM E1592 – “Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference”.
G. ASTM E1646 – “Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference”.
H. ASTM E1680 – “Standard Test Method for Rate of Air Leakage through Exterior Metal Roof Panel Systems”.
I. SMACNA (Sheet Metal & Air Conditioning Contractor’s National Association) – “Architectural Sheet Metal Manual”.
J. UL 580 – “Standard for Tests for Uplift Resistance of Roof Assemblies”.
K. UL 2218 – “Impact Resistance of Prepared Roof Covering Materials”.

1.04 SYSTEM PERFORMANCE REQUIREMENTS

A. Air Infiltration: Provide panel system with no air leakage when tested in accordance with ASTM E 283 at pressure differentials up to 1.57 psf.

B. Water Penetration: Provide panel system with no water penetration as defined in the test method when tested in accordance with ASTM E 331 at an inward static air pressure differential of not less than 6.24 psf and not more than 12.0 psf.

1.05 QUALITY ASURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer shall have a minimum of 10 years' experience in manufacturing metal roofing systems. Panels specified in this section shall be produced by a factory authorized contractor using only ATAS authorized and inspected equipment. A letter certifying the manufacturer's qualifications shall accompany the product material submittals.

B. Source Limitations: Metal standing seam roof panels, sheet metal fascia, soffits copings, flashings, gutter systems, and any other sheet metal roof accessories shall be obtained through one source, from a single manufacturer.

C. Installer Qualifications:
   1. Have received training and licensing from the metal roofing manufacturer for the installation of the specified roof system.
   2. A letter certifying the installer as the Manufacturer's Certified Installer shall accompany the submittal package.
   3. Five years minimum experience in application of similar standing seam roofs.
   4. Minimum of seven satisfactory roofs on similar type of project.
   5. Applicator must be able to furnish a labor and performance bond.
   6. Owner reserves the right to reject any applicator based on qualifications.

D. Field Measurements: Where possible, prior to fabrication of prefabricated panels, take field measurements of structure or substates to receive panel system. Allow for trimming panel units where final dimensions cannot be established prior to fabrication.

E. Except where this Specification imposes a higher standard, do all work in accordance with the manufacturer's recommendations. Manufacturer's literature and details shall be available on the job site at all times when work is in progress.

F. UL Listing: Provide labeled materials which have been tested and listed by UL in "Building Materials Directory" for application indicated, with Class A materials/system for roof slopes shown.

G. Roofing system must meet FM I-90 Wind Uplift Design Criteria.

H. Pre-Installation Conference: Conduct conference at project location with building Construction Manager, Architect, installing contractor, general contractor, and sheet metal roofing manufacturer a minimum of 10 days prior to start of work. All details shall be reviewed including underlayment, substrates, fastening patterns, scheduling, trim and flashing components, accessories such as fasteners and sealants.

I. Installation Quality Control:
   1. All roof systems are subject to interim and final inspections by a technical field representative/inspector to inspect the installation of the metal roofing system in accordance with manufacturer's warranty requirements. Technical field representative shall issue a written report to the Construction Manager, Architect and Contractor for every field visit. Provide onsite inspection at the following intervals:
      a. 50% Sheet Metal Roofing installation completion.
      b. Final inspection upon completion of Metal Roof System.

1.06 SUBMITTALS

A. Pursuant to Section 013300 – Submittal Procedures.

B. Pursuant to Section 016000 – Product Requirements.

C. Manufacturer and Installer's qualifications as outlined in the Quality Assurance paragraph.

D. Product Data: Submit manufacturer's product specifications, standard details, certified product test results, installation instructions and general recommendations, as applicable to materials and finishes for each component and for total system of formed panels.

E. Samples: Submit two (2) samples 8" square, of each exposed finish material.

F. Shop Drawings: Submit of small-scale layouts of panels on walls, soffits, roofs and large-scale details of edge conditions, joints, corners, custom profiles, supports, anchorages, rim, flashings, closures, and special details. Distinguish between factory and field assembly work. Do not use Contract Drawings for Shop Drawings.

G. Test Reports:
   1. Submit test report showing that metal panels have a UL 580, Class 90 rating.
   2. Submit test report showing that metal panels have been tested in accordance with ASTM E1646-95.
   3. Submit test report showing that metal panels have been tested in accordance with ASTM E1680-95.
   4. Submit test report showing that metal panels have a UL 2218, Class 4 hail rating.

H. Close Out Submittals:
   1. Maintenance Data for installed products in accordance with Division 01 close out submittals, maintenance data section. Include methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finish's end performance.

1.07 DELIVERY, STORAGE AND HANDLING

A. Protect products and accessories from damage and discoloration during transit and at project site. Store sheets and components in dry storage area to prevent condensation.

B. Do not overload roof structure with stored materials. Do not permit material storage or traffic on completed roof surfaces.

1.08 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal roof panels to be performed according to manufacturers' written instructions and warranty requirements.

B. Field Measurements: Verify locations of roof framing and roof opening dimensions by field measurements before metal roof panel fabrication and indicate measurements on Shop Drawings.

1.09 ROOFING WARRANTY

A. Finish Warranty: Furnish panel manufacturer's written warranty covering failure of the factory applied exterior finish on metal wall and roof panels within the warranty period. Warranty period is twenty (20) years after the date of final completion.

B. Provide a written warranty for a period of three (3) years after the date of final completion. Under the terms of the warranty, the roofing contractor shall repair, at their cost (no cost to Owner), all leaks due to workmanship.

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. ATAS International, Inc. (Basis of Specification).

B. Other manufacturers seeking approval of their products must comply with requirements of Section 016000 – Product Requirements. Substitute roof panel must match specified panel in size, profile, color, and warranty.

2.02 ROOFING TYPE

A. General: Provide factory-formed metal roof panels designed to be field assembled by lapping and interconnecting raised side edges of adjacent panels with join type indicated and mechanically attaching panels to support using concealed clips inside laps. Include clips, cleats, pressure plates, and accessories required for weather tight installation. Unless more stringent requirements are indicated, comply with ASTM E 1514.

B. Vertical-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels, and mechanically seaming panels together with approved seaming equipment.

C. ATAS International, Inc.; Field-Lok™, FLS 137.

2.03 PANEL MATERIALS AND FABRICATION

A. Aluminum Panels: ASTM B209, G90 (lock-forming quality), extra smooth, tension-leveled, minimum spangle.
   1. Thickness: 0.040.

B. Form roofing panels in longest practical lengths, true to shape, accurate in size, square and free from distribution of manufacturing defects.
   1. Seam Height: 2-3/8 inches.
   2. Seam Spacing: 13-3/4 inches.
   3. Seams shall be mechanically locked in the field with a mechanical seamer.
   4. Seams shall have a factory applied integral seam sealant in leg of panel.
   5. Provide two (2) stiffening ribs per panel.

2.04 METAL FINISHES

A. General: Apply coatings either before or after forming and fabricating panels, as required by coating process and as required for maximum coating performance capability. Protect

coating either by application of strippable film or by packing plastic film or other suitable material between panels in a manner to properly protect the finish.

B. Fluoropolymer Coating: Two-Coat, thermo-cured, full-strength 70 percent “Kynar 500” coating consisting of a primer and a minimum 0.75- mil dry film thickness with a total minimum dry fill thickness of 0.9 mil and 30 percent reflective gloss when tested in accordance with ASTM D523.

C. Durability: Provide coating that has been field tested under normal range of weathering conditions for minimum of twenty (20) years without significant peel, blister, flake, chip, crack, or check in finish; without chalking in excess of NO. 8 in accordance with ASTM D4214; and without fading in excess of 5 NBS units.

D. Color: Kynar based fluoropolymer coating.
1. Color: To be selected by Architect.
2. Color selection shall be limited to “Manufacturer’s Standard” colors.
3. Finish shall be coordinated with and/or shall match other similarly prefinished items.

2.05 PANEL FABRICATION

A. General: Fabricate and finish panels and accessories at the factory to greatest extent possible, by manufacturer’s standard procedures and processes, as required to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and dimensional requirements and with structural requirements. Panels to have no transverse seams.

2.06 UNDERLAYMENT

A. Self-Adhering, High-Temperature Sheet: 45 mil homogeneous rubberized asphalt waterproofing compound, glass fiber reinforced designed specifically for use under sheet metal roofing. Basis of design ATAS ATA-Shield as supplied by ATAS International, Inc. Thermal Stability: Resistant to 240 deg F; ASTM D 1970. Low Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D 1970. With Asphalt free felt: Conforming to ASTM D 226, polyolefin based, 100 percent asphalt free, high strength reinforced roofing underlayment. Basis of design ATAS ATA-Guard as furnished by ATAS International, Inc.

2.07 ROOF INSULATION MATERIALS

A. General: Performed roof insulation boards manufactured or approved by roofing manufacturer, selected from manufacturer’s standard sizes suitable for application, of thicknesses indicated.

B. Polyisocyanurate board insulation, ASTM C 1289 Type II Class 1 CFC- and HCFC-free, with flat recycled content glass-fiber mat facer on both major surfaces.
1. Compressive Strength, ASTM C1621: Grade 2: 20-psi.
2. Conditioned Thermal Resistance at 75 deg F: 14.4 at 2.5 inches thick.

C. Cold Fluid-applied, bead-applied, low-rise adhesive, two-component solvent-free low elastomeric urethane, formulated to adhere roof insulation to substrate.
1. Flame Spread Index, ASTM E 84: 10.
2. Smoke Developed Index, ASTM E 84: 30.
3. Tensile Strength, minimum, ASTM D412: 250 psi.
4. Peel Adhesion, minimum, ASTM D903: 17lbf/in.

2.08 UNDERLAYMENT BOARD

A. Glass-mat faced gypsum panel, ASTM C 1177.
   1. Basis of design product: Georgia Pacific DensDeck® Roof Board.
   2. Thickness: 5/8 inch.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening underlayment board to roof deck.

2.09 MISCELLANEOUS MATERIALS

A. Fasteners:
   1. Self-taping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads. Manufacturer shall provide or authorized all fasteners utilized with the sheet metal roofing system.

B. Accessories: Provide components required for a complete roof or wall panel system, including trim, fascia, finished sills, corner units, ridge closures, clips, seam covers, valley flashings, crickets, counter-flashing, wall flashing, sealants, gaskets, fillers, closure strips, and similar items. Match material's finishes and gauges to panel.

C. Closure Strips: Closed cell, self-extinguishing, expanded cellular rubber or cross-linked polyolefin foam flexible closure strips where indicated or necessary to ensure weathertight construction.

D. Sealants:
   1. Sealing tape: Pressure sensitive 100 percent solids polyisobutylene compound sealing tape with release paper backing. Provide permanently elastic, non-sag, nontoxic, non-staining tape.
   2. Joint Sealant: One part elastomeric polyurethane, polysulfide, or silicone rubber sealant as recommended by the panel manufacturer.

2.10 FABRICATION

A. General: Fabricate sheet metal roofing and components to comply with details shown, manufacturers installation details and recommendations in SMACNA's "Architectural Sheet Metal Manual" and NRCA Waterproofing Manual that apply to the design, dimensions (pan width and seam height), geometry, metal thickness, and other characteristics of installation indicated. Fabricate sheet metal roofing and accessories at the manufacturer's location to the greatest extent possible.

B. General: Fabricate sheet metal roofing panels to comply with details shown and sheet metal roofing manufacturer's written instructions.

C. Fabricate sheet metal roofing to allow for expansion in running work sufficient to prevent leakage, damage, and deterioration of the Work. Form exposed sheet metal work to fit substrates without excessive oil canning, buckling, and tool marks, true to line and levels indicted, and with exposed edges folded back to form hems.
   1. Fold and cleat eaves as required by manufacturer to insure weathertightness and wind uplift resistance.

2. Form and fabricate sheets, seams, strips, valleys, ridges, edge treatments, integral flashings, and other components of metal roofing to profiles, patterns, and drainage arrangements shown and as required for leak proof construction and wind uplift resistance.

D. Metal Protection: Where dissimilar metals will contact each other, protect against galvanic action by painting contact surface, or by other permanent separation as recommended by manufactures of dissimilar metals or by fabricator.

E. Sheet Metal Accessories: Custom fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Obtain field measurements for accurate fit before manufacturer fabrication.

2.11 PREFABRICATED PIPE FLASHINGS

A. Pipe flashings shall provide a weathertight joint at projections through the roof, considering the thermal movement of the roof and the service temperature of the projection. Pipe flashings shall have an aluminum-flanged base ring.

PART 3 – EXECTUION

3.01 SURFACE CONDITIONS

A. Examination:
1. The contractor shall verify installed work of other trades that such work is complete to a point where the roofing system installation may commence.
2. The Contractor shall verify that the substructure installation is in accordance with the approved shop drawings and roof panel manufacturer's requirements.
3. Coordinate with roof panel manufacturer to ensure that the fasteners are correct for the substrate and is installed to accommodate and support the appropriate clip spacing and attachment.

B. Discrepancies:
1. In event of discrepancy, notify the Architect in writing.
2. Do not proceed with installation until discrepancies have been resolved.

C. Verify that roof openings, curbs, pipes, sleeves, ducts vents, and other penetrations through roof substrate are complete and properly located.

3.02 INSTALLATION

A. Back paint concealed metal surfaces and surfaces in contact with dissimilar metals with protective backing paint to a minimum dry film thickness of 15 mil.

B. Panel Installation:
1. General: Comply with manufacturer's instructions and recommendations for installation, ass applicable to project conditions and supporting substrates and as necessary to provide finished and weathertight metal roofs and metal sided walls. Anchor panels and other components of the work securely in place, with provisions for thermal and structural movement.
2. Field cutting of exterior panels by torch is not permitted.
3. Install panels with concealed fasteners.
4. Accessories: Install components required for a complete roof or wall panel system, including trim, fascia, finished sills, corner units, ridge closures, clips, seam covers,

battens, flashings and crickets, sealants, gaskets, fillers, closure strips and similar items.

C. Grounding: Coordinate grounding of metal roofs with Division 26.

D. Install high temperature, self-adhering underlayment over entire substrate area to receive metal roofing.
   1. Follow the manufacturer's installation instructions. Unsealed lap joints and holes which will allow the passage of moisture will not be allowed.
   2. Install the concealed flashing so that the flow of water is not against the edges of the sheets. Lap edges and ends a minimum of 3 inches.
   3. Broom the surface of the sheets to ensure that the Ice and Water Shield is firmly attached to the substrate and that all lap joints are sealed.
   4. Repair punctures and other defects immediately.

3.03 CLEANING AND PROTECTION

A. Damaged units: Replace panels and other components of the Work which have been damaged or have deteriorated beyond successful repair by means of finish touch up or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films (if any) as each panel is installed. Upon completion of panel installation, clean finished surfaces as recommended by panel manufacturer and maintain a clean condition during construction.

END OF SECTION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. Furnish labor and materials necessary to install a complete system.

B. This Section includes the following items, refer to the Drawings for their specific use and location:
   1. Metal counter flashing and base flashing (if any).
   2. Metal wall flashing and expansion joints.
   3. Exposed metal trim, fascia, and soffits.
   4. Miscellaneous sheet metal accessories.
   5. Flexible sheet membrane flashing.
   6. Scuppers.
   7. Step and valley flashing.

C. Integral masonry flashings are part of the masonry work as specified in Section 040523 - Masonry Accessories.

D. Roofing Accessories installed integral with roofing membrane are part of the roofing work as specified in the roofing system sections.

E. Related Sections: The following sections contain requirements that relate to this section;
   1. Section 040523 – Masonry Accessories
   2. Section 042200 – Concrete Unit Masonry
   3. Section 073113 – Composite Shingles
   4. Section 075323.11 - Self Adhering EPDM Roofing System
   5. Section 076113 – Standing Seam Sheet Metal Roofing
   6. Section 077123 – Manufactured Gutters and Downspouts
   7. Section 079200 – Sealants

1.03 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal metal flashings and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.04 STANDARDS

A. All work of this section shall confirm to industry standards and/or manufacturer’s recommendations including:
   1. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association Inc. - "Architectural Sheet Metal Manual" (latest edition).

B. Referenced Standards: The following standards (latest edition or edition in force by AHJ) form part of this specification only to the extent they are referenced as specification requirements.
   1. ASTM B32 - "Standard Specification for Solder Metal".
   2. ASTM B209 - "Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate".

3. ASTM B370 - "Standard Specification for Copper Sheet and Strip Building Construction".
4. ASTM D2244 - "Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates".
5. ASTM D4214 - "Standard Test Methods for Evaluating the Degree of chalking of Exterior Paint Films".

1.05 SUBMITTALS

A. Submit pursuant to Section 013300 - Submittal Procedures.

B. Submit pursuant to Section 016000 - Product Requirements.

C. Qualifications Data: for Fabrication shop.

D. Manufacturer's technical product data, material descriptions, finishes, installation instructions and general recommendations for each specified material and fabricated product.

E. Shop drawings for sheet metal flashing and trim showing layout, profiles, methods of joining, and anchorages details, including flashing, counterflashings, expansion joint systems, termination points and any other system of flashing required. Include details of any special conditions. Distinguish between factory and field assembly work.

F. Provide layouts at 1/4-inch scale and details at 3-inch scale. Layouts shall not be copies of Architectural Drawings.

G. Samples:
   1. Initial Samples for color selection: Submit two small samples of manufacturer's full range of colors for flashings, fascias, soffits and other materials that may have a color choice required.
   2. Submit two (2) samples 6" square of each exposed finish material in the color chosen by the Architect.

1.06 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
   1. For copings and roof edge flashings that are SPRI ES-1 tested and FM Approvals approved, shop shall be listed as able to fabricate required details as tested and approved.

B. Mock-ups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

C. Perform work in accordance with SMACNA details and standards and approved shop drawings and Contract Documents.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturers published instructions.

B. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

C. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.08 PROJECT CONDITIONS

A. Coordinate work of this section with interfacing and adjoining work for proper sequencing of each installation. Ensure best possible weather resistance and durability of work and protection of materials and finishes.

1.09 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Finish Warranty Period: 20 years from date of Substantial Completion.

B. Metal Copings, scuppers, roof edges, counterflashing, and other components incorporated or in contact with the Roofing System shall be pre-approved by and made integral to the 20-year Total Roofing System warranty specified in Division 07. Shop drawings and components shall be reviewed and approved by the Roofing manufacturer prior to submittal to the Architect for approval. Submit a letter signed by a current representative of the manufacturer on Roofing manufacturer letterhead, attesting to this approval and warranty acceptability. Submit this certification letter as part of the shop drawing submittals for this section.

PART 2 PRODUCTS

2.01 FABRICATED UNITS

A. General Metal Fabrication: Shop-fabricate work to greatest extent possible. Comply with details shown and with applicable requirements of SMACNA "Architectural Sheet Metal Manual" and other recognized industry practices. Fabricate for waterproof and weather-resistant performance, with expansion provisions for running work, sufficient to permanently prevent leakage, damage, or deterioration of the work. Form work to fit substrates. Comply with material manufacturer instructions and recommendations for forming material. Form exposed sheet metal work without excessive oil-canning, buckling, and tool marks, true to line and levels indicated, with exposed edges folded back to form hems.

B. Seams: Fabricate nonmoving seams in sheet metal with flat-lock seams. For metal other than aluminum, tin edges to be seamed, form seams, and solder. Form aluminum seams with epoxy seam sealer; rivet joints for additional strength where required.

C. Expansion Provisions: Where lapped or bayonet-type expansion provisions in work cannot be used or would not be sufficiently water/weatherproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

D. Sealant Joints: Where movable, non-expansion type joints are indicated or required for proper performance of work, form metal to provide for proper installation of Elastomeric sealant, in compliance with SMACNA standards.

E. Separations: Provide for separation of metal from non-compatible metal or corrosive substrates by coating concealed surfaces at locations of contact, with bituminous coating or other permanent separation as recommended by manufacturer/fabricator.

F. Aluminum Extrusion Units: Fabricate extruded aluminum running units with formed or extruded aluminum joint covers for installation behind main members where possible. Fabricate mitered and welded corner units.

2.02 SOFFITS

A. Manufacturer: ATAS International, Inc. Corp., 6612 Snowdrift Road, Allentown, PA 18106, 610-395-8445 or Architect approved equivalent.

B. For soffits with lanced vents: Sheet Aluminum meeting ASTM B 209, alloy 3003, temper H14, AA-C22A41 Kynar Finish; .032 inch.

C. For all other soffits: Sheet Aluminum meeting ASTM B 209, alloy 3003, temper H14, AA-C22A41 Kynar Finish; .040 inch except as otherwise indicated.

D. Color as selected by Architect.

2.03 SOFFITS (PERPENDICULAR TO FACE OF BUILDING)

A. Manufacturer: ATAS International, Inc. Corp., 6612 Snowdrift Road, Allentown, PA 18106, 610-395-8445 or Architect approved equivalent.

B. For soffits with lanced vents: ATAS MPV120, Kynar 500 PVDF Finish; .032 inch aluminum.

C. For all other soffits: ATAS MPS120, Kynar 500 PVDF Finish; .032 inch aluminum.

D. Color as selected by Architect.

2.04 METAL FASCIA, DRIP EDGE, TRIM MATERIALS, FLASHING AND SCUPPERS

A. Material: Profile as shown on contract drawings.
   1. .040 aluminum except as otherwise indicated.

B. Finish: Premium fluoropolymer, PVDF, Kynar 500/HYLAR 5000 coating.
   1. Color to be selected by Architect.

2.05 STEP AND VALLEY FLASHING

A. Material: .050 aluminum with premium fluoropolymer, PVDF, Kynar 500 / Hylar 5000 coating.
   1. Color to be selected by Architect.

2.06 ALUMINUM BASE FLASHING AND COVER SHEET

A. Material: Profile as shown on contract drawings.
   1. .032 Premium fluoropolymer, PVDF, Kynar 500/HYLAR 5000 coating.
      a. Color to be selected by Architect.

B. Termination Bar
   1. 1/8” x 1”, 304 Stainless Steel

2.07 MISCELLANEOUS MATERIALS AND ACCESSORIES:

A. Solder: For use with steel or copper, provide 50 - 50 tin/lead solder (ASTM B 32), with rosin flux.

B. Fasteners: Same metal as flashing/sheet metal or other non- corrosive metal as recommended by manufacturer. Match finish of exposed heads with material being fastened.

C. Bituminous Coating: SSPC - Paint 12, solvent-type bituminous mastic, nominally free of sulfur, compounded for 15-mil dry film thickness per coat.

D. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, non- drying, nonmigrating sealant.

E. Elastomeric Sealant: Type recommended by manufacturer of metal and fabricator of components being sealed and complying with requirements for joint sealants.

F. Epoxy Seam Sealer: 2-part noncorrosive metal seam cementing compound, recommended by metal manufacturer for exterior/interior nonmoving joints including riveted joints.

G. Adhesives: Type recommended by flashing sheet manufacturer for waterproof/weather-resistant seaming and adhesive application of flashing sheet.

H. Paper Slip Sheet: 5-lb. rosin-sized building paper.

I. Metal Accessories: Provide sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of work, matching or compatible with material being installed, noncorrosive, size and gage required for performance.

J. Elastic Flashing Filler: Closed-cell polyethylene or other soft closed-cell material recommended by elastic flashing manufacturer as filler under flashing loops to ensure movement with minimum stress on flashing sheet.

2.08 WALL FLASHING (BASE FLASHING, THRU-WALL FLASHING)

A. Refer to Section 040523 - Masonry Accessories.

PART 3 EXECUTION

3.01 INSTALLATION REQUIREMENTS

A. General: Except as otherwise indicated, comply with manufacturer's installation instructions and recommendations and with SMACNA "Architectural Sheet Metal Manual." Anchor units of work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weatherproof.

B. Underlayment: Where stainless steel or aluminum is to be installed directly on cementitious or wood substrates, install a slip-sheet of red rosin paper and a course of polyethylene underlayment.

C. Bed flanges of work in a thick coat of bituminous roofing cement where required for waterproof performance.

D. Install reglets to receive counterflashing in manner and by methods indicated. Where shown in concrete, furnish reglets to trades of concrete work for installation as work of Division 03

sections. Where shown in masonry, furnish reglets to trades of masonry work, for installation as work of Division 04 sections.

E. Install counterflashing in reglets, either by snap-in seal arrangement or by welding in place for anchorage and filling reglet with mastic or elastomeric sealant, as indicated and depending on degree of sealant exposure.

F. Install elastic flashing in accordance with manufacturer's recommendations. Where required, provide for movement at joints by forming loops or bellows in width of flashing. Locate cover or filler strips at joints to facilitate complete drainage of water from flashing. Seam adjacent flashing sheets with adhesive, seal and anchor edges in accordance with manufacturer's recommendations.

G. Nail flanges of expansion joint units to curb nailers, at maximum spacing of 6 inches o.c. Fabricate seams at joints between units with minimum 3-inch overlap, to form a continuous, waterproof system.

H. Roof curbs and sloped roofs
   1. Install metal flashing along the horizontal edge of the roof curbs on the down-slope side.
      a. Install continuous piece of aluminum apron flashing against vertical surface and returning a minimum of 8 inches up the roof slope at corners,
      b. Aluminum apron shall extend a minimum of 5 inches up the vertical surface and 5 inches onto the roof deck.
      c. Install apron flange in bed of roofing cement and mail to roof deck. Do not nail to vertical surface.
   2. Install aluminum step flashings along the sides of the roof curbs that run parallel to the roof slope.
      a. Pieces of step flashing are to be installed with each course of shingles.
      b. Step flashing shall extend a minimum of 5 inches up vertical surface and 5 inches onto roof deck.
      c. Set flange of step flashing on roof deck in full bed of roofing cement and nail flange to roof deck using 2 nails. Do not nail flashing to vertical surface.
      d. Lap flashing sections a minimum of 4 inches.
   3. Install aluminum backer flashing along horizontal edge of the roof curbs on the up-slope side.
      a. Aluminum backer flashing shall extend a minimum 5 inches up the vertical surface of the roof curb and shall extend 18 inches onto the roof deck.
      b. Set backer flashing in roofing cement and nail to roof deck at 6 inches on center each way. Do not nail vertical flange of backer flashing.

I. Base Flashing and coversheet
   1. Lap joints 4” minimum.
   2. Provide sealant at all overlaps.
   3. Lap higher cover sheet over lower cover sheet.
   4. Termination Bar: Provide where shown on contract documents, continuous, fastened at 12” o.c. or less.

3.02 CLEANING AND PROTECTION

A. Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.

B. Protection: Advise Contractor of required procedures for surveillance and protection of flashings and sheet metal work during construction to ensure that work will be without damage or deterioration other than natural weathering at time of Substantial Completion.

**END OF SECTION 076200**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Pre-finished aluminum gutters.
   2. Pre-finished aluminum downspouts.
   3. Pre-finished aluminum collection boxes.
   4. Related Accessories.

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Section 061000 – Rough Carpentry.
   2. Section 076000 – Sheet Metal Flashing and Trim.
   3. Section 107316.13 – Canopies for gutters integral with canopy construction.
   4. Division 26 – Electrical

C. Refer to the Contract Drawings for the locations and extent of each component of the system.

1.03 STANDARDS

A. All work of this section shall conform to industry standards and/or manufacturer's recommendations.

1.04 SUBMITTALS

A. Submit pursuant to Section 013300 - Submittal Procedures.

B. Submit pursuant to Section 016000 - Product Requirements.

C. Prior to start of installation, the installing contractor shall furnish details or catalog cuts indicating products to be used conform with these specifications.

D. Shop drawings showing dimensions, materials, adjacent wall construction, jointing methods, fastening methods including locations and spacing, accessories and all other information needed for a complete system.

1.05 QUALITY ASSURANCE

A. All work of this section shall be performed by experienced workers familiar with the work and according to manufacturer's recommendations and/or industry standards.

B. Installing contractor shall be responsible for installing gutters, collection boxes and downspouts in accordance with manufacturer's printed instructions. Follow primary roofing material manufacturer's printed instructions for installation of joining gravel stops or eave trims.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturer's published instructions.

B. Protect against moisture exposure and damage.

C. All products delivered shall be stored in a clean, dry location prior to installation.

D. Stack pre-formed and pre-finished material to prevent twisting, bending or abrasion, and to provide ventilation. Slope to drain.

E. Prevent contact with materials during storage which may cause discoloration, staining or damage.

F. Products furnished with strippable protective plastic film should have film removed prior to installation. Such film coated products shall not be exposed to sunlight for more than thirty (30) minutes without removing film.

G. Workers shall use diligent care to avoid damage, scars and abrasions to product when handling.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Atas International, Inc., 6612 Snowdrift Rd., Allentown, PA 18106. Phone: (800) 468-1441.

B. Approved standing seam roofing manufacturer if different from ATAS.

C. Gutters and downspouts in this Section may be produced by a factory authorized fabricator using finished metal from the approved manufacturer.

D. Source limitations: Metal gutter systems, standing seam roof panels, fascia, soffits, copings, flashings, and any other metal roof accessories shall be obtained through one source from a single manufacturer for consistent color quality.

2.02 MATERIALS

A. Aluminum: ASTM B209, 3003 alloy, H14 temper; 0.050 inch thickness or as indicated; mill finish interior, shop pre-coated 70% PVDF finish, color to match Fascia, U.N.O.

2.03 COMPONENTS

A. Gutters: Shall be manufactured in 12’ lengths. See Contract Drawings for gutter sizes and profiles.
   1. Provide welded, mitered inside and outside corners where required. Mitered corners to match gutter profile and size.

B. Downspouts: SMACNA rectangular profile seamless 4” x 6” from building gutters, 2” x 3” at manufactured canopies, unless noted otherwise. Configure with soldered elbow offsets to provide minimal clearance to building structure while providing allowance for concealed connectors.

C. Collector Box:
   1. ATAS Collector Box 12” H x 12” W x 8” D.
   2. Material: Pre-finished 0.063 aluminum matching gutter system color.
   3. Provide standard overflow slots in front face.
   4. Outlet size to match downspout.

2.04 ACCESSORIES

A. End Caps/Terminations: Install manufacturer's end caps at all terminations.

B. Anchorage Devices: Concealed type recommended by manufacturer.

C. Gutter Supports: Hidden flanges screwed to fascia and interlocked/fastened to the top front edge of gutter.

D. Downspout Supports: Flat 1-1/4" minimum width concealed straps matching leader profile and color.

E. Downspout Elbows: Fabricate to downspouts profile with factory soldered connections.

F. Fasteners: Aluminum finish exposed fasteners same as leader metal.

G. Provide continuous transitions from downspouts to underground piping without gaps.

H. Splash Blocks: Provide precast concrete type of size and profile indicated on the drawings where downspouts discharge onto grade; minimum 5,000 psi at 28 days with minimum 5 percent air entrainment.

I. Primer: Zinc chromate type.

J. Protective Backing Paint: Bituminous.

2.05 FABRICATION

A. From gutters collector boxes, downspouts of profiles and sizes indicated in accordance with approved shop drawings.

B. Fabricate with required connection, expansion and splice pieces.

C. Form sections square in required profile, true and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. Allow for expansion at joints and at intervals required by the manufacturer.

D. Hem exposed edges of metal.

E. Solder shop formed metal joints. After soldering, remove flux. Wipe and wash solder joints clean. Weather seal all field joints and intersections with adjacent materials with color matching exterior vertical grade sealant.

F. Fabricate gutter and downspout accessories, seal watertight.

2.06 FINISHES

A. Apply bituminous protective backing on surfaces in contact with dissimilar materials.

PART 3 EXECUTION

3.01 INSTALLATION

A. Verify that surfaces are ready to receive work.

3.02 INSTALLATION

A. Install gutters, downspouts and accessories in accordance with manufacturer's instructions and approved shop drawings.

B. Slope gutters 1/8" per foot minimum to leader locations.

C. Install collector box(es) where shown on Contract Drawings per manufacturer and industry standards.

D. Seal metal joints other than factory welded joints watertight.

E. Provide leader strap connections at 5'-0" maximum with a minimum of at least two connections per section.

F. All gutter hangers shall be installed and fastened at 30" o.c. maximum, for gutters less than 6'-0" in length, hanger spacing shall be 16" o.c. maximum.

**END OF SECTION 077123**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Specifications, apply to work of this Section.

1.02 SUMMARY

A. The work of this section includes, but is not limited to, the following:
   1. Pipe style snow guards
   2. Gusset style snow guards
   3. Rail style snow guards

B. Related Sections: Other specification sections which directly relate to the work of this section include, but are not limited to, the following:
   1. Section 073113.11 - Composite Shingles
   2. Section 076113 - Standing Seam Sheet Metal Roofing

1.03 STANDARDS

A. All work of this section shall conform to industry standards and/or manufacturer's recommendations.

1.04 SUBMITTALS

A. Pursuant to Section 013300 - Submittal Procedures.

B. Pursuant to Section 016000 - Product Requirements.

C. Manufacturer's Literature: Technical product data, installation instructions and color samples.

1.05 QUALITY ASSURANCE

A. Experienced workers familiar with all work of this section according to manufacturer's recommendations and/or industry standards.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturers published instructions.

B. Protect against moisture exposure and damage.

1.07 PROJECT CONDITIONS

A. Coordinate work of this section with interfacing and adjoining work for proper sequencing of each installation. Ensure best possible weather resistance and durability of work and protection of materials and finishes.

PART 2 PRODUCTS

2.01 SNOW GUARDS

A. Type A: #40 Gusseted snow guard as manufactured by Alpine Snow Guards, PO Box 430, Stowe, VT 05672-0430, Phone (888) 766-4273.
   1. Material: 0.032 Aluminum

2. Finish: Kynar Kynar 500
3. Color: As selected by the Architect from the manufacturer's full color offering.
4. Layout:
   a. Lower three rows: 24” o.c. in each shingle course. Alternate spacing by 12” in alternating course above.
   b. Upper three rows: 48” o.c. in each shingle course. Alternate spacing by 24” in alternating course above.
5. Install Type A snow guards only in areas shown on Contract Drawings.
6. All exposed hardware to match.

B. Type B: #225 Three Pipe Snow Guard as manufactured by Alpine Snow Guards, PO Box 430, Stowe, VT 05672-0430, Phone (888) 766-4273.
   1. Provide snow guards in aluminum with stainless steel base plate and aluminum accessories.
   2. Finish: Powder coat in standard factory available color.
   3. Base Plate: Size to match roof shingle size.
   4. Provide brackets at 3’-0” o.c. maximum.
   5. Provide end caps & locking collars.
   6. Use stainless steel fasteners.
   7. Install Type B at locations and in lengths as shown on Contract Drawings.

C. Type C: S-5! ® ColorGard by Metal Roof Innovations, Ltd., 8655 Table Butte Road, Colorado Springs, CO 80908 Phone: 888-825-3432.
   1. Clamps:
      a. Manufactured from 6061-T6 aluminum extrusions conforming to ASTM B221 or aluminum castings conforming to ASTM B85 and to AA Aluminum Standards and Data.
      b. Clamp model: No S-5U.
      c. Set screws: 300 Series stainless steel, 18-8 alloy, 3/8-inch diameter, with round nose point.
      d. Attachment bolts: 300 Series stainless steel, 18-8 alloy, 10mm diameter, with flat washers.
      e. Type C snow guards will have clamps 16” o.c.
   2. Cross Members
      a. Manufactured from 6061-T6 alloy and temper aluminum extrusions conforming to ASTM B221 and to AA Aluminum Standards and Data.
      b. Receptacle in face to receive color-matched metal strips
      c. Provide splice connectors ensuring alignment and structural continuity at end joints.
   3. Color Strips: Same materials and finish as metal roof panels; obtained from roof panel manufacturer.
   4. Snow and Ice clips (ice flags): Aluminum, with rubber foot, Sno Cup II™. Install one snow clip per panel between panel seams.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Install units in accordance with the manufacturer’s instructions, unless shown otherwise on the Drawings. Securely anchor units.

B. Isolate dissimilar metals using underlayment or bituminous paint.

C. Where mounting flanges are set directly in the roofing, embed the flanges in roofing cement or other waterproof mastic or adhesive as recommended by the manufacturer of the roofing. On sloping surfaces, integrate mounting flanges with roofing elements to properly shed water.

**END OF SECTION 077253**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This Section includes through-penetration Firestop systems for penetrations through fire-resistance-rated horizontal and vertical constructions, including both empty openings and openings containing penetrating items. Fire-rated joint construction in or between fire-resistance rated construction, at floor edge joints where shown and at exterior curtain wall/floor intersections.

B. Related Sections include the following:
   1. Section 099100 - Painting for stencil paint requirements.
   2. Divisions 21 and 22 Sections specifying piping penetrations.
   3. Divisions 23 Sections specifying pipe and duct penetrations.
   4. Divisions 25, 26 and 27 Sections specifying cable and conduit penetrations.

1.03 STANDARDS

A. All work of this section shall conform to industry standards and/or manufacturer’s recommendations.

B. ASTM E814 “Standard Test Method of Fire Tests of Penetration Firestop Systems”.

C. UL 1479 “Standard for Fire Tests of Penetration Firestops”.

D. UL “Building Materials Directory”.

1.04 SUBMITTALS

A. Submit pursuant to Section 013300 - Submittal Procedures.

B. Submit pursuant to Section 016000 - Product Requirements.

C. Product Data: For each type of product necessary to complete all types of firestopping required on the project.

D. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspection agency.
   1. Engineering Judgements: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system or joint firestopping system condition, submit illustration, with modifications marked, approved by firestopping system manufacturer's fire-protection engineer as an engineering judgement or equivalent equivalent fire-resistance rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

E. Qualification Data: For qualified installer.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: A firm experienced in installing penetration fire stopping similar in material, design, and extent to that Indicated for this Project, whose work has resulted in

construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

1. Installer shall have a documented and archived record-keeping system for all installations.

B. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:
   1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
   2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
      a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
      b. Classification markings on penetration firestopping correspond to designations listed by the following:
         1) FM Global in its "Building Materials Approval Guide".
         2) UL in its "Fire Resistance Directory".

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver through-penetration Firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life if applicable, qualified testing and inspection agency's classification marking applicable to Project, curing time, and mixing instructions for multi-component materials.

B. Store and handle materials for through-penetration Firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

C. Comply with recommended procedures, precautions or remedies described in Material Safety Data Sheets (MSDS) as applicable.

D. Do not use damaged or expired materials.

1.07 REGULATORY REQUIREMENTS

A. Provide fire and smoke resistivity pursuant to IBC NYS and NFPA.

1.08 PROJECT CONDITIONS

A. Environmental Limitations: Do not install through-penetration Firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration Firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate through-penetration Firestop systems per manufacturer's written instructions by natural means or where this is inadequate, forced-air circulation.

1.09 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that through-penetration Firestop systems are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, and/or cut openings to accommodate penetration firestopping.

C. Do not cover up through-penetration Firestop system installations that will become concealed behind other construction until each installation has been examined by building inspector and/or authorities having jurisdiction, if required.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Emerson Industrial Automation; Nelson Firestop Products.
   2. Grace Construction Products; W.R. Grace & Co. - Conn.
   3. Hilti, Inc.
   4. Tremco, Inc., Tremco Fire Protection Systems Group.
   5. USG Corporation.
   6. 3M Fire Protection Products.
   7. EMSEAL Joint Systems, LTD.

2.02 FIRESTOPPING OF THROUGH PENETRATIONS AND VOIDS

A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
   1. Fire-resistance-rated walls include fire walls, fire-barrier walls and fire partitions.
   2. F-Rating: Not less than the fire resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
   1. Horizontal assemblies include ceiling membranes of roof/ceiling assemblies.
   2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
   3. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.

D. Designs: Firestopping designs tested pursuant to ASTM E814 or UL 1479, and UL “Classified” for the application intended.
   1. Through penetration firestops: UL category XHCR for devices; category XHEZ for systems.
   2. Fill void, and cavity firestopping: UL category XHHW for firestopping materials; category XHKU for forming materials; pursuant to UL Classified systems for openings other than through penetrations.

| **UL ASSEMBLIES FOR THROUGH WALL PENETRATIONS** |
| --- |
| **PENETRANTS** |

| WALL TYPE | METAL CONDUIT | CABLES | NON-INSUL. METAL PIPE | INSUL. PIPE | FR POLY PROPYLENE PIPE | INSULATED METAL DUCT |
|---|---|---|---|---|---|---|
| GWB Stud Wall or Shaft Wall up to 2-HR Rating | W-L-1001 | W-L-3001 | W-L-1001 | W-L-5011 | W-L-2002 | W-L-7009 up to 24”x12” W-L-7025 up to 42”x28” |
| CMU Wall up to 2-HR Rating | C-AJ-1044 C-AJ-1008 | C-AJ-3029 C-AJ-3030 | C-AJ-1044 | C-AJ-5001 | C-AJ-2001 | C-AJ-7003 C-AJ-7016 |
| Note: Up to 1-hour rating, submit engineered judgment firestopping system for this combination of penetrant, wall/floor assembly and fire rating. | | | | | | |

E. Performance: F and T rating of not less than 1 hr.; with F rating to match fire resistance rating of assembly or barrier being penetrated.

F. Design selection: Based on performance and, when compared to other designs that may be suitable, based upon ability to provide environmental/water seal and accommodate:
   1. Movement transmitted by the penetration item.
   2. Thermal expansion of construction materials.
   3. Future modifications to utilities, services, and penetrations.

G. Fire-rated Caulk manufacturers:
   1. Approved intumescent sealant or putty.

H. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
   1. Permanent forming/damming/backing materials, including the following:
      a. Slag-wool-fiber or rock-wool-fiber insulation.
      b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
      c. Fire-rated form board.
      d. Fillers for sealants.
   2. Temporary forming materials.
   3. Substrate primers.
   4. Collars.
   5. Steel sleeves.

2.03 JOINT FIRESTOPPING SYSTEMS

A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E1966 or UL 2079.
   1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor or roof in or between which it is installed.

C. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E84.

D. Accessories: provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

2.04 FILL MATERIALS

A. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

B. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

C. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.

D. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

E. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

F. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

G. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

H. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicted below:
   1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and non-sag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of non-sag grade for both opening conditions.

2.05 MIXING

A. For those products requiring mixing before application, comply with penetration firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, missing containers, missing 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 the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:
   1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
   2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.

B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.03 INSTALLATION

A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
   1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.

C. Install fill materials for firestopping by proven techniques to produce the following results:
   1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
   2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
   3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.04 IDENTIFICATION

A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using contrasting color lettering not less than 3 inches high and with minimum 0.375-inch strokes. See specification section 099100 for additional information.

B. Install labeling required by code. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
   1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage".
   2. Contractor's name, address and phone number.

3. Designation of applicable testing and inspecting agency, UL system, F-rating, T-rating, and the hourly rate of the wall.
4. Date of installation.
5. Manufacturer’s name, and product number.
6. Installer’s name.

3.05 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings and or joints as the Work progresses by methods and with cleaning materials that are approved in writing by the firestopping manufacturers and that do not damage materials in which openings and/or joints occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping and joint firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated firestopping and install new materials to produce systems complying with specified requirements.

3.06 JOINT FIRESTOPPING SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHBN or Category XHDG.

B. Where Intertek Group listed systems are indicated, they refer to design numbers in Intertek Group's "Directory of Listed Building products" under product category Firestop Systems.

C. Head-of-Wall, Fire-Resistive Joint Firestopping Systems:
1. UL Classified Systems: HW-S-0000-0999.
2. Assembly Rating: As indicated on Contract Drawings.
3. Nominal Joint Width: As indicated on Contract Drawings.
4. Movement Capabilities: Class 1.

D. Perimeter Joint Firestopping Systems:
1. UL Classified Perimeter Fire Containment Systems: CW-D-2000-2999.
2. Integrity Rating: 1 hour.
3. Insulation Rating: 1 hour.
4. Linear Opening Width: As indicated, maximum.
5. Movement Capabilities: Class II.
6. F-Rating: 1 hour.

E. Slab Edge Joints where indicated:
1. EMSEAL, Emshield DFR2 System full depth of joint.
2. Fire-retardant impregnated foam providing a 2-hours fire protection in accordance with UL-2079.
3. Movement capabilities: +50% and -50%.

3.07 PENETRATION FIRESTOPPING SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL’s “Fire Resistance Directory” under product Category XHEZ.

B. Firestopping with No Penetrating Items:
1. UL-Classified Systems: W-L-0001-0999.
2. F-Rating: 1 or 2 hours.
3. T-Rating: 1 hour
4. Type of Fill Materials: As required to achieve rating.

C. Firestopping for Metallic Pipes, Conduit, or Tubing:
   1. UL-Classified Systems: W-L-1001-1999.
   2. F-Rating: 1 or 2 hours.
   3. T-Rating: 1 hour.
   4. Type of Fill Materials: As required to achieve rating.

D. Firestopping for Nonmetallic Pipe, Conduit, or Tubing:
   1. UL-Classified Systems: W-L-2001-2999.
   2. F-Rating: 1 hour to 2 hours.
   3. T-Rating: 1 hour.
   4. Type of Fill Materials: As required to achieve rating.

E. Firestopping for Electrical Cable:
   1. UL-Classified Systems: W-L-3001-3999.
   2. F-Rating: 1 hour or 2 hours.
   3. T-Rating: 1 hour.
   4. Type of Fill Materials: As required to achieve rating.

F. Firestopping for Miscellaneous Mechanical Penetrants:
   1. UL-Classified Systems: W-L-7001-7999.
   2. F-Rating: 1 hour or 2 hours.
   3. T-Rating: 1 hour.
   4. Type of Fill Materials: As required to achieve rating.

G. Firestopping for Groupings of Penetrants:
   1. UL-Classified Systems: W-L-8001-8999.
   2. F-Rating: 1 hour or 2 hours.
   3. T-Rating: 1 hour.
   4. Type of Fill Materials: As required to achieve rating.

**END OF SECTION 078400**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This Section includes joint sealants for the following locations:
   1. Exterior joints in vertical surfaces and non-traffic horizontal surfaces as follows, unless indicated otherwise:
      a. Control and expansion joints in cast-in-place concrete.
      b. Control and expansion joints in unit masonry.
      c. Joints between different materials.
      d. Perimeter joints (both interior and exterior) between materials listed above, frames of doors, windows, and louvers.
      e. Joints at plumbing, sprinkler, mechanical and electrical penetrations thru the exterior building envelope.
      f. At any fixed joint or space that allows air penetration into the building.
      g. Other joints as indicated.
   2. Exterior joints in horizontal traffic surfaces as follows below, unless indicated otherwise:
      a. Control, expansion, and isolation joints in cast-in-place slabs, sidewalks, aprons and pavement.
         1) Hybrid Joint Sealant where shown on contract drawings in joints 1" wide and larger.
      b. Joints between different materials listed above.
      c. Other joints as indicated.
   3. Interior joints in vertical surfaces and horizontal non-traffic surfaces as follows, unless indicated otherwise:
      a. Control and expansion joints on exposed interior surfaces of exterior walls.
      b. Perimeter joints of exterior openings where indicated.
      c. Vertical control joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
      d. Control joints in GWB walls and ceilings.
      e. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
      f. Perimeter joints of toilet fixtures, urinals, wall hung sinks, mop sinks, drinking fountains, etc.
      g. Any joints or voids between dissimilar materials.
      h. Joints and/or locations as noted on the Contract Drawings requiring acoustical sealant.
      i. Any joints or voids between existing and new construction.
      j. Other joints as indicated.
   4. Interior joints in horizontal traffic surfaces as follows, unless indicated otherwise:
      a. Control and expansion joints in cast-in-place concrete slabs.
      b. Other joints as indicated.

B. This section includes spray foam sealant to be used throughout the project to seal the building envelope penetrations and any break in the building envelope including but not limited to studs, sills, headers, other framing/sheathing gaps, exterior door frames, window frames, louvers, vents, electrical boxes, mail box slots, wall hydrants and at any other exterior penetration creating a gap or break in the envelope insulation.

C. This section includes sealant for setting beds for exterior window and louver sills and exterior door thresholds.

D. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Section 033000 - Cast-In-Place Concrete
   2. Section 042200 - Concrete Unit Masonry
   3. Section 076200 - Sheet Metal Flashing and Trim for sealing joints related to flashing and sheet metal for roofing.
   4. Section 078400 - Firestopping for through-penetration firestopping systems and fire-rated joint construction.
   5. Section 085213 - Aluminum Clad Wood Windows.
   6. Section 088000 - Glazing for sealants used in glazing.
   7. Section 092116 - Gypsum Board Assemblies for sealing concealed perimeter joints of gypsum board partitions to reduce sound transmission.
   8. Section 093013 - Ceramic Tiling for sealing tile corner joints.

1.03 SYSTEM PERFORMANCE REQUIREMENTS

A. All work of this section shall conform to industry standards and/or manufacturer's recommendations.

B. ASTM C834 "Standard Specification for Latex Sealants".

C. ASTM C919 "Standard Practice for Use of Sealants in Acoustical Applications".

D. ASTM C920 "Standard Specification for Elastomeric Joint Sealants".

E. Provide elastomeric joint sealants that have been produced and installed to establish and to maintain watertight and airtight continuous seals without causing staining or deterioration of joint substrates.

F. Provide joint sealants for interior applications that have been produced and installed to establish and maintain airtight continuous seals that are water resistant and cause no staining or deterioration of joint substrates.

1.04 SUBMITTALS

A. Submit pursuant to Section 013300 - Submittal Procedures.
   1. Certification by joint sealant manufacturer that sealants, plus the primers and cleaners required for sealant installation, comply with local regulations controlling use of volatile organic compounds.
   2. Certificates from manufacturers of joint sealants attesting that their products comply with specification requirements and are suitable for the use indicated.
   3. Compatibility and adhesion test reports from elastomeric sealant manufacturer indicating that materials forming joint substrates and joint sealant backings have been tested for compatibility and adhesion with joint sealants. Include sealant manufacturer's interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed to obtain adhesion.
   4. Product test reports for each type of joint sealants indicated, evidencing compliance with requirements specified.
   5. Preconstruction field test reports indicating which products and joint preparation methods demonstrate acceptable adhesion to joint substrates.

B. Submit pursuant to Section 016000 - Product Requirements.

C. Product Data for each different type of sealant to be used.
   1. Indicate specific location/situation the product will be used.

D. Samples for verification purposes of each type and color of joint sealant required and selected by the Architect. Install joint sealant samples in ½-inch wide joints formed between two six (6) inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

E. Provide cured sample of each Architect approved color sealant a minimum of thirty (30) days prior to installation.
   1. Samples for initial selection purposes in form of manufacturer's standard bead samples, consisting of strips of actual products showing full range of colors available, for each product exposed to view. THE SAME COLOR SEALANT WILL NOT BE USED THROUGHOUT THIS PROJECT.
   2. Sample of Bond Breaker Tape: 24-inch long section.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who had completed joint sealant applications similar in material, design, and extent to that indicated for Project that have resulted in construction with a record of successful in-service performance. Installer must be able to comply with warranty requirements.

B. Provide certification from sealant manufacturer signed by a corporate officer attesting that sealant products comply with Contract Documents.

C. Single Source Responsibility for Joint Sealant Materials: Obtain joint sealant materials from a single manufacturer for each different product required.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.07 PROJECT CONDITIONS

A. Environmental Conditions: Do not proceed with installation of joint sealants under the following conditions:
   1. When ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturer.
   2. When joint substrates are wet due to rain, frost, condensation or other causes.

B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than allowed by joint sealant manufacturer for application indicated.

C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

1.08 WARRANTY

A. Special Installer's Warranty: Installer's written warranty in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Two (2) years from the date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's written warranty 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 within specified warranty period.
   1. Warranty Period:
      a. Polyurethane Exterior Building Sealants: Five (5) years from the date of Substantial Completion.
      b. Silicone Exterior Building Sealants: Twenty (20) years from the date of Substantial Completion.
      c. Interior Building Sealants: Two (2) years from the date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
   1. Movement of the structure caused by 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 caused by individuals, tools, or other outside agents.
   4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 PRODUCTS

2.01 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

B. Colors: Provide color of exposed joint sealants to comply with the following:
   1. Provide selections made by Architect from manufacturer’s full range of standard colors for products of type indicated.

2.02 SPRAY FOAM SEALANT

A. One component, minimal expanding, low pressure build, flexible polyurethane foam sealant.
   1. GREAT STUFF PRO™ Window & Door Foam Sealant by Dow Building Solutions.
   2. Energy Complete Sealant by Owens Corning.
   3. Architect approved equivalent.

2.03 ENTRANCES, STOREFRONTS, WINDOWS, AND FLASHING

A. Sealant: BASF polyurethane, one-component (MasterSeal® NP1™) or two component (MasterSeal® NP2™) or Architect approved equivalent.

B. Standard: ASTM C920
   1. NP1™: Type S, Grade NS, Class 35.
   2. NP2™: Type M, Grade NS, Class 25

C. Colors:
1. To be selected by Architect from manufacturer's full range of colors.

2.04 MASONRY AND OTHER EXTERIOR LOCATIONS (AS SHOWN ON DRAWINGS AND ALL REQUIRED INCIDENTAL APPLICATIONS.)

A. Sealant: BASF polyurethane, two component (MasterSeal® NP2™) or Architect approved equivalent.

B. Standard: ASTM C920
1. Type M.
2. Grade NS
3. Class 25

C. Colors:
1. To be selected by Architect from manufacturer's full range of colors.

2.05 INTERIOR CONTROL AND EXPANSION JOINTS

A. Sealant: BASF polyurethane, one-component (MasterSeal® NP1™) or Architect approved equivalent.

B. Standard: ASTM C920.
1. Type: S.
2. Grade: NS.
3. Class: 35.

C. Colors:
1. To be selected by Architect from manufacturer's standard colors.

2.06 CONCRETE CONTROL AND EXPANSION JOINTS (INTERIOR AND EXTERIOR)

A. BASF Multi-Component Self-Leveling Elastomeric Polyurethane Sealant: (MasterSeal® SL2™) or Architect approved equivalent.
1. Standard: ASTM C920, Type M, Class 25, Grade P.
2. Color: Match concrete color.
3. Use slope grade where conditions warrant.

B. Hybrid Joint Sealant - Joints in excess of one inch in width
1. EMSEAL Joint Systems, Ltd., 25 Bridle Lane, Westborough, MA 01581, Phone: 800-526-8365.
a. DSM System watertight preformed joint filler.
b. Size: As shown on Contract Drawings.
c. Color: Gray.

2.07 INTERIOR MATERIAL AND NON-MOVING JOINTS

A. Sealant: siliconized acrylic - latex, non-sag one component.

B. Standard: ASTM C834.
1. Modulus @ 100% 15-20 psi
2. Ultimate tensile 30-40 psi.
3. Ultimate elongation 400%-500%

C. Colors:

1. To be selected by Architect from manufacturer’s full range of colors.

2.08 INTERIOR MILDEW RESISTANT JOINTS

A. Joint Locations:
   1. Joints between plumbing fixtures and adjoining walls, floors, and counters.
   2. Tile corner joints.
   3. Tile control and expansion joints where indicated.

B. Sealant: silicone, one component, fungicidal.

C. Standard: ASTM C920
   1. Type: S.
   2. Grade: NS.
   3. Class: 25.

D. Colors:
   1. To be selected by Architect from manufacturer’s full range of colors.

2.09 ACOUSTICAL JOINT SEALANTS

A. Acoustical Joint Sealant: Manufacturer's standard non-sag, paintable, non-staining latex sealant complying with ASTM C834. Product to effectively reduce airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E90.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Pecora Corporation; AC-20 FTR.
      b. Tremco Incorporated; Tremflex 834, Acoustical/Curtainwall Sealant.
      c. USG Corporation; SHEETROCK® Brand Acoustical Sealant.

2.10 SETTING BEDS FOR EXTERIOR WINDOW AND LOUVER SILLS AND EXTERIOR DOOR THRESHOLDS

A. Sealant: Butyl Rubber and/or Polyisobutylene Mastic Sealant (Tremco® Butyl Sealant or Architect Approved Equivalent).

B. Standard: ASTM C1311.

C. Color: Black unless any is exposed to view.

2.11 ACCESSORY COMPONENTS

A. General: Provide sealant backings of material and type that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Plastic Foam Joint Fillers: Preformed, compressible, resilient, non-staining, non-waxing, non-extruding strips of flexible plastic foam of material indicated below and of size, shape, and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Elastomeric Tubing Joint Fillers: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, capable of remaining resilient at temperatures down to -26deg F (-32 deg C). Provide products with low compression set and of size and

shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.

D. Bond-Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.12 MISCELLANEOUS MATERIALS

A. Primer: Provide sealant manufacturer's primer formulated for each sealant over each substrate surface. Omit only where specifically approved by sealant manufacturer for a specific sealant application over a specific substrate surface.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming in any way joint substrates and adjacent nonporous surfaces and formulated to promote optimum adhesion of sealants with joint substrates.

C. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint sealant performance. Do not proceed with installation of joint sealants until unsatisfactory conditions have been corrected.

B. Clean substrate surfaces around joint free of moisture, oil, dust, release agents, and materials harmful to sealant adhesion and cure.
   1. Clean concrete, masonry, unglazed surfaces of ceramic tile, and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.
   2. Remove laitance and form release agents from concrete.
   3. Clean metal, glass, porcelain enamel, glazed surfaces of ceramic tile, and other nonporous surfaces with chemical cleaners or other means that do not stain, harm surfaces, or leave residues capable of interfering with adhesion of joint sealants.

C. Execute joint preparation pursuant to sealant manufacturer's published instructions.
   1. Joint Priming: Prime joint substrates where indicated and where recommended by joint sealant manufacturer based on Preconstruction joint sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's recommendations. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.
   2. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.02 JOINT SUB-ASSEMBLY

A. Backer rod:
   1. Select size to result in a tight fit without excessive deformation to rod.
   2. Place continuously in joint by means of a roller or other tool approved by sealant manufacturer. Do not stretch rod.
   3. Replace rod that is damaged, ruptured, or torn.
   4. Place at a uniform depth pursuant to sealant manufacturer’s published instructions.

B. Bond breaker tape:
   1. Place continuously and to full dimension between sealant bond surfaces.
   2. Locate and install pursuant to sealant manufacturer’s published instructions.

3.03 PRIMER APPLICATION

A. Apply in a continuous, even application pursuant to sealant manufacturer’s published instructions.

3.04 SEALANT APPLICATION

A. Apply in an even, continuous application.

B. Avoid 3-sided joints. Use backer rod or bond breaker tape to create 2-sided joints pursuant to sealant manufacturer’s published instructions.

C. Avoid vee shaped joints. Use backer rod to bring width of joint back closer to width of joint front.

D. Apply to achieve a solid bond to both joint bond surfaces. Tool sealant surface concave.

E. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, 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. Install acoustical sealant behind edge molding of suspended acoustical ceilings. Install acoustical sealant at bulkheads of operable wall systems where shown on Contract Drawings.

F. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.05 HYBRID JOINT SEALANT INSTALLATION

A. Install EMSEAL DSM System pre-molded joint filler at locations shown on Contract Drawings. Install DSM System in accordance with manufacturer's instructions.

3.06 SEALANT INSTALLATION LOG

A. A tabular log of all sealant installations on the project shall be kept and submitted with Closeout Documents.

B. Tabular Log shall have columns for:
   1. Sealant Type
   2. Sealant Installation Location
   3. Temperature during installation

4. Date of Installation
5. Manufacturer including specific type
6. Sealant Color installed
7. Comments (provide comments if applicable)

3.07 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so that repaired areas are indistinguishable from original work.

**END OF SECTION 079200**

**PAGE INTENTIONALLY BLANK**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section references specification sections relating to commercial door hardware for the following:
   1. Swinging doors.
   2. Sliding Doors.
   3. Other doors to the extent indicated.

B. Commercial door hardware includes, but is not necessarily limited to, the following:
   1. Mechanical door hardware.
   2. Electromechanical and access control door hardware.
   3. Electromechanical and access control door hardware power supplies, back-ups and surge protection.
   4. Automatic operators.
   5. Cylinders specified for doors in other sections.

C. Related Sections:
   1. Division 08 Section “Door Hardware”.
   2. Division 28 Section “Access Control Hardware Devices”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
   1. ICC A117.1 - Accessible and Usable Buildings and Facilities.
   2. ICC/IBC - International Building Code.
   3. NFPA 70 - National Electrical Code.
   4. NFPA 80 - Fire Doors and Windows.
   5. NFPA 101 - Life Safety Code.
   6. NFPA 105 - Installation of Smoke Door Assemblies.
   7. State Building Codes, Local Amendments.

E. Standards: Reference Related Sections for requirements regarding compliance with applicable industry standards.

1.03 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
3. Content: Include the following information:
   a. Type, style, function, size, label, hand, and finish of each door hardware item.
   b. Manufacturer of each item.
   c. Fastenings and other pertinent information.
   d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
   e. Explanation of abbreviations, symbols, and codes contained in schedule.
   f. Mounting locations for door hardware.
   g. Door and frame sizes and materials.
4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Keying Schedule: Prepared under the supervision of the Owner, separate schedule detailing final keying instructions for locksets and cylinders in writing. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner to approve submitted keying schedule prior to the ordering of permanent cylinders.

D. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

E. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact information of the manufacturers providing the hardware and their nearest service representatives. The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.

F. Warranties and Maintenance: Special warranties and maintenance agreements specified in the Related Sections.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.05 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

1.06 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.01 SCHEDULED DOOR HARDWARE

A. Refer to “PART 3 – EXECUTION” for required specification sections.

PART 3 - EXECUTION

3.01 DOOR HARDWARE SETS

A. The door hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
   1. Quantities listed are for each pair of doors, or for each single door.
   2. The supplier is responsible for handing and sizing all products.
   3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
   4. At existing openings with new hardware, the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Products listed in the hardware sets shall be supplied by and in accordance with the requirements described in the specification section as noted for each item.
   1. Section 087100 – Door Hardware.

C. Manufacturer's Abbreviations:

1. MK - McKinney
2. PE - Pemko
3. RO - Rockwood
4. RU - Corbin Russwin
5. SC - Schlage
6. RF - Rixson
7. SU - Securitron
8. SA - SARGENT

## Hardware Sets

### Set: 1.0

Doors: 102A, 102B, 104A, 112B, 113

| | | | | |
|---|---|---|---|---|
| 1 Continuous Hinge | FM__HD1 PT | C | PE | 087100 |
| 1 Access Control Rim Exit | ED5200N N9605ET-SELP10 BIPS B03 | 630 | RU | 281500 ⚡ |
| 1 Cylinder | as required | 626 | RU | 087100 |
| 1 Permanent Core | Compatible with Facility's Existing System | 626 | SC | 087100 |
| 1 Surface Closer | DC6210 A11 | 689 | RU | 087100 |
| 1 Threshold | to architect detail | | PE | 087100 |
| 1 Sweep | 18061CNB | | PE | 087100 |
| 1 ElectroLynx Harness - Frame | QC-C1500P | | MK | 087100 ⚡ |
| 1 ElectroLynx Harness - Door | QC-CXXX (Size as Required) | | MK | 087100 ⚡ |
| 1 Electric Power Transfer | EL-CEPT | | SU | 087100 ⚡ |
| 1 Wiring Diagram | WD-SYSPK | | SA | 087100 |
| 1 Power Supply | AQL Series (Amps & Relays as Required) | | SU | 087100 ⚡ |

Notes: Door closed & locked at all times. Presenting valid credential outside shunts integrated door position switches & allows for authorized entrance. Operating inside trim activates request to exit switch in lock shunting integrated door position switch and allowing authorized egress at all times. With loss of power or activation of building fire system door remains locked.

### Set: 2.0

NOT USED

### Set: 3.0

NOT USED

**Set: 4.0**

Doors: 104B, 107, 201, 114

| | | | | |
|---|---|---|---|---|
| 3 Hinge, Full Mortise | TA2714 | US26D | MK | 087100 |
| 1 Rim Exit Device, Passage | ED5200 N910ET | 630 | RU | 087100 |
| 1 Surface Closer | DC6200 / DC6210 | 689 | RU | 087100 |
| 1 Door Stop | 400 / 441H | US26D | RO | 087100 |
| 3 Silencer | 608 | | RO | 087100 |

**Set: 5.0**

Doors: 202

| | | | | |
|---|---|---|---|---|
| 6 Hinge, Full Mortise | TA2714 | US26D | MK | 087100 |
| 1 Dust Proof Strike | 570 | US26D | RO | 087100 |
| 2 Flush Bolt | 555 | US26D | RO | 087100 |
| 1 Storeroom Lock | CL3357 NZD M69 | 626 | RU | 087100 |
| 2 Permanent Core | Compatible with Facility's Existing System | 626 | SC | 087100 |
| 2 Door Stop | 400 / 441H | US26D | RO | 087100 |
| 2 Silencer | 608 | | RO | 087100 |

**Set: 6.0**

Doors: M02

| | | | | |
|---|---|---|---|---|
| 6 Hinge, Full Mortise | TA2714 | US26D | MK | 087100 |
| 1 Dust Proof Strike | 570 | US26D | RO | 087100 |
| 2 Flush Bolt | 555 | US26D | RO | 087100 |
| 1 Storeroom Lock | CL3357 NZD M69 | 626 | RU | 087100 |
| 1 Permanent Core | Compatible with Facility's Existing System | 626 | SC | 087100 |
| 2 Conc Overhead Stop | 1-X36 | 630 | RF | 087100 |
| 2 Silencer | 608 | | RO | 087100 |

**Set: 7.0**

Doors: M01

| | | | | |
|---|---|---|---|---|
| 3 Hinge, Full Mortise | TA2714 | US26D | MK | 087100 |
| 1 Storeroom Lock | CL3357 NZD M69 | 626 | RU | 087100 |
| 1 Permanent Core | Compatible with Facility's Existing System | 626 | SC | 087100 |
| 1 Door Stop | 400 / 441H | US26D | RO | 087100 |
| 3 Silencer | 608 | | RO | 087100 |

**Set: 8.0**

Doors: 103A, 103B

| | | | | |
|---|---|---|---|---|
| 3 Hinge, Full Mortise | TA2714 | US26D | MK | 087100 |
| 1 Entrance Lock | CL3351 NZD M69 | 626 | RU | 087100 |
| 1 Permanent Core | Compatible with Facility's Existing System | 626 | SC | 087100 |
| 1 Door Stop | 400 / 441H | US26D | RO | 087100 |
| 3 Silencer | 608 | | RO | 087100 |

**Set: 9.0**

Doors: 109, 110

| | | | | |
|---|---|---|---|---|
| 3 Hinge, Full Mortise | TA2714 | US26D | MK | 087100 |
| 1 Privacy Lock | CL3320 NZD | 626 | RU | 087100 |
| 1 Door Stop | 400 / 441H | US26D | RO | 087100 |
| 3 Silencer | 608 | | RO | 087100 |

**Set: 10.0**

Doors: 108

| | | | | |
|---|---|---|---|---|
| 6 Hinge, Full Mortise | TA2714 | US26D | MK | 087100 |
| 1 Dust Proof Strike | 570 | US26D | RO | 087100 |
| 2 Flush Bolt | 555 | US26D | RO | 087100 |
| 1 Passage Latch | CL3310 NZD | 626 | RU | 087100 |
| 2 Conc Overhead Stop | 1-X36 | 630 | RF | 087100 |
| 1 Surface Closer | DC6200 / DC6210 | 689 | RU | 087100 |
| 2 Silencer | 608 | | RO | 087100 |

**Set: 11.0**

Doors: 105

| | | | | |
|---|---|---|---|---|
| 3 Hinge, Full Mortise | TA2714 | US26D | MK | 087100 |
| 1 Passage Latch | CL3310 NZD | 626 | RU | 087100 |
| 1 Conc Overhead Stop | 1-X36 | 630 | RF | 087100 |
| 3 Silencer | 608 | | RO | 087100 |
| 1 Threshold | as per architect detail | | PE | 087100 |
| 1 Gasketing | S773BL | | PE | 087100 |

**Set: 12.0**

Doors: 111, 112A

| | | | | |
|---|---|---|---|---|
| 3 Hinge, Full Mortise | TA2714 | US26D | MK | 087100 |
| 1 Passage Latch | CL3310 NZD | 626 | RU | 087100 |
| 1 Conc Overhead Stop | 1-X36 | 630 | RF | 087100 |
| 1 Surface Closer | DC6200 / DC6210 | 689 | RU | 087100 |
| 3 Silencer | 608 | | RO | 087100 |

**Set: 13.0**

Doors: 101A, 101B, 101C, 101D, 101E, 101F, 101G, 101H, 101J, 101K

| | | | | |
|---|---|---|---|---|
| 1 Cylinder | as required | 626 | RU | 087100 |
| 1 Permanent Core | Compatible with Facility's Existing System | 626 | SC | 087100 |

Notes: Balance of hardware by assembly supplier.

END OF SECTION

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This Section includes the following products manufactured in accordance with Steel Door Institute (SDI) Recommended Standards:
   1. Doors: Flush, hollow or composite construction standard steel doors for interior and exterior locations.
   2. Frames: Pressed steel frames for doors, transoms, sidelights, mullions, interior glazed panels, and other interior and exterior openings of the following type:
      a. Welded unit type.
      b. Thermally broken, welded type at all exterior locations.
      c. Kerfed Frames at interior locations where indicated on Contract Drawings.
   3. Assemblies: Provide standard steel door and frame assemblies as required for the following:
      a. Labeled and fire-rated.
      b. Thermal rated (insulated).
   4. Provide factory primed doors and frames to be field painted.

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Section 080671 - Door Hardware Schedule.
   2. Section 087100 - Door Hardware.
   3. Section 088000 - Glazing.
   4. Section 099100 - Painting.

1.03 STANDARDS

A. All work of this section shall conform to industry standards and/or manufacturer’s recommendations.

B. ANSI/SDI A250.8 "Specifications for Standard Steel Doors and Frames".

C. ANSI/SDI A250.10 "Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames".

D. ANSI/SDI A250.6 "Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames".

E. NFPA 80 "Standard for Fire Doors and Opening Protectives".

1.04 SUBMITTALS

A. Submit pursuant to Section 013300 - Submittal Procedures.

B. Submit pursuant to Section 016000 - Product Requirements.

C. Shop drawings showing dimensions, materials, adjacent wall construction, accessories and all other information needed for a complete system.
   1. Provide schedule of doors and frames using same reference numbers for details and openings as those on the Contract Drawings.

2. Indicate coordination of glazing frames and stops with glass and glazing requirements.

D. Label Construction Certification: For door assemblies required to be fire-rated and exceeding limitations of labeled assemblies, submit manufacturer's certification that each door and frame assembly has been constructed to conform to design, materials and construction equivalent to requirements for labeled construction.

1.05 QUALITY ASSURANCE

A. Provide doors and frames complying with Steel Door Institute "Specifications Standard Steel Doors and Frames" ANSI/SDI A250.8 (SDI-100) latest edition and as herein specified.

B. Membership in good standing in the Steel Door Institute is required. Architect reserves the right to require proof of membership prior to accepting any items described by or related to this Section.

C. Fire-Rated Door Assemblies: Units that comply with NFPA 80, are identical to door and frame assemblies whose fire resistance characteristics have been determined per ASTM E 152 and which are labeled and listed by UL, Factory Mutual, Warnock Hersey, or other testing and inspecting organization acceptable to authorities having jurisdiction.

D. Hot-Rolled Steel Sheets and Strips: Commercial-quality carbon steel, pickled and oiled, complying with ASTM A 569 (ASTM A 569M), free of scale, pitting, or surface defects.

1.06 DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturers published instructions.

B. Deliver, handle, and store doors, and frames at job site in such a manner as to prevent damage.

C. Inspect doors and frames upon delivery for damage. Minor damages may be repaired provided refinished items are equal in all respects to new work and acceptable to Architect; otherwise, remove and replace damaged items as directed.

D. Protect against moisture exposure and damage. Store doors and frames at building site under cover.

E. Store doors, and frames in a vertical position on blocking, clear of floor and with blocking between doors to permit air circulation between doors.

F. Carefully protect frames from twisting or racking and preserve the integrity of spreader bars.

G. Immediately remove from job site all damaged or otherwise unsuitable door, and frame.

1.07 PROJECT CONDITIONS

A. Field Measurements: Verify openings by field measurements before fabrication and indicate measurements on Shop Drawings.
   1. Establish Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating hollow metal frames without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

1.08 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts and items with integral anchors. Deliver such items to Project site in time for installation.

1.09 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering standard steel doors and frames which may be incorporated in the Work, but are not limited to, the following:
   1. Amweld Building Products, LLC
   2. Ceco Door Products; an ASSA ABLOY Group Company
   3. Curries Company; an ASSA ABLOY Group Company
   4. Fleming Door Products Ltd; an ASSA ABLOY Group Company
   5. Republic Doors & Frames, an Allegion PLC Company
   6. Steelcraft; an Allegion PLC Company

2.02 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 metallic coating, mill phosphatized.

D. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z coating designation; mill phosphatized.
   1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011 M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

F. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.

G. Grout: Comply with requirements for grout in Division 03 Section "Grout".

H. Glazing: Furnished and installed by Division 08 Section "Glazing".

2.03 FINISH

A. All Steel Doors and Frames shall be factory prepped.
   1. Galvanize pursuant to ASTM A653, Grade A60 or G60; to ASTM A591, Class A.
   2. Clean, phosphate treat, and paint with a rust inhibitive primer pursuant to ANSI A224.1, applied after fabrication.
   3. Reinforcements for galvannealed frames are to be galvannealed.

2.04 FABRICATION

A. Fabricate steel door and frame units to be rigid, neat in appearance and free from defects, warp or buckle. Wherever practicable, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory-assembled before shipment, to assure proper assembly at Project site. Comply with ANSI/SDI-100 requirements.

2.05 HARDWARE

A. Factory prepare all doors, and frames for hardware pursuant to ANSI A115; ANSI A151; SDI 107; and SDI 111-E. See Door Schedule, Section 080671 - Door Hardware Schedule and Section 087100 - Door Hardware.

B. Hardware Preparation: Prepare doors and frames to receive mortised and concealed hardware in accordance with final Door Hardware Schedule and templates provided by hardware supplier. Comply with applicable requirements of ANSI A115 Series Specification for door and frame preparation for hardware.

C. Locate hardware as indicated on final shop drawings or, if not indicated, in accordance with "Recommended Locations for Builder's Hardware on Standard Steel Doors and Frames," published by Door and Hardware Institute.

D. Coordinate locations of conduits and wiring boxes for electrical connections with Electrical Contractor and Owner's Access Control Contractor.

2.06 INSULATED DOORS:

A. Grade I, Standard Duty, 1-3/4 in. thick.

B. Full flush-composite.

C. Exterior Door Core: Polyurethane with a U-Factor = 0.09, R-Factor = 11.1.

D. Interior Door Core: Polystyrene.

E. Door Edge Construction: Seamless Edge, epoxy filled and finished.

F. Metal thickness: 18 gauge
   1. Construction, and galvanized finish: Pursuant to SDI - 100.

G. Lites/Glazing stops
   1. Fabricate and install pursuant to SDI - 100.
   2. Material: 20-gauge steel.
   3. Corner construction: Mitered.
   4. Fastening to door: Non-removable steel stops on the outside of exterior door, screws interior of door.

H. Doors between “living side” and apparatus bay(s) shall be provided with high frequency hinge reinforcement on the top hinge.
   1. 10 gage auxiliary hinge reinforcement spot welded to the top and bottom of the top hinge reinforcement in two locations of the door.

I. Top and Bottom Edges: Closed with inverted 14-gauge welded channels.
   1. Top edges closed with 24 gauge galvannealed top caps. Seal top caps in field with caulk prior to painting.
   2. Bottom channels of all insulated doors to be provided with concealed double sealing sweeps equivalent to Steelcraft FAS-SEAL™.

2.07 INTERIOR DOORS:

A. Grade: I, Standard Duty, 1-3/4 in. thick.
   1. Class/rating per drawings - UL approved

B. Full flush-hollow steel.

C. Core: Mineral fiberboard.

D. Door Edge Construction: Seamless Edge, No visible edge seam.

E. Metal thickness: 18 gauge
   1. Construction, and galvanized finish: Pursuant to SDI - 100.

F. Lites/Glazing stops
   1. Fabricate and install pursuant to SDI - 100.
   2. Material: 20-gauge steel.
   3. Corner construction: Mitered.
   4. Fastening to door: Screws.

G. Top and Bottom Edges: Closed with inverted 14-gauge welded channels.
   1. Bottom channels of all rated and smoke tight doors to be provided with concealed double sealing sweeps equivalent to Steelcraft FAS-SEAL™.

H. Louvers
   1. 1” Thick
   2. Inverted “Y” blade type
   3. Free air space to be 50% of louver area.
   4. Provide fusible link, fire rated louvers in rated doors with louvers.

I. Doors for fire rated openings:
   1. Provide labeled doors with fire rating per door schedule.

2.08 FRAMES

A. Provide frames in following types:
   1. Height: 84” frame with 2” head for all stud openings.
   2. Height: 84” frame with 4” head for all masonry openings unless noted otherwise.
   3. Welded construction at all locations.
   4. All exterior door frames shall be thermally broken.
   5. Interior doorframes where indicated on Door Schedule to have integral 1/8” kerf for weatherstripping.

6. Frames for doors with electric strikes shall have 4 7/8” strike reinforcement with mud box containing an electrical knock out.
7. Frames for doors scheduled to have door closers, provide full closer sleeve reinforcement.
8. High Frequency Hinge Reinforcement: Door frames between “Living Side” and apparatus bay(s) shall be provided with high frequency hinge reinforcements at top hinge locations.
9. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section “Door Hardware Schedule”.
10. Provide either factory or distributor installed frame back coating (waterborne asphaltic emulsion coating) or field applied primer as indicated in paragraphs 3.01 B 2. and 3.01 B 3 of this section.

B. Frames for fire rated openings:
   1. Provide frames with same hourly rating as door opening.

C. Exterior opening metal thickness:
   1. Grade I: 16 gauge.

D. Interior opening metal thickness:
   1. Grade I: 16 gauge.

2.09 ACCESSORIES

A. Grout Guards
   1. Formed from same material as frames, not less than 0.016 inch thick.
   2. Weld guards to frame at back of hardware mortises in frames to be grouted.

PART 3 EXECUTION

3.01 INSTALLATION

A. General: Install standard steel doors, frames, and accessories in accordance with final approved shop drawings, manufacturer’s data, and as herein specified.

B. Frame Back Painting:
   1. If factory or distributor back coating is furnished touch-up areas of the frame with back coating to cover any bare or primer metal on the inside of the frame. If not factory or distributor back coated, comply with paragraphs 2 and 3.
   2. All metal doorframes to be installed in masonry and exterior walls shall have all hidden surfaces field painted with an additional coat of primer prior to installation. See Section 099100 - Painting.
   3. All metal door frames to be installed in interior non-masonry walls shall have all hidden surfaces field painted with an additional coat of primer from floor level to 48-inches above finish floor prior to installation. See Section 099100 - Painting.

C. Placing Frames: Comply with provisions of SDI-119 and SDI-105 “Recommended Erection Instructions for Steel Frames”, unless otherwise indicated.
   1. Erect frames plumb, level, and square; free of racking, warping, or bowing; for effort-free door operation and without gravity-imposed movement upon door anywhere within door swing.
   2. Except for frames located at existing concrete, masonry or drywall installations, place frames prior to construction of enclosing walls and ceilings. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders leaving surfaces

smooth and undamaged. If screws and/or expansion anchors are required, frames shall be dimpled, and countersunk fasteners utilized.

3. In masonry construction, locate three (3) wall anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Acceptable anchors include masonry wire anchors and masonry Tee anchors.
4. In metal stud partitions, install at least three (3) wall anchors per jamb at hinge and strike levels. Two anchors per head for frames above 42 inches wide and mounted in metal-stud partitions. In closed steel stud partitions, attach wall anchors to studs with screws.
5. Install fire-rated frames in accordance with NFPA Standard No. 80.

D. Door Installation: Fit hollow metal doors accurately in frames, within clearances specified in ANSI/SDI-100.
   1. Install fire-rated doors with clearances as specified in NFPA Standard No. 80.

3.02 ADJUST AND CLEAN

A. Prime Coat Touch-up: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer, providing for a continuous unbroken primer coating.

B. Cover countersunk exposed screw heads with epoxy metal filler. Finish smooth and level with frame.

C. Finish Paint per Section 099100 - Painting.

D. Protection Removal: Immediately prior to final inspection, remove protective plastic wrappings from prefinished doors.

E. Final Adjustments: Check and readjust operating hardware items, leaving steel doors and frames undamaged and in complete proper operating condition. Shims used for alignment purposes must be inserted between hinge and frame. Do not insert shims between hinge and door. Shims shall not be visible.

**END OF SECTION 081113**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Specifications, apply to work of this Section.

B. Section 033000 - Cast-In-Place Concrete

C. Section 042200 - Concrete Unit Masonry

D. Section 092116 - Gypsum Board Assemblies

E. Section 099100 - Painting.

1.02 SUBMITTALS

A. Submit pursuant to Section 013300 - Submittal Procedures.

B. Submit pursuant to Section 016000 - Product Requirements.

C. Product Data: For each type of access door.
   1. Include construction details, fire ratings, insulation information, material descriptions, dimensions of individual components and profiles, attachment methods, and finishes.

1.03 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Fire Rated Access Doors For Walls: Complete assemblies complying with Underwriter's Laboratories, Inc (UL) requirements for 1-1/2 hour "B Label" rating. Identify each assembly with UL label.
   2. Fire Rated Access Doors For Ceilings: Complete assemblies complying with Warnock Hersey (WHI) requirements for one-hour rating in wood-framed assemblies and three-hour rating in non-combustible assemblies. Identify each assembly with WHI label and NFPA requirement indicating "For Horizontal Installation".

PART 2 PRODUCTS

2.01 ALL ACCESS DOORS

A. Doors in insulated assemblies must be insulated and weatherstripped.

B. Doors in wet locations are to be Stainless Steel, U.N.O.

2.02 NON-FIRE RATED ACCESS DOORS FOR WALLS AND CEILINGS

A. Frames: Minimum 16 gage steel.
   1. Flange: Integral exposed flange not less than 3/4-inch wide around the perimeter.
      a. Plaster Applications: Expanded metal lath and exposed casing bead welded to perimeter of frame, in place of integral exposed flange.
      b. Acoustical Tile Applications: Frames without exposed flange.
   2. Finish: Match door panel.
   3. Anchorage, Except for New Concrete or Masonry Construction: Predrilled holes in frame for anchoring with fasteners.
   4. Anchorage for New Concrete or Masonry Construction: Adjustable metal masonry anchors.

B. Door Panel: Flush type, minimum 14 gage steel.
   1. Hinges: Concealed type set to open a minimum of 135 degrees; continuous type, or sufficient number to support the door size.
   2. Finish: Factory-applied rust inhibitive baked enamel or primer over phosphate treated steel.

C. Door Panel: Recessed type, minimum 18 gage steel with face of panel formed to provide a 1 inch recessed surface for application of finish material, and reinforced as required to prevent buckling.
   1. Hinge: Continuous type hinge.
   2. Finish: Factory-applied rust-inhibitive baked enamel or primer over phosphate treated steel.
   3. Plaster Applications: Self-furring 3.4 lb. per sq. yd. galvanized expanded metal mesh welded to panel face and casing bead welded to perimeter of panel.

D. Cam Locks: Flush, screwdriver operated; sufficient number to hold door panel in flush, smooth plane when closed.

E. Sleeves (For Recessed Type Door Panels): One for each locking device.
   1. Plaster Ceilings: Integral steel sleeves welded to panel face with plastic grommet on exposed end.
   2. Acoustic Tile or Gypsum Board Ceilings: Plastic grommets for installation in holes cut thru ceiling finish material.

2.03 FIRE RATED ACCESS DOORS FOR WALLS AND CEILINGS

A. Frames: Minimum 16 gage steel, with integral exposed flange not less than one inch wide around the perimeter.
   1. Anchorage, Except for New Concrete or Masonry Construction: Predrilled holes in frame for anchoring with fasteners.
   2. Anchorage for New Concrete or Masonry Construction: Adjustable metal masonry anchors.

B. Door Panel: Flush type, minimum 20 gage steel double wall construction with insulation, equipped with automatic closer and inside release mechanism.
   1. Hinge: Concealed pin hinge or continuous hinge set to open to approximately 100 degrees.

C. Finish: Factory-applied baked enamel or primer over phosphate treated steel.

D. Automatic Latches: Direct action knurled knob or turn ring operated; sufficient number to hold door panel in flush, smooth plane when closed. Equip each latch with inside release device.

2.04 FABRICATION

A. Assemble access doors as integral units complete with all parts and ready for installation. Fabricate units of continuous welded steel construction unless otherwise indicated or specified. Grind welds smooth and flush with adjacent surfaces. Anchorage devices shall be of size and type required to secure access doors to types of supports indicated on the Drawings.
   1. Allowable Size Variations: Manufacturer's standard size units that vary slightly from the sizes indicated may be acceptable, subject to the approval of the Director.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Install the access doors in accordance with the manufacturer's printed installation instructions, except as shown or specified otherwise.

B. Coordinate access door installation with installation of supporting construction.

C. Set units accurately in position and securely attach to supports with face panel plumb or level in relation to adjoining finish surface.

D. Install access doors in location as shown on the drawings or location determine by the Architect.

### 3.02 ADJUSTING

A. Adjust hardware and doors for proper operation.

### 3.03 SCHEDULE

A. Provide non-fire rated access doors in non-fire rated construction fire rated access doors in fire rated construction and insulated access doors in insulated walls and ceilings.

**END OF SECTION 083113**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

B. Division 26 - Electric.

1.02 SUMMARY

A. Furnish and install new commercial, sectional overhead doors, operators, controls and wiring from individual door operators to door motors as shown on the Contract Drawings. Provide additional open/close/stop push button controls for each front door in Radio Room and adjacent to Apparatus Man Doors.

B. Wiring and conduits from each overhead door to Radio Room or other remote locations are the responsibility of the Electrical Contractor.

C. Connection to other systems is the responsibility of the Electrical Contractor.

1.03 STANDARDS

A. All work of this section shall conform to industry standards and/or manufacturer’s recommendations.

B. ASTM A924 "Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process".

C. ASTM A653 "Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process".

D. ANSI/DASMA 102 - “American National Standard Specifications for Sectional Overhead Type Doors”.

E. ANSI/DASMA 105 - “Test Method for Thermal Transmittance and Air Filtration of Garage Doors”.

1.04 SUBMITTALS

A. Pursuant to Section 013300 - Submittal Procedures.

B. Pursuant to Section 016000 - Product Requirements

C. Product Data: Submit installation, operating and maintenance instructions.

D. Shop Drawings: Submit shop drawings which show compliance with specified qualities and the way sectional overhead doors fit in with and are fastened to rest of the Work including interface with power systems. Provide shop drawings indicating track details, head and jamb conditions, spring shafts, anchorage, accessories, finish colors, operator mounts, remote operator specifications and other related information.

E. Manufacturer’s Certificates: Certify products meet or exceed specified requirements.

F. Door Installer: Submit qualifications of door installer.

1.05 QUALITY ASSURANCE

A. Experienced workers familiar with the work and according to manufacturer's recommendations and/or industry standards shall perform all work of this section.

B. Door Installer must be an authorized distributor of the manufacturer of the doors and openers with a minimum of five (5) years documented experience, to be assured of accessibility to parts, updated product changes, recalls and warranty claims. Door installer must offer 24/7 emergency service and be located within 60 miles of the project.

C. Operator manufacturer must be the same manufacturer as door manufacturer to eliminate any questions or problems with warranty claims.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturers published instructions.

B. Protect against moisture exposure and damage.

1.07 WARRANTY

A. Warranty: 1-year limited warranty. Component parts to be free from defects in material and workmanship for a period of one year from date of substantial completion. Door shall be free from delamination of the insulation to the skins for ten (10) years from installation date.

PART 2 PRODUCTS

2.01 OVERHEAD DOORS

A. Doors shall be steel sectional insulated overhead, with lites as shown on the Contract Drawings. Overhead doors shall be as manufactured by:
   1. Thermaseal® Series, Model TM300 as manufactured by Raynor Garage Doors, 1101 East River Road, Dixon, IL 61021, Phone 800-472-9667. Basis of Specification
   2. Thermacore AP, Model 850 as manufactured by Overhead Door Corp., 2501 S. State Hwy. 121, Suite 200, Lewisville, TX 75067, Phone 800-275-3290.

B. DOOR SECTIONS
   1. Doors consisting of sections to be 3" thick roll formed from commercial quality hot dipped galvanized (G40 exterior) steel complying with ASTM A-653. Door sections constructed of 26 gauge (exclusive of finish) interior and exterior skins.
   2. Interior and exterior skins to be mechanically interlocked and pressure bonded to an expanded polyurethane foam core with a minimum R-value of 24.54.
   3. Interior and exterior skins to be separated by a continuous dual durometer vinyl extrusion to form an effective thermal break and a complete weather-tight seal along section joint.
   4. Thermal break extrusion to be held in place by means of mechanical interlock.
   5. End stiles to be minimum 16 gauge separated from exterior skin with a thermal break.
   6. Hinge reinforcement strips shall be 20-gauge galvanized steel.

C. FINISH
   1. Exterior door skin pre-coated prior to roll forming with an epoxy primer. Provide two coats baked on polyester finish or Kynar finish as selected by Architect.
   2. Surface Texture: Stucco embossed and pencil groove exterior and interior.

D. COLOR

1. Color to be selected by the Architect from manufacturer's full range of colors including Kynar finish colors.

E. WEATHERSTRIPPING
1. Door to be fully weather-stripped (extreme weather condition type) to reduce air infiltration. Top of door with EPDM rubber sealing strips.
2. Bottom of door to have flexible U shaped black ribbed EPDM seal encased in extruded aluminum retainer to conform to irregularities in floor. Bottom seal must be encased in aluminum retainer, not screwed into bottom section. Jamb seal to be EPDM rubber blade type attached to track angle mounting with rigid vinyl snap on extrusion.
3. Weather-stripping to be replaceable without removal of track, angle mounting, or door hardware. . No air leakage shall be detected between section joints when tested in accordance with ASTM E-283.
4. Provide IECC (International Energy Conservation Code) compliant Overhead Doors.
   a. Air Infiltration: 25mph/1.57psf - 0.18cfm/sq.ft.

F. TRACKS
1. Hot dipped galvanized 12-gauge track per ASTM A-653, 3". Tracks to have graduated seal for weathertight closing.
2. See Contract Drawings for track profile and heights.
3. Tracks to be continuous angle mounted and fully adjustable for sealing door to jamb. Continuous angle mount to be not less than 11-gauge steel angle, 2-5/16" x 5" for 3-inch track. Horizontal track to be adequately reinforced with continuous angle.
4. Hanger Angle: 11-gauge

G. TRACK STOPS
1. Provide manufacturers standard stop at the end of the overhead door track.

H. HARDWARE
1. Provide full, heavy duty (11gauge) hinges and brackets made from galvanized steel.
2. Provide 3" diameter, heavy duty track rollers with ten (10) hardened steel ball bearings.

I. SPRING COUNTERBALANCE
1. Heavy Duty oil tempered wire torsion springs on continuous solid, ball bearing cross header shaft. Galvanized aircraft type lifting cables w/minimum safety factor of 5 to 1. 50,000 Cycle springs for extended spring life.

J. WINDLOAD
1. Windload to withstand 20 lb. per sq. ft. Deflection of door in horizontal position to be a maximum 1/120th of door width.

K. GLAZING
1. Full View Lites of maximum allowable width consisting of extruded PVC lite frames, color matched to door exterior with thermal break.
2. Glazing: 5/8" insulated, low-E glass.
3. Configuration of Lites as shown on Drawings.

L. THERMAL CONDUCTIVITY
1. When calculated in accordance with ASTM C-518 the door must test for the following energy values. Minimum R-Value = 24.54 (U Value = 0.040). Insulation must not be manufactured with nor contain chlorofluorocarbons (CFC) which are known to have harmful effects on the earth's ozone layer and the environment.

M. ELECTRIC OPERATORS

1. Operator shall be Raynor Control Hoist Optima, 1/2 HP (continuous), single-phase garage door operators, industrial duty, belt-drive, jackshaft with manual chain hoist, auxiliary contact type-SR-2 wiring-pneumatic safety edge, reversing equipment.
2. Motor; provide continuous duty motor. Motor shall be separate from reduction mechanism for ease of maintenance.
3. Reduction: Furnish V-belt drive from motor to full ball bearing power train with additional reduction by chain and sprockets. All power train shafts shall be a minimum 3/4" diameter.
4. Roller Chain Drive - door shall be driven by roller chain at 6" to 12" per second.
5. Adjustable Friction Clutch shall be provided to protect door and operator if door movement is obstructed.
6. Starter - Reversing Contactor type (Type RGJH). Furnish heavy duty across the line reversing type with mechanical interlock.
7. Limit switches - provide positive chain drive screw type limit switch, enclosed in electrical control box, easily accessible for precision setting. Limit switches will remain in time when emergency chain hoist is used and door is operated manually.
8. Provide auxiliary output module with the capability to integrate with other devices including:
   a. Dry relay contacts at door limit positions.
   b. Lamp output contacts.
   c. Selectable ADA outputs to sound a horn or run a flashing light.
   d. Multiple relay contact points.
9. Provide Model #022160 NEMA-4 Pushbuttons - Surface mounted at each overhead door..

N. CONTROL WIRING
1. Provide long distance module. Control wiring shall be 24 volts for safety.
2. Three button (open-close-stop) to be installed at each door. Provide SR2 Three button momentary contact on open-close-stop. Open override feature. Open button, photo eye and pneumatic safety edge will reverse door to open position when door is closing. Doors to be equipped with pneumatic safety edge for protection against damage to door on contact of object.
3. Provide additional individual, three button (open-close-stop) to be installed in the Radio Room to operate each individual front overhead door. Provide Model #300320 RC Operator Pushbuttons - Flush Mounted in the Radio Room. Flush mounted overhead door switches can not be installed in gang boxes.
4. Provide additional individual, three button (open/close/stop) surface mounted adjacent to Man Door #102B to operate each rear overhead door.
5. Provide additional individual, three button (open/close/stop) surface mounted adjacent to Man Door #102A to operate each front overhead door.
6. Provide heavy duty through-beam car wash (NEMA 4X rated) photoelectric reversing system for each door to reverse door’s downward path if visible beam is broken. Photo-eye to utilize interference reduction technology.
7. Overload Protection - Provide manual reset for over load protection. All electrical components shall be in NEMA 1 enclosure. Horsepower of Motor to be of manufacturers standards based on the size and weight of the door.
8. Emergency operation - Supply a chain hoist that may be engaged from the floor for mechanical operation. An electric interlock disconnects power when the chain hoist is engaged.
9. Magnetic Brake - furnish magnetic solenoid brake for positive stop.

O. RECEIVERS AND TRANSMITTERS
1. Provide individual receivers to operate each overhead door.
2. Provide four channel, four button transmitters to operate overhead doors shown on the Drawings. Total quantity of transmitters shall be equal to number of overhead doors plus two (2).

PART 3 EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Examine existing conditions in Work before installing doors. In the Record Documents, list unsatisfactory conditions and steps taken to correct them.

B. Correct unsatisfactory conditions before installing doors. Beginning installation shall mean acceptance of related work and corrected existing conditions by installer and Contractor.

3.02 INSTALLATION

A. General: Install door, track and operating equipment complete with all necessary accessories and hardware according to shop drawings and manufacturer's instructions.

B. Coordinate with Electrical Contractor to connect door controls and operating devices to other building systems such as power systems.

C. Select, identify, and locate controls so that safety of users and protection of property and vehicles is ensured.

D. Provide inserts, anchors, hangers, brackets, moldings, seal strips, and welding as needed to make door assembly secure against air pressure, operating loads and intrusion, and so that air infiltration is held to minimum. Conceal bolt heads so that access cannot be made from outside.

E. Securely brace door tracks suspended from structure. Secure tracks to structural members only.

F. Completely remove from all components bar codes, visible markings and shipping labels. Clean away all residues from tags and stickers. Clean installed products in accordance with manufacturer's instructions prior to substantial completion.

G. Lubricate bearings, rollers and sliding parts in accordance with manufacturer's recommendations.

H. When door assembly is complete and hooked up to other systems test and adjust doors until they operate easily and quietly, maintaining airtightness and water tightness, under all conditions of normal and emergency use. Doors must be in full contact with weather stripping.

I. Re-adjust doors just prior to substantial completion and after installation of any finished flooring materials.

**END OF SECTION 083613**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Exterior aluminum-framed storefronts windows.
   2. Engineering design of storefront window systems.

B. Related specification sections include the following:
   1. Section 079200 - “Sealants” for installation of joint sealants installed with aluminum-framed systems and for sealants to the extent not specified in this Section.
   2. Section 088000 - “Glazing” for glazing requirements to the extent not specified in this Section.

1.03 STANDARDS

A. All work of this section shall conform to industry standards and/or manufacturer’s recommendations.

B. AA 45 "The Aluminum Association Designation System for Aluminum Finishes".

C. AAMA CW-10 - “Care and Handling of Architectural Aluminum from Shop to Site”.

D. AAMA 501.2 - “Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems”.

E. AAMA 611 - “Voluntary Specification for Anodized Architectural Aluminum”.

F. AAMA 1503 - “Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Door and Glazed Wall Sections”.

G. AAMA 2605 - “Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix)”.

H. ANSI H35.2 "American National Standard Dimensional Tolerances for Aluminum Mill Products".

I. ASTM B221 "Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes".

J. ASTM E283 - “Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen”.

K. ASTM B633 "Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel".

1.04 SUBMITTALS

A. Pursuant to Section 013300 - Submittal Procedures.

B. Pursuant to Section 016000 - Product Requirements.

C. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of product indicated.

D. Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication and assembly of aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
   1. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   2. Include details of provisions for system expansion and contraction and for draining moisture occurring within the system to the exterior.

E. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

F. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.

C. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including pre-construction testing, field testing, and in-service performance

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturers published instructions.

B. Protect against moisture exposure and damage.

C. Protect against any damage. Handle to avoid racking and excessive or improperly applied loads.

1.07 PERFORMANCE REQUIREMENTS

A. Design and size components to withstand the following load requirements without damage or permanent set, when tested in accordance with ASTM E 330, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
   1. Design Wind Loads: Comply with requirements of IBC - International Building Code (latest edition).
   2. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.

B. Movement: Accommodate movement between storefront and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.

C. Air Infiltration: Limit air infiltration through assembly to 0.06 cu ft/min/sq. ft of wall area, measured at a reference differential pressure across assembly of 6.24 psf as measured in accordance with ASTM E 283.

D. Condensation Resistance Factor: CRF of not less than 57 (exterior frames) when measured in accordance with AAMA 1503.1.

E. Thermal Resistance of Exterior Framing: Thermal transmittance U value not more than 0.38 BTU/HR/FT2/°F when measured in accordance with AAMA 1503.1.

F. Water Leakage: None, when measured in accordance with ASTM E 331 with a test pressure difference of 12 lbs./sq. ft.

G. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.

H. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170° F over a 12-hour period without causing detrimental effect to system components, anchorages, and other building elements.

1.08 WARRANTY

A. Total Storefront Installation: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to the following:
      a. Structural failures including, but not limited to, excessive deflection.
      b. Noise or vibration caused by thermal movements.
      c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
      d. Adhesive or cohesive sealant failures.
      e. Water leakage through fixed glazing and framing areas.

B. Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.
   1. Warranty Period: 20 years from date of Substantial Completion for 70% based on AAMA standard 2605 for Storefront and Doors.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. EFCO Corporation (EFCO).
   2. Kawneer, An Arconic Company.

2.02 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
   1. Sheet and Plate: ASTM B 209
   2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221
   3. Extruded Structural Pipe and Tubes: ASTM B 429
   4. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M

B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
   1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M
   2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M
   3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M

2.03 FRAMING SYSTEMS

A. Products:
   1. EFCO; Series 403T
   2. Kawneer; Trifab VG 451T thermal Break

B. Framing Members: Manufacturer's standard extruded-aluminum 6063-T6 alloy and temper framing members, minimum wall thickness of 0.080" and reinforced as required to support imposed loads.
   1. Construction: Thermally Broken Frame.
   2. Glazing System: Retained mechanically with gaskets on four sides.
   3. Glazing Plane: Center
   4. Depth of Frame: Not less than 4-1/2"
   5. Face of Frame: Not less than 2".

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with non-staining, non-ferrous shims for aligning system components.

D. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.
   1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
   2. Reinforce members as required to receive fastener threads.
   3. Use exposed fasteners with countersunk Phillips screw heads to install hardware only, finished to match framing system.

E. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.

F. Concealed Flashing: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding flashing compatible with adjacent materials.

G. Thermal Barrier:
   1. All exterior Aluminum shall be separated from interior aluminum by a rigid, structural thermal barrier.
   2. Barrier material shall be poured-in place two-part polyurethane. A nonstructural thermal barrier is unacceptable.

H. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.

2.04 GLAZING SYSTEMS

A. Glazing: As specified in Division 08 Section "Glazing".

B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

2.05 GLAZING SYSTEMS

A. Glazing: As specified in Division 08 Seciton "Glazing".

B. Glazing: Gaskets: Manufacture's standard compression types; replaceable, extruded EPDM rubber.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

E. Glazing Sealants: For structural-sealant-glazed systems, as recommended by manufacturer for joint type, and as follows:
   1. Structural Sealant: ASTM C1184, single-component neutral-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 a structural-sealant manufacturer for use in aluminum-framed systems indicated.
      a. Color: Black
   2. Weatherseal Sealant: ASTM C 920 for Type S, Grade NS, Class 25, Uses NOT, G, A, and O; single-component neutral-curing formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and aluminum-framed-system manufacturers for this use.
      a. Color: Matching structural sealant.

2.06 ACCESSORY MATERIAL

A. Joint Sealants: For installation at perimeter of aluminum-framed systems, furnished and installed by Division 07 Section "Sealants".

B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil thickness per coat.

2.07 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
   1. Profiles that are sharp, straight, and free of defects of deformations.
   2. Accurately fitted joints with ends coped or mitered.
   3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
   4. Physical and thermal isolation of glazing from framing members.
   5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
   6. Provisions for field replacement of glazing from exterior.
   7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Storefront Framing: Fabricate components for assembly using screw-spline system.

F. After fabrication, clearly mark components to identify their locations in Project according to shop drawings.

2.08 FINISHES

A. Finish: Providing coverage on all exposed areas of aluminum components.
   1. Manufacturer’s standard factory applied baked-on fluorocarbon-based (Kynar 500 thermoplastic enamel).
   2. Architect shall select color from manufacturer’s standard range of colors

PART 3 EXECUTION

3.01 INSTALLATION

A. Erect level, square, plumb, and in alignment with other elements of the Work; and pursuant to manufacturer's published instructions.

B. Seal all joints watertight between framing and adjacent construction.

C. Apply isolating coating at a rate of at least 1.6 to 2.1 mils, dry film thickness, where aluminum contacts other metals, concrete, plaster, or other alkaline materials.
   1. In contact with other metals: apply coating to other metal.
   2. In contact with alkaline material: apply coating to aluminum.

D. Provide perimeter anchors of sufficient size, adequate material, and proper spacing to transmit all loads into building structure. Isolate carbon steel anchors from aluminum.

3.02 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 1/16 inches per 10 ft, whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.03 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

C. Remove excess sealant by method acceptable to sealant manufacturer.

3.04 PROTECTION

A. Protect exposed aluminum surfaces against any damage from subsequent construction activities and from any contaminants, including, but not limited to, concrete, mortar, plaster, lime, acid, paint, spray foam insulation and waterproofing materials.

B. Remove and replace all damaged materials.

**END OF SECTION 084113**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. Extent and location of each type of Aluminum-Clad Wood Window is indicated on Construction Documents and in schedules.

B. Factory-assembled aluminum-clad wood windows, glass and glazing, mullions, operable hardware, weather-stripping, insect screen, and standard or specified anchors, trim, attachments and accessories.

C. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Section 061000 - Rough Carpentry
   2. Section 072129 - Spray Foam Insulation.
   3. Section 079200 - Sealants.
   4. Section 099100 - Painting.

1.03 STANDARDS

A. American National Standards Institute (ANSI):
   1. ANSI Z97.1, Safety Performance Specifications and Methods of Test for Safety Glazing Material Used in Buildings.

B. American Society for Testing and Materials (ASTM):
   1. ASTM A36, “Standard Specification for Carbon Structural Steel”.
   2. ASTM C1036, “Standard Specification for Flat Glass”.
   3. ASTM C1048, “Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass”.
   4. ASTM D4216, “Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) and Related PVC and Chlorinated Poly (Vinyl Chloride) (CPVC) Building Products Compounds”.
   5. ASTM E90, “Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements”.
   6. ASTM E283, “Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen”.
   7. ASTM E330, “Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference”.
   8. ASTM E413, “Classification for Rating Sound Insulation”.
   9. ASTM E547, “Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors and Curtain Walls by Cyclic Static Air Pressure Difference”.
   10. ASTM F588, “Standard Test Methods for Measuring the Forced Entry Resistance of Window Assemblies, Excluding Glazing Impact”.

C. Consumer Product Safety Commission (CPSC):
   1. CPSC 16CFR-1201, “Safety Standard for Architectural Glazing Materials”.

D. National Fenestration Rating Council Incorporated (NFRC):
   1. ANSI/NFRC 100-2014, “Procedure for Determining Fenestration Products U-factors”.
   2. ANSI/NFRC 200-2014, Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence”.

E. Window and Door Manufacturers Association (WDMA), (formerly National Wood Window & Door Association (NWWDA)):
   1. WDMA I.S. 2, Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors.
   2. WDMA Industry Standard I.S. 4, Industry Standard for Water-Repellent Preservative Non-Pressure Treated for Millwork.

F. American Architectural Manufacturers Association (AAMA)
   1. AAMA 450 - Voluntary Performance Rating Method for Mulled Fenestration Assemblies.
   2. AAMA 502 - Voluntary Specification for Field Testing of Newly Installed Fenestration Products.
   3. AAMA 2605 - Voluntary Specification, Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
   4. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site.

G. Federal Specifications (FS)
   1. Aluminum mesh, 18 x 16, 0.011-inch wire diameter, black or charcoal color finish; FS RR-W-365, Type VII.

H. All work of this section shall conform to industry standards and/or manufacturer’s recommendations.

1.04 PERFORMANCE REQUIREMENTS - DOUBLE HUNG UNITS AND COMBINED ASSEMBLIES

A. Window units shall meet Performance Class LC and Grade, Impact-Resistant: PG 50 in accordance with WDMA I.S.-2.

B. Window unit air leakage, when tested in accordance with ASTM E283 at 1.57 psf. (25mph), must be 0.15 cfm/ft 2 of frame or less.

C. No water infiltration when tested in accordance with ASTM E547 under static pressure of 6.0 psf. after 3 cycles of 5 minutes each, with water being applied at a rate of 5 U.S. gallons per square foot per hour.

D. Window assembly shall withstand positive and negative pressures of 60 psf. acting normal to the plane of the window. Structural tests shall be conducted in accordance with ASTM E330.

1.05 SUBMITTALS

A. Pursuant to Section 013300 - Submittal Procedures.

B. Pursuant to Section 016000 - Product Requirements.

C. Shop Drawings: Submit shop drawings for each type of window including information not fully detailed in the manufacturer's standard product data and the following:
   1. Typical unit elevations at 1/2" scale
   2. Half size section details of every typical composite member
   3. Horizontal & Vertical Mullion Details-Field Mullion Details must be detailed and include specific instructions for field personnel. Any requirements for structural mullions must be noted at time of bid and fully detailed on shop drawings. All efforts shall be made to provide factory mulling of separate window units. This may necessitate temporary bracing for shipping and handling.
   4. Anchors
   5. Hardware

6. Operators
7. Accessories
8. Glazing Details
9. Muntin Details
10. Screening Details

D. Product Data: Submit manufacturer's product specifications, technical product data, recommendations and standard details for type of aluminum clad window unit required. Include the following information:
   1. Fabrication Methods
   2. Finishing
   3. Hardware
   4. Accessories

E. Certification: Provide certification by the manufacturer showing that window unit(s) complies with requirements where the manufacturer's standard window units have been tested in accordance with specified tests and meet performance requirements specified. Where such testing has not been accomplished, perform required tests through a recognized testing laboratory or agency and provide certified test results.

1.06 QUALITY ASSURANCE

A. All work of this section shall be performed by experienced workers familiar with the work and according to manufacturers' recommendations and/or industry standards.

B. Standards: Requirements for aluminum clad wood windows, terminology and standards of performance and fabrication workmanship are those specified and recommended in AAMA/WDMA/CSA 101/I.S.2/A440-17 and applicable general recommendation published by AAMA, WDMA and CSA.

C. Single Source Responsibility: Provide aluminum clad wood windows and aluminum framed screen panels produced by a single manufacturer.

1.07 DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturers published instructions.

B. Protect against moisture exposure and damage.

C. Protect materials from damage before installation per instructions and in accordance with Section 016000 - Product Requirements.
   1. Materials shall be packed, loaded, shipped, unloaded, stored and protected in manner that will avoid abuse, damage, and defacement in accordance with AAMA CW-10.
   2. Remove wrappings and interleaving’s that are wet, or which could become wet when unloading materials.
   3. Store inside if possible in a clean, well-drained area free of dust and corrosive fumes.
   4. Stack vertically or on edge so that water cannot accumulate on or within materials. Use nonstaining wood or plastic shims between components to provide water drainage and air circulation.
   5. Cover materials with tarpaulins or plastic hung on frames to provide air circulation and prevent contaminants from contacting aluminum components.
   6. Store off ground.
   7. Keep water away from stored assemblies.

1.08 WARRANTIES

A. Window System:
   1. Contractor shall warrant for one year the satisfactory performance of the window installation that includes windows, hardware, glass, glazing, screening and anchorage as called for by the specifications and approved shop drawings.
   2. Provide manufacturer's standard warranty for:
      a. Wood Members: 10 years.
      b. Aluminum Cladding Structural Performance: Lifetime.
      c. Exterior Aluminum Finish: Kynar finish 20 years.
      d. Insulating Glass: 20 years.
      e. Other Components: 10 years.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include the following:
   1. Andersen E-Series windows manufactured by Eagle Window & Door; 2045 Kerper Blvd, Dubuque, IA 52001. (Basis of Design)

2.02 MATERIALS

A. Aluminum clad double-hung units as manufactured by Eagle Window & Door. Factory-assembled aluminum-clad wood window with sash installed in the frame. Sash shall pivot between jambs without removal for cleaning.
   1. FRAME: Exterior frame parts shall be clad with premium grade tempered aluminum extrusions, which shall be mitered at the corners and mechanically fastened together with corner locks and stainless-steel screws. Fitted to the aluminum extrusions on the inside are wood members produced from select kiln dried wood, water repellent and preservative treated wood in accordance with WDMA standard IS4. The Pine wood frame members are block mitered, power stapled and sealed at the corners with silicone. The wood frame members shall be clad with an aluminum extrusion. The interior surface shall be suitable for a stained finish. The frame shall be completely assembled with both side jambs equipped with a rigid vinyl jamb liner extrusion. Basic jamb width is 4 9 /16". Pre-applied extension jambs to be available to accommodate the wall thickness required. Masonry clips shall be applied on all four sides of the frame to permit positive anchorage to the building. Frames must be capable of being joined together easily and efficiently in multiple unit groups.
      a. Provide 11/16" drywall return on frames.
   2. SASH: All exterior sash parts are composed of a one-piece tempered aluminum extrusion, which shall be mitered and fastened at the corners. The aluminum shall be joined to water repellent, preservative treated wood in accordance with WDMA standard IS4. Sliding the aluminum onto the wood shall join it. The wood shall be mortised and tenoned, mechanically fastened at the corners and sealed with silicone.
   3. EXTERIOR FINISH:
      a. Exterior finish shall be PVDF finish complying with AAMA 2605-05. Color: To be selected by Architect from manufacturer's standard colors (minimum 50 standard colors).
   4. INTERIOR FINISH: The interior finish shall be a factory applied factory stained with polyurethane top coat (Color: To be selected by Architect from manufacturer's standard stains).

5. INSULATED GLAZING: Sealed insulating glass; glass of thickness recommended by manufacturer for size and application; rated CBA in accordance with ASTM E 774.
   a. Overall Thickness: 5/8 inch, except ¾ inch for doors, sidelights, transoms, geometrics, and circle top windows.
   b. All windows, without Decorative glass or between-the-glass blinds, shall be covered with a protective film applied to the interior and exterior lites to protect against damage and aid in final cleaning.
   c. Windows, unless indicated as Impact Resistant: Inboard and outboard lite annealed, complying with ASTM C 1036 quality Q3.
   d. Glazing: LowE-366 Low SHGC, High Performance Low-E4, Titanium Dioxide and Silicone Dioxide hydrophilic low-emissivity coated, with Argon glass blend fill and a translucent protective film.
      1) Low-Emissivity Coating. Three layers of silver Magnetron sputtering vapor deposition (MSVD) type applied to No. 2 surface.
      2) Thermal Transmission: U-value of 0.26.
         (a) Thermal Transmission: U-value of 0.26.
         (b) Solar Heat Gain Coefficient (SHGC): 0.25.
         (c) Visible Light Transmittance (VLT): 66 percent.
         (d) Ultraviolet Transmittance (UV): 16 percent.
         (e) Krochmann Damage Weighted Fading Function (Tdw): 35 percent.
   e. Tint: None.
   f. Provide obscure glass and/or tempered glass where shown on Drawings.

6. WEATHER-STRIPPING: All units shall have a compression bulb weather-strip on the sill and foam weather-strip at the head for maximum resistance to water and air infiltration. The upper and lower sash are sealed with a compression bulb weather-strip at the interlock. The frame shall consist of rigid vinyl jamb liners to create a positive seal between the sash and frame.
7. HARDWARE: The sash shall have locks and lifts (two locks on 3'-0" wide up to but excluding 4'-0", three locks on 4'-0" and wider, two lifts on 3'-0" and wider) factory installed. The locks are made of a high-pressure zinc die cast with a phosphate coating that is electrostatically finished in either bronze, polished brass, gold, white, black, antique brass, pewter, oil-rubbed bronze, satin chrome or bright chrome finish. The lifts are made of plastic and shall match the locks. Finish color of locks and lifts will be chosen by the Architect from the above finishes. Each sash shall have two specially designed; pivot-lock mechanisms which permit each sash to be tilted 90° inward from a bottom pivot and positively held in place for washing. Each sash shall have two spring balances or a block and tackle assembly depending on sash weight. Balances shall be factory installed and semi-concealed in vertical channels of the jamb liners. Color of balance assemblies to match exterior aluminum color chosen by Architect.
8. SCREENS: Screens shall be 18/16 aluminum screen mesh. The frame shall match the window in color and shall be mitered and secured with corner locks for additional strength. Screens shall be fastened to the window using butterfly clips or plunger pins through the side of the screen frame.
9. BETWEEN GLASS MUNTINS
   a. Size 1” (One inch profiled)
   b. Interior and Exterior color to match exterior aluminum finish color.

B. Aluminum clad double hung picture units shall be used for fixed window units that are not transom units.

2.03 TOLERANCES

A. Windows to accommodate the following opening tolerances:

1. Vertical dimensions between high and low points: plus ¼" or minus 0"
2. Width dimensions: plus ¼" or minus 0"
3. Building columns or masonry openings: plus, or minus ¼" from plumb

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that openings are dimensionally within allowable tolerances, plumb, level, clean, provide a solid anchoring surface and are in accordance with approved shop drawings.
   1. Masonry surfaces shall be dry and free of construction debris.
   2. Wood frame walls shall be dry, clean, sound, well-nailed, free of voids, and without offsets at joints. Ensure that nail heads are driven flush with surfaces in opening and within 3-inches (75 mm) of corner.
   3. Coordinate window installation with wall flashings and other built-in components.

B. Do not install windows until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Install windows in accordance with manufacturer's recommendations and approved shop drawings to achieve weathertight and freely operating installation.

B. Maintain alignment with adjacent work. Secure assembly to framed openings, plumb and square, without distortion.

C. Place foam insulation in shim spaces around unit perimeter to maintain continuity of building thermal barrier.

D. Use finish nails to apply wood trim and moldings.

E. Putty all nail and staple holes in wood framing of window. Putty to match color of surrounding wood.

F. Install sealant and related backing materials at perimeter of assembly to provide weathertight construction.

G. Leave window units closed and locked.

3.03 ADJUSTING AND CLEANING

A. After installation, windows and glazing shall be inspected and adjusted. Protect finished installation against damage.
   1. Adjust operating sash and hardware to provide a tight fit at contact points and weather-stripping for smooth operation and a weathertight closure. Lubricate hardware and moving parts.
   2. Re-adjust at the completion of the project if directed by the Architect.

B. Clean interior and exterior surfaces immediately after installation. Remove excess glazing and sealants, dirt, and other substances.
   1. Final Cleaning of painted finish shall be in accordance with AAMA 610.1.
   2. Wash and polish glass on both faces before Substantial Completion. Remove non-permanent labels from glass surfaces.
   3. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during the construction period.

3.04 PROTECTION

A. Protect window units from damage or deterioration until time of Substantial Completion.

B. Protect windows from field applied CMU sealer overspray.

**END OF SECTION 085213**

**PAGE INTENTIONALLY BLANK**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes commercial door hardware for the following:
   1. Swinging doors.
   2. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:
   1. Mechanical door hardware.
   2. Electromechanical door hardware.
   3. Cylinders specified for doors in other sections.

C. Related Sections:
   1. Division 06 Section “Rough Carpentry”.
   2. Division 06 Section “Finish Carpentry”.
   3. Division 08 Section “Hollow Metal Doors and Frames”.
   4. Division 08 Section “Flush Wood Doors”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
   1. ICC A117.1 - Accessible and Usable Buildings and Facilities.
   2. ICC/IBC - International Building Code.
   3. NFPA 70 - National Electrical Code.
   4. NFPA 80 - Fire Doors and Windows.
   5. NFPA 101 - Life Safety Code.
   6. NFPA 105 - Installation of Smoke Door Assemblies.
   7. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:
   1. ANSI/BHMA Certified Product Standards - A156 Series.
   2. UL10C – Positive Pressure Fire Tests of Door Assemblies.
   3. ANSI/UL 294 – Access Control System Units.
   4. ULC-S319 - Electronic Access Control Systems.
   5. ULC-60839-11-1, Alarm and Electronic Security Systems - Part 11-1: Electronic Access Control Systems - System and Components Requirements.
   6. UL 305 – Panic Hardware.
   7. ULC-S132, Emergency Exit and Emergency Fire Exit Hardware.
   8. ULC-S533 – Egress Door Securing and Releasing Devices.
   9. ANSI/UL 437- Key Locks.
   10. ULC-S328, - Burglary Resistant Key Locks.

1.03 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
   1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
   2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
   3. Content: Include the following information:
      a. Type, style, function, size, label, hand, and finish of each door hardware item.
      b. Manufacturer of each item.
      c. Fastenings and other pertinent information.
      d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
      e. Explanation of abbreviations, symbols, and codes contained in schedule.
      f. Mounting locations for door hardware.
      g. Door and frame sizes and materials.
      h. Warranty information for each product.
   4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:
   1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
      a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
      b. Complete (risers, point-to-point) access control system block wiring diagrams.
      c. Wiring instructions for each electronic component scheduled herein.
   2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instruction. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

E. Informational Submittals:
   1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

1.04 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).

C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware 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.

D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
   1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
   2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
   1. Function of building, purpose of each area and degree of security required.
   2. Plans for existing and future key system expansion.
   3. Requirements for key control storage and software.
   4. Installation of permanent keys, cylinder cores and software.
   5. Address and requirements for delivery of keys.

H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s),

Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

I. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.06 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.

C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.07 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of

the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
   1. Structural failures including excessive deflection, cracking, or breakage.
   2. Faulty operation of the hardware.
   3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   4. Electrical component defects and failures within the systems operation.

C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods:
   1. Seven years for heavy duty cylindrical (bored) locks and latches.
   2. Five years for exit hardware.
   3. Twenty five years for manual overhead door closer bodies.
   4. Two years for electromechanical door hardware.

1.08 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.01 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
   1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.02 HANGING DEVICES

A. Hinges: ANSI/BHMA A156.1 certified butt hinge with number of hinge knuckles and other options as specified in the Door Hardware Sets.
   1. Quantity: Provide the following hinge quantity:
      a. Two Hinges: For doors with heights up to 60 inches.
      b. Three Hinges: For doors with heights 61 to 90 inches.
      c. Four Hinges: For doors with heights 91 to 120 inches.
      d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
   2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
      a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
      b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.

   3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
      a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
      b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

   4. Hinge Options: Comply with the following:
      a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.
   5. Manufacturers:
      a. Bommer Industries (BO).
      b. Hager Companies (HA).
      c. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK).

B. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 certified continuous geared hinge. with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.
   1. Manufacturers:
      a. Bommer Industries (BO).
      b. Ives (IV).
      c. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).

2.03 POWER TRANSFER DEVICES

A. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.
   1. Manufacturers:
      a. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE) – EL-CEPT Series.
      b. Securitron (SU) - EL-CEPT Series.
      c. Von Duprin (VD) - EPT-10 Series.

B. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.
   1. Provide one each of the following tools as part of the base bid contract:
      a. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - Electrical Connecting Kit: QC-R001.
      b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - Connector Hand Tool: QC-R003.
   2. Manufacturers:
      a. Hager Companies (HA) - Quick Connect.
      b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) – QC-C Series.

## 2.04 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified.
   1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
   2. Furnish dust proof strikes for bottom bolts.
   3. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
   4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
   5. Manufacturers:
      a. Door Controls International (DC).
      b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
      c. Trimco (TC).

## 2.05 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.

C. Cylinders: Original manufacturer cylinders complying with the following:
   1. Mortise Type: Threaded cylinders with rings and cams to suit hardware application.
   2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
   3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
   4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
   5. Keyway: Match Facility Standard.

D. Removable Cores: Provide removable cores as specified, core insert, removable by use of a special key, and for use with only the core manufacturer's cylinder and door hardware.

E. Keying System: Each type of lock and cylinders to be factory keyed.
   1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
   2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
   3. Existing System: Field verify and key cylinders to match Owner's existing system.

F. Key Quantity: Provide the following minimum number of keys:
   1. Change Keys per Cylinder: Three (3).
   2. Master Keys (per Master Key Level/Group): Five (5).
   3. Construction Keys (where required): Ten (10).
   4. Construction Control Keys (where required): Two (2).
   5. Permanent Control Keys (where required): Two (2).

G. Construction Keying: Provide temporary keyed construction cores.

H. Key Registration List (Bitting List):
   1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
   2. Provide transcript list in writing or electronic file as directed by the Owner.

## 2.06 MECHANICAL LOCKS AND LATCHING DEVICES

A. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Operational Grade 1 Certified Products Directory (CPD) listed.
   1. Furnish with solid cast levers, standard 2 3/4” backset, and 1/2" (3/4" at rated paired openings) throw brass or stainless steel latchbolt.
   2. Locks are to be non-handed and fully field reversible.
   3. Extended cycle test: Locks to have been cycle tested in ordinance with ANSI/BHMA 156.2 requirements to 2 million cycles.
   4. Manufacturers:
      a. Corbin Russwin Hardware (RU) – CL3300 Series.
      b. Schlage (SC) – ND Series.
      c. Yale Commercial (YA) 5400LN Series.

## 2.07 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
   1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
   2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
   3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
   4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:
   1. Strikes for Mortise Locks and Latches: BHMA A156.13.
   2. Strikes for Bored Locks and Latches: BHMA A156.2.
   3. Strikes for Auxiliary Deadlocks: BHMA A156.36.

4. Dustproof Strikes: BHMA A156.16.

2.08 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:
   1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
   2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
   3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
   4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
   5. Energy Efficient Design: Provide lock bodies which have a holding current draw of 15mA maximum and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.
   6. Motorized Electric Latch Retraction: Devices with an electric latch retraction feature must use motors which have a maximum current draw of 600mA. Solenoid driven latch retraction is not acceptable.
   7. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
      a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
      b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
   8. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
   9. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
   10. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
   11. Rail Sizing: Provide exit device rails factory sized for proper door width application.
   12. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.
   1. Manufacturers:
      a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
      b. Detex (DE) – Advantex.
      c. Yale (YA) - 7000 Series.

## 2.09 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:
   1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
   2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
   3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
   4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
   5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
   6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.
   1. Manufacturers:
      a. Corbin Russwin Hardware (RU) – DC6000 Series.
      b. Norton Door Controls (NO) – 7500 Series.
      c. Yale Commercial (YA) – 4400 Series.

## 2.10 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
   1. Manufacturers:
      a. Hiawatha, Inc. (HI).
      b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
      c. Trimco (TC).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.
   1. Manufacturers:

a. dormakaba (DO).
b. Rixson Door Controls (RF).
c. Sargent Manufacturing (SA).

## 2.11 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
   1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: 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 UL-10C.
   1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Manufacturers:
   1. National Guard Products (NG).
   2. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).
   3. Reese Enterprises, Inc. (RE).

## 2.12 ELECTRONIC ACCESSORIES

A. Intelligent Switching Power Supplies: Provide power supplies with single, dual or multi-voltage configurations at 12 and/or 24VDC. Power Supply shall have battery backup function with an integrated battery charging circuit. The power supply shall have a standard, integrated Fire Alarm Interface (FAI). The power supply shall provide capability for secondary voltage, power distribution, direct lock control and network monitoring through add on modules. The power supply shall be expandable up to 16 individually protected outputs. Output modules shall provide individually protected, continuous outputs and/or individually protected, relay controlled outputs. Network modules shall provide remote monitoring functions such as status reporting, fault reporting and information logging.
   1. Manufacturers:
      a. Securitron (SU) - AQL Series.

2.13 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.14 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.02 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.03 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
   1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

## 3.04 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures” and “Cash Allowances”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.
   1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.
   2. Submit documentation of incomplete items in the following formats:
      a. PDF electronic file.
      b. Electronic formatted file integrated with the Openings Studio™ door opening management software platform.

## 3.05 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

## 3.06 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

## 3.07 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

## 3.08 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
   1. Quantities listed are for each pair of doors, or for each single door.
   2. The supplier is responsible for handing and sizing all products.
   3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
   4. At existing openings with new hardware, the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Refer to Section 080671, Door Hardware Sets, for hardware sets.

END OF SECTION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This Section includes glazing for the following products, including those specified in other Sections where glazing requirements are specified by reference to this Section:
   1. Aluminum Clad Wood Window Units. (Refer to Window Specification).
   2. Exterior Doors.
   3. Interior Doors.
   4. Aluminum Storefront Windows.
   5. Overhead Door Lites.

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Section 081113 - Hollow Metal Doors and Frames
   2. Section 083613 - Sectional Overhead Doors
   3. Section 084113 - Aluminum Framed Entrances and Storefronts (windows)
   4. Section 083300 - Mirrors

1.03 STANDARDS

A. All work of this section shall conform to industry standards and/or manufacturer's recommendations. Refer to the below referenced publications (latest edition) for glazing terms not otherwise defined in this section.

B. AAMA A804.1 "Voluntary Specification for Ductile Back-Bedding Compound" (mandatory).

C. AAMA A807.1 "Voluntary Specification for Oil-Extended Cured Rubber Back-Bedding Glazing Tapes" (mandatory).

D. ANSI Z97.1 "American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test".

E. ASTM C162 "Standard Terminology of Glass and Glass Products".

F. ASTM C509 "Standard Specification for Elastomeric Cellular Preformed Gasket and Sealing Material".

G. ASTM C864 "Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers".

H. ASTM C920 "Standard Specification for Elastomeric Joint Sealants".

I. ASTM C1036 "Standard Specification for Flat Glass".

J. ASTM C1048 "Standard Specification for Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass".

K. ASTM E1300 "Standard Practice for Determining Load Resistance of Glass in Buildings".

L. CPSC "16CFR1201, Safety Standard for Architectural Glazing Materials".

M. FGMA (Flat Glass Manufacturers Association) "Glazing Manual".

N. AAMA Recommendations and Guidelines.

O. NFRC (National Fenestration Rating Council) 100 "Procedure for Determining Fenestration Product U-Factors"

P. NFRC 200 "Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence".

Q. NFRC 300 "Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems".

1.04 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thickness: Indicated by thickness designations in millimeters according to ASTM C1036.

C. Interspace: Space between lites of an insulating-glass unit.

D. Sealed Insulating Glass Unit Surface Designations:
1. Surface #1 - Exterior surface of the outer glass lite.
2. Surface #2 - Interspace surface of the outer glass lite.
3. Surface #3 - Interspace surface of the inner glass lite.
4. Surface #4 - Interior surface of the inner glass lite or the interlayer surface of the first layer of laminated glass.
5. Surface #5 - Interlayer surface of the second layer of laminated glass.
6. Surface #6 - Interior surface of the second layer of laminated glass.

1.05 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Design glass, including comprehensive engineering analysis according to ASTM E1300 by a qualified professional engineer licensed in the State of the project, using the following design criteria:
1. Design Wind Pressure: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Contract Drawings.
   a. Wind Design Data: As indicated on Contract Drawings.
   b. Basic Wind Speed : 120 mph.
   c. Importance Factor: III.
   d. Seismic Zone: As indicated on Contract Drawings.
2. Design Snow Loads: As indicated on Contract Drawings.
3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or one (1) inch, whichever is less.
4. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure, based on glass type factors for short duration load.
5. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of glass.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
   1. Temperature Change: 120 degree F, ambient; 180 degree F, material surfaces.
   2. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

1.06 SUBMITTALS

A. Pursuant to Section 013300 - Submittal Procedures.

B. Pursuant to Section 016000 - Product Requirements

C. Product data: Description of each type of glass, glazing product, and accessory product.

D. Samples: Provide 12” x 12” samples of all tinted glass and other glass only if requested by Architect.

E. Product Certificates:
   1. Statement that fire-protected-rated glazing provided for fire rated doors meets labeling or certification requirements of public authorities.
   2. Statement that the extent of tempered glass meets requirements of public authorities.

F. Maintenance data for glass and other glazing materials to be included in Operating and Maintenance Manual specified in Division 01.

1.07 QUALITY ASSURANCE

A. All work of this section shall be performed by experienced workers familiar with the work and according to manufacturer’s recommendations and/or industry standards.

B. Qualifications of installer: Provide glazing work by an installer who has installed the specified products for at least 2 years.

C. Single-Source Responsibility for Glass and Glazing Accessories: Obtain glass and accessories from one source for each product indicated.

D. Insulating Glass Certification Program: Provide insulating glass units permanently marked either on spacers or at least one component lite of units with appropriate certification label of inspecting and testing agency indicated below:
   1. Insulating Glass Certification Council (IGCC).
   2. Associated Laboratories, Inc. (ALI).
   3. National Certified Testing Laboratories (NCTL).

E. Safety Glass: Products complying with ANSI Z97.1 and testing requirements of 16 CFR Part 1201 for Category II materials.
   1. Subject to compliance with requirements, provide safety glass permanently marked with certification label of Safety Glazing Certification Council (SGCC) or other certification agency acceptable to authorities having jurisdiction.

F. Fire-Protection Rated Glazing Labeling: Permanently mark fire-protection rated glazing with certification label of testing agency acceptable to authorities having jurisdiction. Label shall indicate the following:
   1. Manufacturer
   2. Test Standard
   3. Whether glazing is for use in fire doors

4. Hose-stream test
5. Temperature rise rating
6. Fire -resistance rating in minutes

1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturers published instructions.

B. Protect against moisture exposure and damage.

C. Package, handle, and store glass and mirrors so that water does not touch or condense on glass surfaces or mirror edges.

D. Protect glass edges against chipping and other damage. Protect coated glass surfaces from abrasion and scratching.

E. Store glass and glazing products in controlled environment, out of sunlight, so that temperature does not go above 80º F. Bring glazing materials to at least 40º F, or higher temperature if recommended by producer, before installing.

F. Furnish labels identifying each type of glass. Keep labels in place until glass is installed.

1.09 WARRANTY

A. General: Warranties specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

B. Manufacturer’s Warranty on Insulating Glass: Submit written warranty signed by manufacturer of insulating glass agreeing to furnish replacements for insulating glass units that deteriorate as defined in “Definitions” article f.o.b. point of manufacture, freight allowed Project site, within specified warranty period indicated below. Warranty covers only deterioration due to normal conditions of use and not to handling, installing, protecting, and maintaining practices contrary to glass manufacturer’s published instructions.
   1. Warranty Period: Manufacturer’s standard, but not less than ten (10) years after date of Substantial Completion.

C. Manufacturer’s Warranty on Coated Glass Products: Submit written warranty signed by manufacturer of coated glass agreeing to furnish replacements for those coated glass units that deteriorate as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating. Warranty covers only deterioration due to normal conditions of use and not to handling, installing, protecting, and maintaining practices contrary to glass manufacturer’s published instructions.
   1. Warranty Period: Manufacturer’s standard, but not less than ten (10) years after date of Substantial Completion.

D. Manufacturer’s Warranty on Laminated Glass: Submit written warranty signed by manufacturer of laminated glass agreeing to furnish replacements for those laminated glass units that deteriorate within specified warranty period. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard. Warranty covers only deterioration due to normal conditions of use and not to handling, installing, protecting, and maintaining practices contrary to glass manufacturer’s published instructions.

1. Warranty Period: Manufacturer’s standard, but not less than ten (10) years after date of Substantial Completion.

PART 2 PRODUCTS

2.01 GLAZING PERFORMANCE REQUIREMENTS

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
   1. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.
   2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout project.

B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with Performance Requirements. Where fully tempered glass is indicated or required, provide Kind FT heat-treated float glass.

C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
   1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
   2. For laminated-glass lites, properties are based on products of construction indicated.
   3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
   4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed in Btu/sq.ft. x h x deg F (W/sq. m x K).
   5. Solar Heat Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
   6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.02 GLASS PRODUCTS

A. Heat-Treated Float Glass: ASTM C1048; Type 1; Quality-Q3; Class 1 (clear) unless otherwise indicated; of kind and condition indicated.
   1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
   2. For uncoated glass, comply with requirements for Condition A.
   3. For coated vision glass, comply with requirements for Condition C (other coated glass).

B. Pyrolytic-Coated, Self-Cleaning, Low-Maintenance Glass: Clear float glass with a coating on first surface having both Photocatalytic and hydrophilic properties that act to loosen dirt and to cause water to sheet evenly over the glass instead of beading.
   1. Products: Subject to compliance requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Cardinal Glass Industries: Neat™
      b. Pilkington North America Activ™
      c. PPG Industries, Inc.: SunClean®

C. Tinted Float Glass: Class 2, complying with other requirements specified.
   1. Basis of Design Product: Subject to compliance with requirements, provide Solargray by PPG Industries or comparable product by one of the following:
      a. Guardian Industries
      b. Oldcastle BuildingEnvelope®
   2. Tint Color: Optigray
   3. Visible Light Transmittance: 76 for Clear glazing and 54 for Gray Tinted glazing percent minimum.

2.03 LAMINATED GLASS

A. Laminated Glass: ASTM C1172, and complying with testing requirements in 16 CFR 1201 for Category 11 materials, and with other requirements specified. Use materials that have proven record of no tendency to bubble, discolor, or loose physical and mechanical properties after fabrication and installation.
   1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written recommendations.
   2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements
   3. Interlayer Color: Clear unless otherwise indicated.

B. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by designations in "Laminated-Glass Types" Article.

2.04 INSULATING GLASS

A. Insulating-Glass Units: Factory assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E2190, and complying with other requirements specified.
   1. Manufacturer and Product: Cardinal Lo E 366.
   2. Sealing System: Dual seal, with manufacturer's standard primary and secondary.
   3. Spacer: Manufacturer's standard stainless steel spacer material and construction.
   4. Desiccant: Angstrom molecular sieve beaded dessicant.
   5. Interspace Content: Argon
   6. Provide edge deletion of Lo E pure coating for proper bonding of sealants to glass.
   7. Provide laser engraved manufacturer's identity and date code on all units.

2.05 FIRE-PROTECTION-RATED GLAZING

A. A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering fire rated glass products that may be incorporated in the Work include, but are not limited to, the following:
   1. SAFTI FIRST, 100 N. Hill Dr., Suite 12, Brisbane, CA 94005. Phone: 888-653-3333 (Basis of Specification).
   2. Technical Glass Products, 8107 Bracken Place SE, Snoqualmie, WA 98065 Phone: 800-426-0279.
   3. Architect Approved Equivalent.

B. Material:
   1. SuperClear 45-HS-LI 45 minute fire and safety rated glazing.
   2. GP Firelite Plus®

C. Design Requirements:
   1. Thickness: ¾” standard.
   2. Weight: 9 lbs./sq.ft.
   3. Sound Transmission Rating: Must meet 37 STC/35 OITC in standard hollow metal frames. Glass and frame must be tested as an assembly. Glass only STC/OITC values are not acceptable.
   4. Appearance: clear, wireless and tint-free.
   5. Visual Light Transmission: Must meet 90% VLT for low-iron.
   6. Fire Rating: 45 minutes with hose stream.
   7. Impact Safety Resistance: Must meet CPSC 16 CFR 1201 Category I and II, ANSI Z91.1 Class A and B and CAN/CGSB 12.1 Class A and B.

D. Manufacturer's Fire Rated Glazing Material:
   1. Each piece of fire-rated glazing material shall be labeled with a permanent logo including name of product, manufacturer, testing laboratory, fire rating period and safety glazing standards.
   2. Glazing material installed in Hazardous Locations, subject to human impact, shall be certified and permanently labeled as meeting applicable requirements referenced in NFPA 80:
      a. CPSC 16 CFR 1201, Cat. I or II.

2.06 DECALS

A. Description: Self-adhering acrylic or polyester sheet material with silk screened logo or lettering in one-color design as directed by Architect.
   1. Size: Per Code.

2.07 GLAZING MATERIALS

A. Description: Provide glazing materials that are compatible with one another and with materials of glazing channel as well as with any sealants or interlayers in the glass units.
   1. Product quality assurance: Confirm compatibility of all products used or encountered in executing the work of this Section. Test as necessary to assure short and long term performance of frames, glazing materials, and glass without loss of seal, gassing, staining, discoloration, softening, deterioration, racking, breaking, or leaking.
   2. Color: Provide glazing materials, which match color of glazing channel. If color match is not available, submit color samples to Architect for color selection.

2.08 GLAZING TAPES

A. Description: 100% solids, extruded, non-staining butyl-isobutylene tape. Provide hard spacer rod for use in lights over 80 united in.

B. Standards:
   1. AAMA A804.1, for normal use.
   2. AAMA A807.1, for use where much thermal movement is anticipated.

2.09 GLAZING GASKETS

A. Description: Chloroprene (neoprene), EPDM, or Silicone compression gaskets in a soft and a dense formulation for the two sides of the glass. Select soft gasket to compress 25 to 40% when glass and dense gasket are in place.
   1. Where small lites (as in doors) can be glazed with a continuous preformed elastomeric glazing extrusion, use a gasket of the dense formulation, compressed to watertightness outside and inside, with either a bent joint or a tightly compressed cut joint at corners.

B. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
   1. Neoprene complying with ASTM C864.
   2. EPDM complying with ASTM C864.
   3. Silicone complying with with ASTM C1115.
   4. Thermoplastic polyolefin rubber complying with ASTM C1115.

C. Soft Compression Gaskets: Extruded or molded, closed cell, integral-skinned neoprene EPDM gaskets complying with ASTM C509, Type II, black; of profile and hardness required to maintain watertight seal.

1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side o glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

2.10 GLAZING ACCESSORIES

A. Setting blocks, edge blocks, spacers, and gaskets: Chloroprene (neoprene), EPDM, or silicone: ASTM C864.
   1. Hardness of setting blocks: Sufficient to compress no more than 20% under weight of glass.

B. Cleaners, solvents: As recommended by glazing material producer for each type of glass, glazing material, and substrate.

PART 3 EXECUTION

3.01 PREPARATION

A. Examine frames and other construction, which supports or underlies glazing work. Where frames are out of square, out of plane, subject to excessive deflection, or where substrates contain bond breaking substances, moisture, unsound material, or where there are other conditions unsuitable for proper installation or performance of the glazing work, do not start glazing work until defective earlier construction has been completed or corrected.

B. For exterior glazing, do not start glazing until each lite is provided with 2 or more weepholes, not more than 3 ft o.c.

C. Remove dust and other bond breaking substances from surfaces to be glazed. Do not glaze wet, damp, or uncured surfaces.

3.02 INSTALLATION

A. Installation includes such work as surface preparation, priming, cleaning, protecting, and repairing or replacing defective and damaged work.

B. Provide safety glass in lites where required by 16CFR1201 and public authorities, and at other locations as specified herein.

C. Install glazing according to FGMA Glazing Manual.

D. Orient glass so that wave and other distortions run horizontally.

E. Install glass and glazing materials only when the temperatures of air, materials, and substrate are above 40 F. If air temperature is below 40 F, protect the and bring glazing materials to temperature recommended by producer.

F. Install fire-protection-rated glazing in fire rated door vision lites and fire rated windows using sealant approved by the fire rating agency for use with the tested assembly.

G. At fixed lites which extend within 18 in. of floor, place permanent decals 54 in. off floor, 24 in. o.c. maximum, but not closer than 12 in. edge-to-edge. At doors with lites which extend within 18 in. of floor, place one decal 54 in. off floor, in center of lite width.

3.03 PROTECTION

A. Identify glazed areas by hanging narrow streamers from walls and mullions. Do not mark glass nor affix decals to glass.

B. Clean installed glass frequently during construction. Do not place other materials in contact with glass nor in such a way as to create a heat trap.

C. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way, including natural causes, accidents and vandalism, during construction period.

D. Wash glass on both faces in each area of project not more than 4 days prior to date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

3.04 GLAZING SCHEDULE EXTERIOR

A. Aluminum Storefront Windows
   1. 1” Lo E 366 insulated glass.
   2. Temper: all lites within 18” of doors or floor.
   3. Provide between the glass muntins.
   4. Color:
      a. Interior glazing: Clear
      b. Exterior Glazing: Clear.
   5. Type: Plain
   6. Glazing method: Gasket

B. Hollow Metal Entrance Doors
   1. 1" Lo E 366 insulated glass.
   2. Temper: all lites.
   3. Color:
      a. Interior glazing: Clear
      b. Exterior Glazing: Clear.
   4. Type: Plain
   5. Glazing method: Tape or gasket for lites smaller than 5 sq. ft.

C. Overhead Door Vision Lites
   1. 5/8” or 3/4" Lo E 366 insulated glass. Coordinate with door manufacturer for maximum thickness.
   2. Temper: all lites
   3. Color:
      a. Interior glazing: Clear
      b. Exterior glazing: Clear.
   4. Type: Plain
   5. Glazing method: Gasket

3.05 GLAZING SCHEDULE INTERIOR

A. Fire Rated Doors
   1. Thickness: 3/4”
   2. Color: Clear
   3. Type: Fire-Protection-rated
   4. Glazing Method: Fire rated gasket

B. Other Interior Doors
   1. Thickness: ¼”
   2. Color: Clear
   3. Type: Temper all lites
   4. Glazing Method: Tape or gasket perimeters.

**END OF SECTION 088000**

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Glass mirrors.
   1. Annealed float glass.
   2. Tempered safety glass.

1.02 REFERENCE STANDARDS

A. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

B. ASTM C1036 - Standard Specification for Flat Glass; 2016.

C. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.

D. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.

E. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2018.

F. GANA (GM) - GANA Glazing Manual; 2008.

G. GANA (SM) - GANA Sealant Manual; 2008.

H. GANA (TIPS) - Mirrors: Handle with Extreme Care (Tips for the Professional on the Care and Handling of Mirrors); 2011.

1.03 SUBMITTALS

A. See Section 013300 - SUBMITTALS, for submittal procedures.

B. Product Data on Mirror Types: Submit structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

C. Product Data on Glazing Compounds: Submit chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.

D. Samples: Submit two samples, 6 x 6 inch in size, illustrating mirrors design, edging, and coloration.

E. Manufacturer's Certificate: Certify that mirrors, meets or exceeds specified requirements.

F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016100 - BASIC PRODUCT REQUIREMENTS, for additional provisions.
   2. Extra Mirror Glazing: One of each type and size.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with GANA (GM) and GANA (SM) for glazing installation methods.
   1. Maintain one copy on project site.

B. Fabricate, store, transport, receive, install, and clean mirrors in accordance with recommendations of GANA (TIPS).

1.05 FIELD CONDITIONS

A. Do not install mirrors when ambient temperature is less than 50 degrees F (10 degrees C).

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.06 WARRANTY

A. See Section 017700 - CLOSEOUT PROCEDURES, for additional warranty requirements.

B. Provide ten year manufacturer warranty for reflective coating on mirrors and replacement of same.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Mirrors:
1. Trulite Glass and Aluminum Solutions; ScarGard: www.trulite.com.
2. Binswanger Mirror/ACI Distribution: www.binswangerglass.com.
3. Lenoir Mirror Co.: www.lenoiermirror.com.
4. Dunlea Glass & Mirrorwww.dunleaglass.net.

2.02 MATERIALS

A. Mirror Design Criteria: Select materials and/or provide supports as required to limit mirror material deflection to 1/200, or to the flexure limit of glass, with full recovery of glazing materials, whichever is less.

B. Mirror Glass: ASTM C1036, Type 1 - Transparent Flat, Class 1 - Clear, Quality - Q1 (high-quality mirrors); silvering, protective coating, and quality requirements in compliance with ASTM C1503.
1. Thickness: 1/4 inch (6 mm).
2. Size: As noted on drawings.

2.03 GLAZING COMPOUNDS

A. Manufacturers:
1. Tremco.
2. Pecora.
3. Gunther.

B. Silicone Sealant; Type : ASTM C920, Type S, Grade NS, Class 25, Uses M and A; single component; chemical or solvent curing; non-bleeding, non-staining, cured Shore A hardness of 15 to 25; color as selected.

2.04 ACCESSORIES

A. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness.

B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness.

C. Glazing Tape: Preformed butyl compound; 10 to 15 Shore A durometer hardness; on release paper.

D. Glazing Clips: Manufacturer's standard type.

E. Mirror Attachment Accessories: Stainless steel clips.

F. Mirror Primer: Primer and sealer to promote adhesion to substrate surfaces. Environmentally safe.
   1. Product: Gunther Prime-N-Seal or approved equal.

G. Mirror Adhesive: Chemically compatible with mirror coating and wall substrate.
   1. Product: Gunther Premier, Low VOC mirror mastic or approved equal.

H. Mirror Edge Seal: Protective edge seal for mirror edges.
   1. Manufacturer: Gunther Seal-Kwik or approved equal.

I. Rolled Formed Frame: One piece, roll-formed angle frame, stainless steel, Type 430, satin finish, with welded frame corners, ground and polished smooth.

J. Channel Frame: One piece, channel frame, stainless steel, Type 430, satin finish, 1/2 inch by 1/2 inch by 3/8 inch deep (12.7 mm by 12.7 mm by 9.5 mm deep) with 90 degree mitered corners.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that openings for mirrored glazing are correctly sized and within tolerance.

B. Verify that surfaces of mirror frames or recesses are clean, free of obstructions, and ready for installation of mirrors.

### 3.02 PREPARATION

A. Clean contact surfaces with solvent and wipe dry.

B. Seal porous mirror frames or recesses with substrate compatible primer or sealer. Prime surfaces scheduled to receive sealant.

C. Prepare installation in accordance with ASTM C1193 for solvent release sealants, and install sealant in accordance with manufacturer's instructions.

### 3.03 INSTALLATION

A. Install mirrors in accordance with GANA (TIPS) and manufacturers recommendations.

B. Set mirrors plumb and level, and free of optical distortion.

C. Set mirrors with edge clearance free of surrounding construction including countertops or backsplashes.

D. Installation in Frames:
   1. Cut glazing tape to length and install against permanent stops, projecting 1/16 inch (1.6 mm) above sight line.

2. Place setting blocks at 1/4 points with edge block no more than 6 inches (150 mm) from corners.
3. Rest mirrors on setting blocks and push against tape to ensure full contact at perimeter of mirror.
4. Install removable stops, insert spacer shims between mirrors, and apply stops at 24 inch (600 mm) on center and at 1/4 inch (6 mm) below sight line.
5. Fill gaps between mirror and applied stop with sealant to depth equal to bite on glazing, to uniform and level line.
6. Trim protruding tape edge.

3.04 CLEANING

A. Remove wet glazing materials from finish surfaces.

B. Remove labels after work is complete.

C. Clean mirrors and adjacent surfaces.

**END OF SECTION 088300**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Extruded aluminum architectural louvers.

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Section 033000 - Cast-In-Place Concrete
   2. Section 042200 - Concrete Unit Masonry
   3. Section 079200 - Sealants
   4. Section 081113 - Hollow Metal Doors and Frames for Louvers in Hollow Metal Doors.
   5. Division 23 - Heating, Ventilating and Air Conditioning

1.03 STANDARDS AND REFERENCES

A. All work of this section shall conform to industry standards and/or manufacturer's recommendations.

1.04 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

B. Horizontal Louver: Louver with horizontal blades (i.e., the axis of the blades are horizontal).

C. Vertical Louver: Louver with vertical blades (i.e., the axis of the blades are vertical).

D. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

E. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven-rain performance, as determined by testing according to AMCA 500-L.

F. Windborne-Debris-Impact-resistant Louver: Louver that provides specified windborne-debris-impact resistance, as determined by testing according to AMCA 540.

1.05 SUBMITTALS

A. Submit pursuant to Section 013300 - Submittal Procedures.

B. Submit pursuant to Section 016000 - Product Requirements.

C. Manufacturer's product data illustrating and describing materials, components, hardware, and installation methods.

D. Shop drawings, including but not limited to, plans, elevations, details of connecting, mounting, anchoring, and assembling.

1.06 QUALITY ASSURANCE

A. Experienced workers familiar with the work and according to manufacturer's recommendations and/or industry standards shall perform all work of this section.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturers' published instructions.

1.08 FIELD MEASUREMENTS

A. Verify field measurements, as shown on Contract Documents, before installation.

1.09 PROJECT CONDITIONS

A. Coordinate installation of louvers with mechanical ducts and flues, if any connected to the louver.

1.10 WARRANTY

A. Special Finish Warranty: Manufacturer agrees to repair or replace components on which finishes fail in materials or workmanship within specified warranty period.
   1. Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
      d. Warranty Period: 20 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering louvers that may be incorporated into the Work include, but are not limited to, the following:
   1. The Airolite Company, 114 Westview Ave., Marietta, OH 45750, Phone: (740) 373-7676 (Basis of Design)
   2. GREENHECK, PO Box 410, Schofield, WI 54476, Phone: (715) 359-6171.
   3. Arrow United Industries, 450 Riverside Drive, Wyalusing, PA 18853, Phone: (570) 746-1888

2.02 LOUVER CONSTRUCTION

A. Louvers shall be constructed entirely of extruded aluminum, alloy 6063-T5.

B. Blades and frames shall be minimum 0.081" wall thickness.

C. Blades shall be joined to each jamb frame and vertical stiffening member with two fillet welds each 1" long produced with the pulsed gas metal arc welding (GMAW) process with a minimum 0.125" throat.

D. Frames shall be joined at each corner with a full length GMAW fillet weld, concealed from view with a minimum 0.125" throat.

E. Louver assemblies shall be 6" deep with drainable, stationary blades, providing 50% free area.

F. Each louver shall be fitted with ½" mesh x 0.063" diameter aluminum bird screen in a U-shaped frame.

G. Louver sizes and shapes: See Contract Drawings.

2.03 FINISH

A. Louvers shall be factory primed and finished after assembly with a Kynar 500 resin coating. Primer and coating shall be oven baked in accordance with the coating manufacturer's instructions.

B. Color as selected by Architect from manufacturer's standard colors.

PART 3 EXECUTION

3.01 INSTALLATION

A. Coordinate installation with ductwork/flue pipes, if any, connecting to the louver.

B. Provide perimeter reveals and openings of uniform width for sealants and joint fillers.

C. Comply with manufacturer's published instructions. Conceal fasteners wherever practicable. Install complete with trim, hardware, and accessories. Paint any visible fasteners to match louver color.

D. Tolerances: Install straight, true, plumb, and in alignment for uniform appearance; permanently anchored to building construction with anchors of suitable size and type.

E. Perform all necessary cutting and drilling of adjacent surfaces required for the installation of the Work. Perform all drilling for anchors with carbide or diamond tipped rotary drills of minimum required sizes, to minimize damage to adjacent construction and finishes.

3.02 ERECTION TOLERANCES

A. Maximum Variation from Plum or Level: 1/8-inch

B. Maximum Misplacement from Intended Position: 1/8-inch

3.03 CLEANING AND PROTECTION

A. Before acceptance, clean Work thoroughly of dirt, grease, and other foreign matter, and leave all surfaces in perfect condition.

B. Remove all protective coverings.

C. After erection, protect finished installation as necessary to avoid damage.

**END OF SECTION 089100**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Pre-formed moisture suppression membrane installed over new concrete subfloor as a floor covering underlayment.

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Section 033000 - Cast-In-Place Concrete
   2. Section 093013 - Ceramic Tiling
   3. Section 096513.23 - Resilient Stair Treads (Corridor Flooring)
   4. Section 096519 - Resilient Tile Flooring

1.03 REFERENCES

A. Referenced Standards: These standards (latest edition or edition in force by AHJ) form part of this specification only to the extent they are referenced as specification requirements.
   1. ASTM International (ASTM):
      a. ASTM E96 - "Standard Test Methods for Water Vapor Transmission of Materials".
      b. ASTM E648 - "Standard Test method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source".
      c. ASTM E662 - "Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials."
      d. ASTM F710 - "Standard Practice Preparing Concrete Floors to Receive Resilient Flooring".
      e. ASTM F2170 - "Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in Situ Probes".

1.04 SUBMITTALS

A. Pursuant to Section 013300 - Submittal Procedures.

B. Pursuant to Section 016000 - Product Requirements.

C. Product Data: Manufacturer’s data indicating product physical characteristics, performance criteria, and limitations of use, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods and instructions.
   4. Two sided and seam tape product data.
   5. Patching and leveling compound product data.

D. Warranty Registration: Manufacturer’s warranty registration with concrete subfloor moisture test results and building ambient air temperature and relative humidity test results.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum 5-year experience manufacturing similar products.

B. Installer Qualifications: Acceptable to manufacturer, experienced in performing work of this section and specialized in work similar to that required for this project. Minimum 3-year experience installing similar products.

C. The same product shall be used thru out the project.

1.06 PRE-INSTALLATION MEETINGS

A. Convene minimum two weeks prior to starting work of this section.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products in manufacturer’s unopened packaging bearing the brand name and manufacturer’s identification until ready for installation.

B. Handling: Handle materials to avoid damage.

C. Remove packaging materials from site and dispose of at appropriate recycling facilities.

1.08 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer’s recommended limits.

1.09 SEQUENCING

A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.10 COORDINATION

A. Coordinate the work of this section and directly related sections with finish flooring work.

1.11 WARRANTY

A. Fully executed, issued in Owner's name, and registered with Manufacturer’s including:
   1. Manufacturer's Ten (10) year warranty, from date of substantial completion, against moisture damage to finished floor covering.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:
   1. GCP Applied Technologies Inc., 62 Whittemore Ave., Cambridge, MA 02140, Phone: (617) 876-1400. (Basis of Specification)
   2. TRAXX Corporation, 1201 East Lexington Avenue, Pomona, CA 91766, Phone: 888-872-9926.
   3. Architect Approved Equivalent.

2.02 MOISTURE SUPPRESSION SYSTEM FOR FLOORING PRODUCTS

A. Product: KOVARA™ MBX (formerly Versa Shield) Flooring Underlayment as manufactured by GCP Applied Technologies Inc., 62 Whittemore Ave., Cambridge, MA 02140, Phone: (617) 876-1400.
   1. Material: Free-standing, dimensionally stable, 4-ply composite product, engineered as a moisture suppression membrane to be used on concrete floors where high moisture exists.
   2. Dimensions: Manufacturer's standard roll.
   3. Mold, Mildew and Fungal Resistance, ASTM G21: Passed.
   4. Moisture Vapor Transmission rate, ASTM E96: Less than 0.01 g/hr/sq m.
   5. Flame Spread: Exceed Class 1, per ASTM E648.
   6. Smoke Developed: 450 or less, meeting ASTM E662.

B. Accessories:
   1. KOVARA™ Tape as manufactured by GCP Applied Technologies Inc.
      a. Membrane manufacturer’s MBX double sided tape and seam tape.
      b. Properties: Moisture suppression and adhesion per manufacturer’s specifications.
      c. Double sided size: 4 inches.
      d. Seam Tape: 2 ½” one sided pressure sensitive tape.
   2. Primer: As recommended by manufacturer.
   3. Patching and leveling compound: Warranted by manufacturer for high moisture applications and approved by membrane manufacturer.
   4. Crack Mending Compound: Approved by membrane manufacture as compatible.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Concrete Subfloor:
   1. Verify internal RH of the concrete according to ASTM F-2170.
   2. Record readings and submit with manufacturer’s warranty registration.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Concrete Sub Floor:
   1. Prepare floor according to manufacturer’s instructions including removal of existing materials on concrete surface, grinding protrusions flat, and filling low spots with water-resistant (moisture resistant, or exterior grade) cementitious patching or leveling compound.
   2. Patch cracks greater than 1/8 inch width using manufacturer’s approved crack mending compound.
   3. Remove debris and excessive dust from the surface.

3.03 UNDERLAYMENT INSTALLATION

A. Install in accordance with manufacturer's written instructions.

B. Where plank type tile or LVT is to be installed, membrane shall be installed perpendicular to the tile/LVT layout.

C. Install KOVARA™ MBX Double Sided Tape in a 5' x 5' box grid pattern and at both sides of all doorways where membrane runs thru doorway or partition opening. If the particular piece of membrane is less than 16' in length, switch to a 2.5' x 2.5' box grid pattern for the double-sided tape.

D. Install moisture suppression membrane with smooth film side facing concrete slab.

E. Do not overlap seams.

F. If any jobsite condition interferes with compliance with manufacturer's instructions, contact manufacturer and obtain written job-specific procedures. Notify Architect or Owner's representative describing the interfering jobsite condition and manufacturer's job-specific instructions.

G. Install finish material upon moisture suppression membrane immediately after placement. Minimize all foot traffic and/or rolling loads directly on surface of membrane prior to installation of finish materials.

3.04 FLOORING INSTALLATION

A. Adhesives: Spray adhesives, latex, acrylics, urethanes, poly-urethanes, epoxies, modified mortar, and other non-solvent based adhesives to be applied at "finish flooring" manufacturer's recommended "non-porous spread rates".

B. Protection: Protect moisture suppression membrane from damage during flooring installation. Do not tear, rip, puncture, or delaminate membrane when applying trowel-on adhesive. Repair damaged areas according to membrane manufacturer's instructions before flooring installation. Provide continuous, intact moisture suppression membrane under entire designated flooring area.

C. Ceramic and Porcelain Tile: Adhere directly to moisture suppression membrane per tile manufacturer's recommendations.

D. Vinyl Tile: Adhere directly to moisture suppression membrane using tile manufacturer's recommended adhesive.

3.05 INITIAL MAINTENANCE

A. Upon completion of the finished flooring installation, KOVARA™ MBX requires a minimum of 120 hours (5 days) before conducting initial "wet" cleaning or maintenance. Failure to follow this requirement may result in improper adhesive curing and/or failure of the adhesive bond. Always clean and maintain flooring with neutral PH cleaning products.

3.06 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged membrane products before installing permanent floor covering.

**END OF SECTION 090561.13**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Non-load bearing steel framing members for gypsum board walls, soffits and ceilings.
      a. Custom curved tracks and framing for curved surfaces.
   2. Gypsum board assemblies attached to steel framing.
   3. Tile backing panels.
   4. Gypsum soffits.
   5. Gypsum board ceilings.
   6. Shaft wall assemblies.
   7. Resilient channels and metal furring.
   8. Suspension systems for interior gypsum ceilings and soffits.
   9. Control Joints in gypsum board ceiling and wall assemblies.
   10. Levels of finish for gypsum board surfaces

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Section 054000 - Cold Formed Metal Framing
   2. Section 061000 - Rough Carpentry for solid wood blocking built into gypsum board assemblies
   3. Section 061643 - Gypsum sheathing for exterior building sheathing.
   4. Section 072116 - Blanket Insulation for thermal and sound attenuation insulation installed in assemblies that incorporate gypsum board.
   5. Section 072129 - Sprayed Insulation for foam insulation installed in assemblies that incorporate gypsum board and/or non-load bearing framing.
   6. Section 078400 - Firestopping for firestopping systems and fire-resistive-rated joint sealants.
   7. Section 095100 - Acoustical Ceiling suspension assemblies for suspension systems for gypsum ceilings.
   8. Section 099100 - Painting for finishes.

1.03 STANDARDS

A. All work of this section shall conform to industry standards and/or manufacturer's recommendations.

B. ASTM C754 "Standard Specification for Installation of Steel Framing Members To Receive Screw-Attached Gypsum Board, Backing Board, or Water-Resistant Backing Board".

C. ASTM C840 "Standard Specification for Application and Finishing of Gypsum Board".

D. ASTM C1396/C1396M "Standard Specification for Gypsum Board".

E. GA-216 "Recommended Specifications for the Application and Finishing of Gypsum Board".

F. Recommended Levels of Gypsum Board Finish" published jointly by AWCI, CISCA, GA and PDCA.

G. Gypsum Board Construction Technology: Refer to ASTM C11 and GA-505 for definitions of terms related to gypsum board assemblies not defined in this Section or in other referenced standards.

1.04 TERMINOLOGY

A. The terms “drywall”, “GWB”, “gypsum board”, “gypsum wallboard”, and “sheetrock” are synonymous.

1.05 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide interior non-load-bearing metal framing capable of withstanding design loads within limits and under conditions indicated.
   1. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
      a. Interior Framing Systems:
         1) Maximum Deflection: L/240 at 5 psf, stud spacing at 16 inches o.c.
   2. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 129° F.
   3. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
      a. Upward and downward movement of ¾ inch.

B. Cold-Formed Steel Framing, General: Design according to AISI’s “Standard for Cold-Formed Steel Framing - General Provisions”.
   1. Provide interior framing systems sized to accommodate maximum deflection using limiting heights of metal studs without contribution of gypsum wallboard (non-composite).

C. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.

D. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

1.06 SUBMITTALS

A. Pursuant to Section 013300 - Submittal Procedures.

B. Pursuant to Section 016000 - Product Requirements

C. Submit manufacturers’ product information, specifications, and installation instructions for the specified products including, GWB, joint compounds, fasteners, trim, control joints, joint reinforcing, metal furring members, metal studs, tracks, runners, bridging, resilient channels, steel grounds, and all related accessories.

1.07 QUALITY ASSURANCE

A. Experienced workers familiar with the work and according to manufacturer’s recommendations and/or industry standards shall perform all work of this section.

B. Single-Source Responsibility for Steel Framing: Obtain steel framing members for gypsum board assemblies from a single manufacturer, unless otherwise indicated.

C. Single-Source Responsibility for Panel Products: Obtain each type of gypsum board and other panel products from a single manufacturer.

D. Single-Source Responsibility for Finishing Materials: Obtain finishing materials either from the same manufacturer that supplies gypsum board and other panel products or from a manufacturer acceptable to gypsum board manufacturer.

E. Fire-Test-Response Characteristics: Where fire-rated gypsum board assemblies are indicated, provide gypsum board assemblies that comply with the following requirements:
   1. Fire Resistance Ratings: As indicated by reference to GA File Numbers in GA-600 “Fire Resistance Design Manual” or design designations in UL “Fire Resistance Directory” or in the listing of another testing and inspecting agency acceptable to authorities having jurisdiction.
   2. Gypsum board assemblies indicated are identical to assemblies tested for fire resistance according to ASTM E119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
   3. Deflection and Firestop Track: Top runner provided in fire-resistance-rated assemblies indicated is labeled and listed by UL, Warnock Hersey, or another testing and inspecting agency acceptable to authorities having jurisdiction.

1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturers published instructions.

B. Protect against moisture exposure and damage.

C. Neatly stack gypsum panels flat to prevent sagging.

D. Do not install GWB that is wet, that is moisture damaged, and/or that is mold damaged.

1.09 ENVIRONMENTAL CONDITIONS

A. General: Establish and maintain environmental conditions for applying and finishing gypsum board to comply with ASTM C840 and with gypsum board manufacturer’s recommendations.

B. Room Temperatures: For non-adhesive attachment of gypsum board to framing, maintain not less than 40 deg F (4 deg C). For adhesive attachment and finishing of gypsum board, maintain not less than 50 deg F (10 deg C) for 48 hours prior to application and continuously after until dry. Do not exceed 95 deg F (35 deg C) when using temporary heat sources.

C. Provide adequate ventilation to carry off excess moisture. Avoid drafts during hot dry weather to prevent finishing materials from drying too rapidly.

D. Do not install gypsum board that is wet, those that are moisture damaged, and those that are mold damaged.

1.10 DEFINITIONS

A. Gypsum Board Construction Terminology: Refer to ASTM C11 and GA-505 for definitions of terms related to gypsum board assemblies not defined in this Section or in other referenced standards.

B. Rated or Tested Assemblies: As specified under the individual assembly description and shown in the drawings.

C. Non-rated Assemblies: As specified under the individual assembly description and shown in the drawings.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to the following:
   1. Gypsum Board and Related Products
      a. CertainTeed
      b. G-P Gypsum Corp.
      c. National Gypsum Company
      d. USG Corporation.
   2. Steel Framing and Furring
      a. ClarkDietrich Building Systems
      b. National Gypsum Company
      c. United States Gypsum Company
      d. Marino/Ware: a Division of Ware Industries, Inc.

2.02 MATERIALS

A. Runners: "U" shaped steel of same type, gage, and finish as studs with web depth compatible with studs and designed to hold studs temporarily in place at top and bottom by friction.
   1. Top Runners (Track): Where framing extends to overhead structural supports and/or decking, install to produce joints at top of framing systems that prevent axial loading of finished assemblies. In fire rated walls use Firestop Deflection Track.

B. Steel Stud Framing:
   1. Channel shaped with return leg.
   2. Non-load bearing: ASTM C 645.
   3. Hot dip galvanized:

C. Metal/Rigid Furring Channel:
   1. Product: ASTM C645.
   2. Hot dip galvanized:

D. Resilient Channel:
   1. Product: Sound Transmission Resilient Channel.
   2. Corrosion-resistant steel channel.

E. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
   1. Products: Subject to compliance with requirements, provide one of the following:
   2. ClarkDietrch Building Systems; BlazeFrame.
   3. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Posi Clips.
   4. Metal-lite, Inc.; The System.
   5. Sliptrack Systems; SLP-TRK.

F. Deflection Track:
   1. Double track condition.
   2. Oversized outer track (2” deep minimum).
   3. Long leg inside track.
   4. Same gage or heavier than studs.
   5. Hot dip galvanized.

G. Bridging
   1. Cold-rolled Channel Bridging
      a. 16 Gauge (minimum) screwed to each stud with a clip angle not less than 1-1/2" x 1-1/2", 16 gauge, galvanized steel. Clip angle to be screwed to bridging at each stud. Use 3-3/8" wide clips for 3-5/8" studs and 5-3/4" wide clips for 6" studs. Two screws into bridging and two screws into stud.

H. Hat-Shaped Rigid Furring Channels: ASTM C645
   1. Minimum Base-Metal Thickness: 20 gauge.
   2. Depth: 7/8 inch, 1-1/2 inches as indicated on the Contract Drawings.

I. Resilient Furring Channels: 1/2-inch deep, 20 gauge galvanized steel sheet members designed to reduce sound transmission.
   1. Configuration: Asymmetrical, single leg with 1-1/2" screw flange.

J. Z-Shaped Furring: With non-slotted web, face flange of 1-1/4 inches, wall attachment flange of 3/4 inch, minimum uncoated-metal thickness of 16 gauge unless noted otherwise and depth required to fit insulation thickness indicated. Created with ASTM A1003 conforming G60 galvanization.

K. Blocking
   1. Solid wood - See Section 061000 - Rough Carpentry

L. Column and beam clip
   1. “The Claw” manufactured by Claw International, 139 Parkview Drive, Lakeview, AR 72642 Phone: 870-431-5654 www.BEAMCLIPS.com or Architect Approved equivalent.

M. Fasteners:
   1. Steel drill screws; for fastening gypsum boards to steel members from 0.033 to 0.112 in. thick: ASTM C954.
   2. Steel drill screws:
      a. Type S: for fastening gypsum board to steel framing members.
      b. Type W: for fastening gypsum boards to wood members.
      c. Type G: for fastening gypsum board to gypsum board.
   3. Concrete anchors: Sized for installation loads imposed.
      a. Power driven.
      b. Pre-drilled expansion type.
      c. Self-drilling expansion type.

N. Gypsum Wall Board:
   1. Recycled Content of Gypsum Panel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
   2. Gypsum Board (GWB):
      a. Type ‘X’ unless noted otherwise.
      b. Thickness: 5/8” GWB unless noted otherwise.
   3. Cementitious Board:
      a. Provide on all surfaces to receive tile finish in shower area only.

b. Thickness: 5/8”

4. Gypsum Soffit Board
   a. Description: Specially formulated core to resist sag and moisture
   b. Thickness - 5/8” unless noted otherwise
   c. Use:
      1) Provide on all exterior soffit/ceiling locations
      2) Provide on interior soffit locations where noted on Drawings
5. Shaftwall
   a. Liner Boards:
      1) ASTM C442, Type SLX
      2) Edges: Beveled
      3) Thickness: 1”
      4) Acceptable Product: Sheetrock gypsum liner panels by USG or Architect approved equivalent meeting the required ratings.
   b. Face Boards:
      1) ASTM C1396 (Section 5), type X
      2) Thickness: 5/8”
6. Tile Backing Panels
   a. Provide on all walls to receive ceramic tile except showers.
   b. Glass-mat, Water-Resistant Backing Board
      1) Complying with ASTM C 1178.
      2) Core: 5/8”, Type X
      3) Products:
         (a) DensShield® Tile Backer by Georgia Pacific Gypsum.
         (b) FIBEROCK® Tile Backerboard by USG

O. Gypsum Board Accessories:
   1. All accessories must be taped.
   2. Galvanized steel; ASTM C1047
   3. Corner bead: Solid flange.
   4. Expansion (control) joint, with removable strip.
   5. U-bead.
   6. L-bead:
      a. Solid flange.
      b. Tear away L-bead at window applications.
   7. LK-bead: Solid flange.
   8. LC-bead: Solid flange.
   9. Edge trim: Tapeable J-bead.

P. Joint Finishing Materials: ASTM C475
   1. Joint reinforcing tape: ASTM C475
      a. Size: not less than 1-7/8 in. or more than 2-1/4 in.
      b. Thickness: Not more than 0.012 in.
      c. Tensile strength: Not less than 30 lb./in. when tested pursuant to ASTM
         1) C474.
      d. Dimensional stability: Expansion no more than 0.40% lengthwise and not more than 2.5% crosswise when tested pursuant to ASTM C474.
   2. Glass fiber joint reinforcement tape: Open weave tape; ASTM C475.
   3. Joint compound: Provide one or more of following pursuant to ASTM C475:
      a. Ready-mix or dry taping or bedding compound.
      b. Ready-mix or dry finishing or topping compound.
      c. Ready-mix or dry all-purpose compound.
      d. Compounds selected to be compatible.

2.03 STEEL FRAMED PARTITION: (NON-LOAD BEARING)

A. Fire Rating: Per Drawings.

B. Steel Framing:
   1. Runners, floor and ceiling:
      a. Size: As shown on the drawings.
      b. Material: 20 gage MSG (minimum) galvanized standard steel track or 33 mil (50 ksi) if using ViiperStud®, ProSTUD®, or other proprietary stud system unless noted otherwise on the Drawings.
      c. Attachment to Floor and Ceiling: 16 in. o.c., maximum.
   2. Steel Studs:
      a. Size: As shown on the drawings.
      b. Material: 20 gage MSG (minimum) standard, galvanized steel stud, 33 mil (33 ksi) ViperStud®, 33 mil (33ksi) ProSTUD®, 33 mil (33 ksi) other proprieitary stud unless noted otherwise on the Drawings.
      c. Spacing: As shown on the Drawings.

C. Bridging:
   1. U-Channel
      a. 16 gauge (minimum).
      b. 4’-0” o.c. vertically (maximum). Screwed to each stud. Provide bridging within 12" of the stud end at deflection top track.
   2. Blocking
      a. FR Solid Wood - See Section 061000 - Rough Carpentry.

D. Boards, Both Sides:
   1. Layers: As required for fire rating of wall assembly:
      a. Edge: Tapered.
      b. Type: As listed in 2.02 N.
      c. Orientation: Parallel with studs or perpendicular to studs.

E. Fasteners: Steel drill screws.

2.04 FURRED ASSEMBLY

A. Rating: None.

B. Metal/Rigid Furring Channel:
   1. Orientation: Installed vertically.
   2. Type: DWC.
   3. Depth: 7/8” or 1 ½” in.
   4. Gage: 20.
   5. Finish: Galvanized, G60.
   6. Substrate Attachment:
      a. Direct Method: Fasten alternately through both flanges directly to wall substrate at 24 in. o.c., maximum.
      b. Fasteners to substrate: Steel power driven fasteners.

C. Metal Furring Stud:
   1. Orientation: Installed vertically.
   2. Type: DWS.
   3. Depth: 1 5/8”.
   4. Gage: 20

5. Finish: Galvanized, G60.
6. Substrate Attachment:
   a. No attachment to substrate. Furring studs and GWB are an independent system when built tight to substrate.

D. Boards and Sheathing:
1. Layers: Single, face layer only.
2. Face layer:
   a. Type: As listed in 2.02 N.
   b. Edge: Tapered.
   c. Orientation: Parallel with, or perpendicular to, framing.

E. Fasteners: Steel drill screws.

2.05 STEEL FRAMED NON-LOAD BEARING SOFFIT, FASCIA, AND EXTERIOR SHEATHING

A. Rating: None.

B. Installation Type: Braced.

C. Steel Framing:
1. Runners, floor and ceiling:
   a. Size: As shown on the Drawings.
   b. Material: 20 gage MSG (minimum) galvanized steel track or 33 mil (50 ksi) if using ViiperStud®, ProSTUD®, or other proprietary stud system unless noted otherwise on the Drawings.
   c. Attachment to substrate: steel drill screws at 24-in. o.c., maximum.
2. Steel Studs:
   a. Size: As shown on the Drawings.
   b. Material: 20 gage MSG (minimum) standard, galvanized steel stud, 33 mil (33 ksi) ViperStud®, 33 mil (33ksi) ProSTUD®, 33 mil (33 ksi) other proprietary stud unless noted otherwise on the Drawings.
   c. Spacing: As shown on the Drawings.

D. Diagonal Bracing: Use studs or runners.

E. Boards:
1. Layers: Single, face layer only.
2. Material:
   a. Interior assembly:
      1) Gypsum soffit board
      2) Edge: Tapered.
      3) Orientation: Parallel with studs or perpendicular to studs.
   b. Exterior assembly:
      1) See Section 061643 - Gypsum Sheathing.

F. Fasteners: Steel drill screws.

2.06 FURRING FOR GYPSUM BOARD CEILING ATTACHED TO METAL TRUSSES

A. Furring Channel (18-gauge, DOUBLE leg) mounted perpendicular to bottom chord of truss at 16” o.c. maximum.

2.07 FURRING FOR BOARD INSULATION

A. "Z" Furring Channel, 16 gauge, Galvanized G60 Coating, profile depth to match insulation thickness.

B. To be installed in vertical configuration only, 16" on center unless noted otherwise.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates to which gypsum board assemblies attach or abut, installed hollow metal frames, cast-in-anchors, and structural framing with Installer present for compliance with requirements for installation tolerances and other conditions affecting performance of assemblies specified in this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Ceiling Anchorage: Coordinate of ceiling suspension systems with installation of overhead structural assemblies to ensure that inserts and other provisions for anchorage to building structure have been installed to receive ceiling hangers that will develop their full strength and at spacing required to support ceilings.

3.03 INSTALLATION

A. Install Pursuant to: Manufacturer's published instructions. Comply with ASTM C754 and with ASTM C840 requirements that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

D. Install bridging at 4'-0" o.c. vertically for full length of wall. If wall has a top deflection track, install an additional row of bridging within 12" of the top end of the studs. Install bridging prior to electrical conduit, piping and other utility installation within the wall or passing thru the wall to avoid conflicts. If bridging can not run full length of wall due to obstruction, continue bridging above or below obstruction overlapping one full stud cavity of main bridging run. Do not exceed 2 feet vertical between offset bridging runs and primary bridging run.

E. Install bracing at terminations in assemblies.

F. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

G. Runner Installation:
   1. Attach steel runners at floor and ceiling to structural elements with suitable fasteners located 2 in. from each end and spaced 16 in. o.c., maximum.

H. Steel Stud Installation:
   1. Position studs vertically, with open side facing in the same direction, engaging floor and ceiling runners, and spaced pursuant to specific partition description. Trade holes (knockouts) shall not be located within 10 inches of the end of the stud. When necessary,

splice studs with 8 in. nested lap and two positive attachments per stud flange. Place studs in direct contact with all door frame jambs, abutting partitions, partition corners, and existing construction elements. Where studs are installed directly against exterior walls and a possibility of water penetration through walls exists, install asphalt felt strips between studs and wall surfaces.

2. Anchor both flanges of all studs to ceiling (unless it is deflection track) and floor runner or track flanges as specified under specific partition description, or, if silent, with metal lock fastener tool, or 3/8 in. Type S or Type S-12 steel drill screw. Securely anchor studs to jamb and head anchors of door or borrowed-light frames by bolt or screw attachment. Over metal door and borrowed-light frames, place horizontally a cut-to-length section of runner or track, with a web-flange bend at each end, and secure to strut-studs with 2 screws in each bent web. Position a cut-to-length stud (extending to ceiling runner or track) at vertical board joints over door frame header.
    a. Install two studs at each jamb unless otherwise indicated.
    b. Install cripple studs at head adjacent to each jamb stud, with a maximum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
    c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

I. Metal/Rigid Furring Channels Erection:
1. Direct attachment: Attach furring channels in a vertical position directly to interior concrete or masonry surface with appropriate anchors and fasteners staggered 16 in. o.c. on opposite flanges. When there is a possibility of moisture penetration through walls, install asphalt felt protection strip between furring channel and wall.

J. Soffit and Fascia Erection:
1. Fasten runners to concrete or masonry substrate with appropriate fasteners spaced 16 in. o.c., maximum. Fasten runners to steel studs used as a substrate used as a substrate with steel drill screws.
2. Fasten steel studs to runners and other steel studs with steel drill screws.
3. Install steel stud diagonal bracing, if necessary; fasten with steel drill screws.

K. Gypsum Board Erection:
1. Clean stud and furring cavities of all construction debris and vacuum clean all track sections prior to installing GWB.
2. Apply gypsum boards pursuant to specific partition description. Position all edges centered over studs for parallel application; all ends centered over studs for perpendicular application. Use maximum practical lengths to minimize end joints. Fit ends and edges closely, but not forced together.
3. Stagger vertical board joints from joints in adjacent layer and from joints on opposite side of studs. Stagger horizontal joints 1 stud spacing from boards directly above and below, from joints in adjacent layer, and from joints on opposite side of studs. Locate screws 1/2 in. from board edges or ends.
4. For single-layer parallel application of gypsum boards, space screws pursuant to specific partition description in field of boards and along vertical abutting edges. For single-layer perpendicular board application, space screws pursuant to specific partition description in field and along abutting end joints.

L. For single layer application erect and fasten gypsum boards pursuant to GA-216.

M. For double layer application erect and fasten gypsum boards pursuant to GA-216.

N. For exterior gypsum boards, erect pursuant to GA-216, and fasten at 6” o.c. along panel edge locations and 12” o.c. field locations with 1¼” S #6 screws.

O. All joints and screw heads in GWB construction not exposed to view shall be fire taped and finished to a minimum AWCI Level 2 finish.

3.04 ACCESSORY APPLICATION

A. Corner Bead:
   1. Reinforce all vertical and horizontal exterior corners with corner bead fastened by crimping at 6” o.c. on both flanges along entire length of bead. If framing is wood, apply screws at 9” o.c. both flanges along entire length of bed in addition to crimping.

B. Edge Trim:
   1. Where assembly terminates against masonry or other dissimilar material, apply tapeable metal trim over board edge and fasten with 9/16 in. galvanized staples 9” o.c.

C. Opening Trim:
   1. Provide and attach with screws 9” o.c. special J-type (semi-finishing) zinc-alloy edge trim at all exposed edges of exterior gypsum board that are not concealed by applied moldings.
   2. Provide and attach with screws 9” o.c. special J-type plastic edge trim at all exposed edges of exterior gypsum board that are not concealed by applied moldings.

D. Control Joints:
   1. Provide control joint units, of either metal or PVC at one side of door frame extending from door frame head upward to top track and/or window unit extending from window jamb upward and downward at a maximum spacing of 24’ o.c. of straight wall and for straight wall sections longer than 24’ without a door or window provide full height control joint extending from door frame head upward to top track and elsewhere, where control joints are indicated.
   2. Control joints shall be provided in gypsum board ceilings not more than 30’-0” o.c. in each direction and at junction of gypsum board partitions with walls or partitions of other finish materials, and at “T”, “U” and “I” shaped areas.
   3. Each side of a control joint must be independently supported.
   4. Provide acoustical sealant at control joints as recommended by Drywall System manufacturer.
   5. In fire rated assemblies, control joints shall be backed as required to maintain rating of wall or ceiling.
   6. Where gypsum board is vertically continuous, as at stairwells, provide control joints at each floor level.

3.05 CONTROL JOINT INSTALLATION

A. Attach control joint with screws or Architect approved substitution, spaced not over 6 in. apart in each flange. Cut end joints square and align for neat fit. Remove protective tape when joint treatment is completed.

3.06 FASTENER APPLICATION

A. Drywall Screws:
   1. Power-drive with an electric screwdriver so screw heads provide a slight depression below surface of gypsum boards without breaking face paper. Do not drive screws closer than 3/8 in. from edges and ends of gypsum boards.

3.07 PRE-FILL APPLICATION

A. Use ready-mix or field mix dry taping or bedding compound pursuant to directions on container. Do not over mix, nor use extremely cold water or cold joint compound.

B. Pre-fill all "V" grooves formed by abutting tapered eased edges of gypsum board with taping or bedding compound, or Architect approved substitution, using a flexible 5 in. or 6 in. joint finishing knife or specialty pre-fill tool. Fill "V" joint flush and wipe off excess compound beyond "V" groove, leaving a clear depression to receive tape. Allow pre-fill to harden prior to next application, taping, or embedding coat.

3.08 JOINT TREATMENT APPLICATION

A. Mix joint compound pursuant to manufacturer's published instructions.

B. Apply taping, embedding, or ready-mixed all-purpose compound in a thin uniform layer to all joints, angles, finishing beads, trim and control joints. Immediately apply reinforcing tape centered over joint and seated into compound. Sufficient compound, approximately 1/64 in. to 1/32 in., must remain on tape to provide proper bond. Follow immediately with a thin skim coat to embed tape, but not to function as a second coat. Fold and embed tape properly in all interior angles to provide a true angle. Tape or embedding coat must be thoroughly dry prior to application of second coat. Exception: Some joint compounds need only to have hardened prior to application of next coat. Refer to instructions on container.

C. Spread finish coat evenly over and extend at least 2 in. beyond second coat on all joints and feather to a smooth, uniform finish. Over tapered edges, do not allow finished joint to protrude beyond plane of surface. Apply a finish coat to cover tape and taping compound at all tapered angles and provide a true angle. Where necessary, sand lightly between coats and following final application of compound to provide a smooth surface ready for decoration. When sanding, do not roughen face paper.

3.09 FINISHING FASTENERS

A. Apply a taping, all-purpose type, or ready-mixed compound to fastener depressions as first coat. Follow with a minimum of 2 additional coats of topping or all-purpose compound, leaving all depressions level with surface.

3.10 FINISHING BEADS, TRIMS, AND CONTROL JOINTS

A. Apply first coat and tape to all flanges, and properly feather out from ground to plane of surface. Compound must thoroughly dry prior to application of second coat. Some joint compounds need only to have hardened prior to application of next coat. Refer to instructions on container.

B. Apply a second coat in same manner as first coat, extending compound slightly beyond onto face of board. Compound must be thoroughly dry prior to application of finish coat.

C. Apply finish coat, extending compound slightly beyond second coat and properly feathering from ground to plane or surface. Exception: Only two coats of some ready-mixed compounds are needed. Sand finish as necessary to provide a flat, smooth surface ready for decoration. When sanding, do not roughen face paper.

3.11 LEVEL OF FINISH

A. Surfaces to receive tile, surfaces to receive fire taping, and/or surfaces not exposed to view, shall be finished to a minimum of AWCI Level 2.

B. Surfaces to receive heavy textured finish or heavy grade wall covering shall be finished to a minimum of AWCI level 3.

C. Surfaces to receive paint or light grade wall coverings shall be finished to a minimum of AWCI level 4.

D. Surfaces to receive gloss, semi-gloss, or egg shell paint shall be finished to a minimum of AWCI level 4.

3.12 TOLERANCES

A. Maximum variation of finished gypsum board surface from true flatness: 1/8 inch in 10 feet in any direction.

3.13 WASTE MANAGEMENT

A. Plan and coordinate work to minimize generation of off-cuts and waste. Sequences work to maximize use of GWB off-cuts and waste.

3.14 CLEANING AND REPAIR

A. Clean all excess materials each day. Promptly remove any residual joint compound from adjacent surfaces.

B. Provide final protection and maintain conditions, in a manner suitable to Installer, which ensures gypsum board assemblies remain without damage or deterioration at time of Substantial Completion.

C. Repair damaged work prior to Punch List

**END OF SECTION 092116**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Ceramic and Porcelain tile.
   2. Waterproof membrane for thin-set tile installations
   3. Setting products and grouts.
   4. Thresholds
   5. Metal transition strips between tile and other floor finishes.

B. Related sections include the following:
   1. Section 079200 - “Sealants” for sealing of expansion, contraction, control, corner, and isolation joints in tile surfaces.
   2. Section 092116 - “Gypsum Board Assemblies” for gypsum backer units and cementitious backer units installed as underlayment for tile installations.
   3. Section 090561.13 - "Moisture Vapor Emission Control".

1.03 STANDARDS

A. All work of this section shall conform to industry standards and/or manufacturer’s recommendations.

B. Tile Council of North America, Inc. (TCNA) "Handbook for Ceramic, Glass and Stone Tile Installation".

C. Ceramic Tile Standards
   1. Bond Strength: ASTM C482
   2. Breaking Strength: ASTM C648
   3. Color Uniformity: ASTM C609
   4. Crazing: ASTM C424
   5. Facial Dimensions: ASTM C499
   6. Warpage: ASTM C482
   7. Waster Absorption: ASTM C373
   8. Wedging: ASTM C502

D. Installation Standards: ANSI A108 series

E. Material Standards: ANSI A118 Series

F. ANSI A137.1 “American National Standards Specifications for Ceramic Tile”

1.04 SUBMITTALS

A. Pursuant to Section 013300 - Submittal Procedures.

B. Pursuant to Section 016000 - Product Requirements

C. Samples: submit actual products, no plastic mock-ups or photos representing colors and textures.

1. Tile - quantity to show full range of colors, markings and textures that will occur. Samples may be on color boards or as individual tiles of minimum size 4” square.
2. Thresholds/Transition Strips - 12” long samples of each type.
3. Sealant - 6” sample of each type and color.
4. Grouts - Full range of colors available.

D. Submit Installer qualification certifications for Installer(s) and Installing Contractor required by the Quality Assurance paragraph below.

1.05 QUALITY ASSURANCE

A. Experienced workers familiar with the work and according to manufacturers recommendations and/or industry standards shall perform all work of this section.

B. All tiles supplied must exceed standard grade requirement set forth in the latest ANSI tile specification A137.1.

C. Manufacturer Qualifications:
1. In business manufacturing ceramic/porcelain tile for at least 15 years.

D. Provide waterproofing membrane, crack control membrane, grout and setting materials from one manufacturer.

E. Installer Qualifications:
1. Installing Contractor is a five-star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors’ Association of America.
2. Installing Contractor employs Ceramic Tile Education Foundation Certified Installers.
3. Not less than five (5) years experience with tile work and not less than three (3) installations of similar size and scope.

F. The work hereunder shall be performed by a single entity with unit responsibility for field measurements, submittals, field installation and warranty.

G. Allowable tolerances:
1. Except for allowable tolerances in tile as specified, make corners of all tiles flush and level with corners of adjacent tile.
2. For flat surfaces, the maximum deviation from true plan shall be 1/8”in 8’ as measured under straight edge placed at any location on surface.
3. Where noted or required slope floors to drains, complying with the tolerance stated for flat surfaces.

H. Large format floor and wall tile shall be installed utilizing a tile leveling system.

I. Slip Resistant Floor Surface Requirements: The floor surface of the finished installation shall comply with the slip resistant requirements of the authorities having jurisdiction.

1.06 DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturers published instructions.

B. Protect against moisture exposure and damage.

C. Deliver material only in and undamaged condition; store above ground and in a dry place within building. Keep packaged material in original containers with seals unbroken and labels intact until time of use. Wrapped or bundled material must bear name of manufacturer and product. Immediately remove damaged or otherwise unsuitable material form job site.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Following are approved manufacturers for materials shown in the specification:
   1. Ceramic wall and floor tile
      a. American Olean
      b. United States Ceramic Tile
   2. Setting Products
      a. LATICRETE International, Inc. (Basis of Specification)
      b. MAPEI
   3. Grout
      a. LATICRETE International, Inc. (Basis of Specification)
      b. MAPEI
   4. Waterproofing & Crack Control Membranes
      a. LATICRETE International, Inc. (Basis of Specification)
      b. MAPEI
   5. Control joints and transition strips
      a. Schluter (Basis of Specification)

B. Tile shall be of size, type and pattern shown on the Drawings and described in this Project Manual. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

C. Proprietary names used to designate materials are not intended to imply that products of those manufacturers are required to the exclusion of Architect approved equivalent products of other manufacturers.

2.02 WALL, FLOOR, AND BASE TILE

A. Type A: Shower Ceilings
   1. American Olean - glazed wall tile, base and trim.
   2. Size: 4¼" x 4¼" x 5/16" dust pressed body, cushion edged with contact spacer lugs.
   3. Glazed Wall Tile, Base and Trim:
      a. Series: Matte and Bright
      b. Back tab mounting in sheets.
      c. Location: Field and accents.
   4. Trim tile to match wall tile in size and texture. All internal corners to be square, all external corners and exposed edges to be rounded using bullnose tile.
   5. Ceiling patterns and borders are indicated on the Drawings.
   6. Colors: to be selected by Architect.
      a. Price Groups 1, 2 and/or 3.

B. Type B: Lavatory Wall Tile, Shower Wall Tile, Lavatory and Shower Room Floor Tile
   1. Roca Tile.
   2. Size 12" x 24" porcelain tiles with a 1/4" grout joint.
   3. Series: Legend.
   4. Stagger tile 33%.
   5. Color: to be selected by Architect.
      a. Wall Tile - Polished.
      b. Floor Tile - unpolished.

C. Type C: Shower Floor (Handicap accessible showers)
   1. American Olean, Unglazed Ceramic Mosaics

2. Size: 2” x 2” with 1/16” grout joint.
3. Patterns: Twelve accent color tile randomly spread
4. Color: to be selected by Architect.
   a. 100% of Price Groups 1, 2 and/or 3.

2.03 SETTING PRODUCTS

A. Wall Tile.
   1. Large Format Tile: LATICRETE MULTIMAX™ LITE Polymer Fortified Mortar.
   2. Small Format Tile: LATICRETE 254 Platinum Polymer Fortified Thin Set Mortar.

B. Floor Tile
   1. LATICRETE 125 TRI MAX™ Adhesive Mortar.

2.04 GROUTS

A. Walls and Floors: LATICRETE SPECTRALOCK® PRO Premium Grout (Epoxy grout).

B. Color: to be selected by Architect.

2.05 THRESHOLDS

A. Marble:
   1. Profile: As shown on Contract Drawings.
   2. Size: Match jamb length. Align width with inside edge of door frame. See detail on Contract Drawings.
   3. Location: At locations shown on Door Schedule and Floor Finish Drawing.
   4. Color: Provide color range to coordinate with range of submitted tile colors. Architect shall select final color.

B. Metal:
   1. Manufacturer: Schluter or Architect approved equal.
   2. Material: Mill-finished aluminum.
   3. Style: as indicated by transition details shown in Drawings.
   4. Size: Height to match tile thickness.

2.06 ACCESSORIES

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Crack Isolation Membrane
   1. LATICRETE HYDRO BAN®

C. Tile Cleaner
   1. A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

2.07 MEMBRANE SYSTEM AT SHOWERS & LAVATORY WALLS

A. Showers with ceramic tile floors.
   1. LATICRETE HYDRO BAN® Waterproofing Membranes under shower floor and threshold and 6 foot vertically on all shower walls.

B. Lavatories and Shower Rooms.
   1. LATICRETE HYDRO BAN® Waterproofing Membranes 18” vertically on all walls and horizontally over entire floor surface.

PART 3 EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Examine all surfaces to receive the parts of the Work specified herein.
   1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are:
      a. incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
   2. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
      a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
      b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
   3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
   4. Verify all dimensions of existing and subsequent construction.
   5. Verify that GWB backing is the required type and is installed and prepared in accordance with Gypsum Association GA 216.
   6. Application of materials constitutes acceptance of substrate.
   7. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of Work, and similar items located in or behind tile have been completed before installing tile.
   8. On CMU walls to receive membrane and tile, smooth out any depressions with LATICRETE 254 Platinum Thin Set Mortar or LATICRETE 226 Thick Bed Mortar mixed with LATICRETE 3701 Mortar Admix or 3701 Fortified Mortar as recommended by manufacturer.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

C. Keep containers in which tile and other materials are packed, dry until tiles and other materials are removed; take every precaution to see that tiles are not stained before they are set in place. Maintain temperatures in rooms where tile is being set at a minimum of 50 F and for 7 days after tile has been set. Vent temporary heaters to outside to prevent carbon dioxide damage to the Work.

D. Layout tile in each area in such a manner as to minimize cutting of tile, especially cuts less than one half-tile size, and maximize alignment of joints.

E. Blending: For tile exhibiting color variations within the ranges selected during sample submittals, verify that tile has been blended in factory and packaged accordingly so that tile units taken from one package show the same range in colors as those taken from other packages and match approved samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.02 INSTALLATION OF WATERPROOFING MEMBRANE

A. Install waterproofing membrane as recommended by manufacturer.

B. Protect membrane until tile installation.

3.03 INSTALLATION OF TILE

A. ANSI Tile Installation Standard: Comply with parts of ANSI 108 series of tile installation standards included under “American National Standard Specifications for the Installation of Ceramic Tile” that apply to type of setting and grouting materials and methods indicated.

B. TCNA Installation Guidelines: TCNA “Handbook for Ceramic, Glass, and Stone Tile Installation”; comply with TCNA installation methods.
   1. Mortar Coverage for Ceramic/Porcelain Tile: Minimum contact area must be 95% with no voids exceeding 2 square inches and no voids within 2” of the tile corners. All corners and edges of the tiles must be fully supported. Back-parging or back-buttering is recommended on all large format tile. Use notched trowel sized to facilitate the proper coverage.

C. 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.

D. 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.

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. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths unless otherwise shown.
   1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so that extent of each sheet in not apparent in finished work.

F. Crack Isolation Membrane Installation
   1. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer’s written instructions to produce membrane of uniform thickness that is bonded securely to substrate.
   2. Allow crack isolation membrane to cure before installing tile or setting materials over it.
   3. Control Joints: Locate manufactured control joints in tile surfaces directly above joints in concrete substrates. Do not saw.
   4. Prepare joints and apply sealants to comply with requirements of Division 07 Section “Sealants “.

G. Grout tile to comply with the requirements of the following installation standards:
   1. For ceramic tile grouts (epoxy grout), comply with ANSI A108.10.

H. At showers, tubs, and similar wet areas, install cementitious backer units and treat joints to comply with manufacturer’s instructions for type of application indicated.

I. All inside corners of wall tile shall be caulked, not grouted.
   1. Install bond breaker behind all caulking.

J. All outside corners and tile terminations exposed to view shall receive a bullnose tile.

3.04 INSTALLATION OF GROUT

A. Install grout pursuant to ANSI A 108.10 and A 118.8.

B. Observe the general grouting procedures outlined in ANSI A108.10, Installation of Grout in Tilework.

C. Do not disturb, walk on or grout tiles until adhesive or dry-set has cured completely.

D. Remove all spacers, strings, ropes or pegs before grouting.

E. Wipe tile surfaces to remove dust or substances that may cause color contamination or discoloration during grouting.

F. Cure epoxy grout in accordance with manufacturer's recommendations.

G. Keep grout joints clean and free from standing water, dust and foreign substances.

3.05 CLEANING AND PROTECTION

A. Cleaning: Upon completion of placement and grouting, clean all surfaces so they are free of foreign matter.
   1. Remove grout residue from tile as soon as possible.
   2. Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's printed instructions, but no sooner than fourteen (14) days after installation. Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.

B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, and otherwise defective tile work.

C. Prohibit foot and wheel traffic from tiles floors for at least seven (7) days after grouting is completed.

D. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.

E. Protect all walls from impact or vibration from impact to adjacent or opposite walls for 14 days minimum.

F. Protect all tile installation from freezing or total water immersion for 21 days minimum.

G. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

H. Contractor to supply to Owner information regarding regular maintenance of wall and floor tile. See Section 017700 -Closeout Procedures.

**END OF SECTION 093013**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Acoustical Ceiling Panels.
   2. Wire hangers, fasteners, main runners, cross tees, and wall angle moldings.
   3. Accessories.

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Section 092116 - Gypsum Board Assemblies
   2. Division 21 - Fire Suppression
   3. Division 22 - Plumbing
   4. Division 23 - Heating, Ventilating and Air Conditioning
   5. Division 26 - Electrical

1.03 STANDARDS

A. All work of this section shall conform to industry standards and manufacturer's recommendations. Where differences occur, the stricter requirement shall apply.

B. ASTM A1008 "Standard Specifications for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability".

C. ASTM A641 "Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire".

D. ASTM C635 "Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings".

E. ASTM C636 "Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels".

F. ASTM E84 "Standard Test Method for Surface Burning Characteristics of Building Materials".

G. ASTM E1264 "Standard Classification for Acoustical Ceiling Products".

H. ASTM E1414 "Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum".

I. ASTM E1477 "Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers".

J. ASTM D3273 "Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber".

K. FS SS-S-118B "Sound Controlling (Acoustical) Tiles and Panels".

L. Ceilings & Interior Systems Contractors Association (CISCA) "Code of Practices for Acoustical Ceiling System Installations".

1.04 SUBMITTALS

A. Submit pursuant to Section 013300 - Submittal Procedures.

B. Submit pursuant to Section 016000 - Product Requirements.

C. Product Data: Materials description, installation, and maintenance instructions for each type of acoustical ceiling panel and suspension system required.

D. Samples: Minimum 6”x6” samples of each style of panel, 8” long pieces of exposed wall moldings, and suspension system.

1.05 QUALITY ASSURANCE

A. Experienced workers familiar with the work and according to manufacturers recommendations and/or industry standards shall perform all work of this section.

B. Provide acoustical panel units and grid components by single manufacturer.

C. Coordinate work of this Section with other Work supported by or penetrating through suspended ceiling systems, including partition systems, both fixed and tracked (if any), light fixtures, HVAC equipment, fire protection systems, speakers (if any), and movie screens (if any).

D. Each carton of panel material to have Underwriter’s Laboratory classification of acoustic performance. If label is absent, Contractor shall be required to send material from every production run appearing on the site to an independent approved laboratory for testing. Panels not meeting requirements shall be replaced at Contractor’s expense.

E. Maintain installation tolerances specified in ASTM C635 and C636.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical ceiling units carefully to avoid chipping edges or damaging units in any way.

1.07 JOB SITE CONDITIONS

A. Do not store or begin installation of acoustical ceiling materials until:
   1. All wet work such as concrete, plastering, and terrazzo is completed and thoroughly dried.
   2. Building has been enclosed to the weather and suitable mechanical ventilation is supplied to maintain conditional ranges of 60º F to 85º F at not more than 70% relative humidity. Maintain these conditions for a minimum of 48 hours prior to installation as well as during and after installation.
   3. Dust generating activities have terminated.
   4. Overhead work such as mechanical, electrical, fire protection, etc. is completed, tested, and approved.

B. Meet CISCA requirements for seismic design category as indicated on structural documents.

PART 2 PRODUCTS

2.01 ACOUSTICAL CEILING PANELS

A. Acceptable Manufacturers:
   1. Armstrong (Basis of Design)

B. 2' X 2' TILES
   1. Type22A: Description based on Fine Fissured Ceramaguard by Armstrong
      a. Mineral fiber lay-in panels/cast or molded.
      b. Surface Texture: fine fissures, non-directional, perforated.
      c. Exposed surface color: Manufacturer's standard white finish.
      d. Panel Size: 24' x 24" x 5/8" thick.
      e. Edge Profile: square.
      f. Noise Reduciton Coefficient (NRC): 0.55.
      g. Ceiling Attenuation Class: (CAC): 40.
      h. Flame Spread: Fire Guard™
      i. Light Reflectance: 0.79
      j. Durability: Washable, scrubbable.
      k. Humidity reistant HumiGuard® Max with 10-year warranty.
      l. Anti-mold and anti-mildew.
         1) Surface Texture: fine textured, non-directional.
   2. Type 22B: Description based on Dune Sqaure Lay-in by Armstrong
      a. Material: Mineral fiber lay-in panels/cast or molded.
      b. Surface Texture: fine textured, non-directional.
      c. Exposed surface color: Manufactuer's standard white finish.
      d. Panel Size: 24" x 24" x 5/8" thick.
      e. Edge Profile: Square.
      f. Noise Reduction Coefficient (NRC): 0..50
      g. Ceiling Attenuation Class (CAC): 30
      h. Flame Spread: Class A.
      i. Light Reflectance: 0.81
      j. Durability: Scratch Resistant.
      k. Humidity Resistant HumiGuard® Plus with 10-year warranty.
      l. Anti-mold/mildew, Anti-order/stain/bacteria.

2.02 SUSPENSION SYSTEM

A. Suspension system/steel, direct hung exposed tee:
   1. Acceptable manufacturers:
      a. Armstrong. (Basis of Design)

B. Description based on Prelude XL by Armstrong:
   1. Double web steel/non-fire rated
   2. Structural Classification per ASTM C635: Intermediate duty with interlocking of main runners and cross tees.
   3. Components and sizes:
      a. 1-1/2" high main tee runners, standard.
      b. 15/16" wide exposed finished face.
      c. Manufacturer's standard angle wall molding. Exposed flange to match size of exposed runners.
      d. All exposed surfaces to match in color and texture.
   4. Exposed tee surface color, finish:
      a. Color to match ceiling panels unless noted otherwise.

C. Anchoring Devices: Provide hot-dipped galvanized steel, ASTM A153, Coating Class C and D, screws, bolts, rods, hooks and eyes, and other devices designed for attachment to various types of structural framing systems, including system indicated, for support of ceiling suspension system.
   1. Provide tested and certified carrying and pull-out capacities, for each device, for not less than five (5) times the design load in ASTM C635, Table 1, Direct Hung installations.
   2. Hanger wire and ties:
      a. Galvanized steel wire pursuant to ASTM A641, soft temper, Class 1 coating.
      b. Size hanger wire to carry three (3) times hanger design load pursuant to ASTM C635, Table 1, Direct Hung, but not less than 12 gauge.
      c. Tie Wire: not less than 16 gauge.

2.03 SUPPLEMENTAL MATERIALS

A. Hold Down Clips for Non-Fire-Resistance-Rated-Ceilings: For interior ceilings composed of acoustical panels weighing less than 1 lb. Per sq. ft., provide hold-down clips spaced 24-inches o.c. on all cross tees.

B. Angle Hangers: Angles with legs less than 7/8-inch (22 mm) wide, formed with 0.0396-inch (1 mm) thick galvanized-steel sheet complying with ASTM A446, G 90 ASTM
   1. A446M, Z 275 Coating Designation, with bolted connections and 5/16-inch (8 mm) diameter bolts.

C. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's product designations, complying with the following requirements:
   1. Aluminum Alloy: Alloy and temper recommended by aluminum producer and finisher for type of finish indicated and with aluminum extrusions complying with ASTM B 221 (ASTM B 221M) not less than the strength and durability properties for alloy and temper 6063-TS.
   2. Baked-Enamel Finish: AA=C12C42R1x - Apply baked enamel according to paint manufacturer's specifications for cleaning, conversion coating, and applying organic coating.
      a. Organic Coating: Manufacturer's standard thermosetting coating system with a minimum dry film thickness of 0.8 to 1.2 mil.
      b. Color: White.

PART 3 EXECUTION

3.01 INSPECTION

A. Examine areas to receive materials for conditions which will adversely affect installation. Provide written report of discrepancies with copies to Contractor and Architect.

B. Do not start work until unsatisfactory conditions are corrected or architect issues notice to proceed. Application or installation of materials constitutes acceptance of supporting construction.

C. Work to be concealed: Verify work above ceiling suspension system is complete and installed in manner that will not affect layout and installation of suspension system components.

3.02 PREPARATION

A. Field Dimensions: Verify ceiling layouts by actual field dimensions prior to installation.

B. Acoustical panels must reach room temperature and stabilized moisture content prior to installation.

3.03 INSTALLATION - DIRECT HUNG CEILING SUSPENSION SYSTEM

A. Install pursuant to ASTM C636, CISCA current published recommendations, CISCA 0-2 and applicable code requirements in force at time of installation.

B. Install pursuant to manufacturer's published instructions where more stringent than standards specified, or where procedure is not covered by standards.

C. Suspend main beams from overhead construction with hanger wires spaced a maximum of 4'-0" o.c. along the length of the main runner. Install hanger wires plumb and straight.

D. Do not load system so as to produce rotation of runners.

E. Allowable deflection of main runners and cross runners is limited to 1/360 of the span between supports pursuant to ASTM C635.

F. When weight of components supported on main runners and cross runners causes total dead load to exceed deflection capability, provide additional hangers located within 6 in. of each corner of the component, unless otherwise recommended by manufacturer, or support components independently of the suspension system.

G. No. 12 gage hangers shall be attached to the grid members within 3 inches of each corner of each lighting fixture. Tandem fixtures may use common wires. Lighting fixtures must be positively attached to the suspended ceiling system - see Division 26 - Electrical for further information.

H. Support system independent of walls, columns, ducts, pipes, and conduit. When splicing carrying T's, maintain face plane with adjacent members.

I. Use properly placed and suspended load carrying bracing channels to maintain hanger vertical when interrupted by mechanical ducts and other horizontally run equipment.

J. Attachment to metal roof deck is prohibited.

K. Provide and coordinate installation of hanger clips during erection of structural framing.
   1. Space hangers not more than 48-inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise shown; and provide hangers not more than 8-inches (22 mm) from ends of each member.

L. Center suspended ceiling grid on room axis so as to provide equal border units, so arranged that units less than one-half width do not occur unless otherwise shown on Drawings.

M. Install wall molding at intersection of ceiling and vertical surfaces after primer and first coat of finish paint has been applied, using longest practical lengths. Continuously back bed vertical leg of molding with acoustical sealant. Firmly secure moldings to walls with corners neatly mitered or provide corner caps.
   1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
   2. Screw attach moldings to substrate at intervals not over 16-inches o.c. and not more than 3-inches from ends, leveling with ceiling suspension system to a tolerance of 1/8-inch in 12-feet. Miter corners accurately and connect securely.
   3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

N. Where circular or radius penetrations occur, provide preformed closers to match edge moldings.

3.04 INSTALLATION, LAY-IN CEILING PANELS

A. Install acoustical ceiling materials in compliance with manufacturer's specifications and recommendations, including the following:
   1. Fit acoustic units in place, free from damaged edges, soiled surfaces, or other defects detrimental to appearance and function.
   2. Install acoustic units level, in uniform plane, free from twist, warp, and dents.
   3. Lay directional patterned units one way with pattern parallel to longest room axis, unless otherwise shown on the drawings.
   4. Fit border panels neatly against abutting surfaces.

3.05 CLEANING AND PROTECTION

A. Upon completion of the Work, remove all unused materials, debris, containers, and equipment from the project site. Clean and repair floors, walls, and other surfaces that have been stained, marred, or otherwise damaged by work under this Section.

B. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension member. Comply with manufacturer’s instructions for cleaning and touch-up of minor finish damage. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

C. Protect acoustical ceilings during the construction period so that they will be without any deterioration or damage at the time of acceptance by Owner.

**END OF SECTION 095100**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SCOPE

A. This section includes exterior, suspended, linear metal ceilings.

B. Related Divisions include the following:
   1. Division 26 – Electrical for light fixtures within the linear metal ceilings.

1.03 STANDARDS

A. All work of this section shall conform to industry standards and/or manufacturer's recommendations.

1.04 SUBMITTALS

A. Submit pursuant to Section 013300 – Submittal Procedures.

B. Submit pursuant to Section 016000 – Product Requirements.

C. Product Data: Submit product data for linear ceiling panels, carrier system, filler strips, edge angles and trims.

D. Samples: Submit color charts for preliminary color selections. Submit three (3) physical samples (3" x 4" approximately) in the finish specified of all colors chosen for final color selection by Architect.

1.05 QUALITY ASSURANCE

A. All work of this section shall be performed by experienced workers familiar with the work and according to manufacturer's recommendations and/or industry standards.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturers published instructions.

B. Protect against moisture exposure and damage.

1.07 WARRANTY

A. Thirty (30) year limited warranty against chalking and fading.

PART 2 PRODUCTS

2.01 METAL CEILING PANELS

A. Manufacturer:
   1. ATAS International, Inc., 6612 Snowdrift Road, Allentown, PA 18106, Phone: (800) 468-1441.

B. Material – Metal Ceiling Panels:

1. Linear Ceiling LCR with recessed filler strip.
2. Size – 3 3/8” Wide.
3. 0.032 aluminum

C. Material – Carrier for Suspended Ceiling
1. Thickness: 0.040
2. Radius carrier per manufactured recommendation.
3. Carrier Spacing as recommended by manufacturer.

D. Finish:
1. Premium fluoropolymer, PVDF, Kynar 500/HYLAR 5000 coating.
2. Color to be selected by Architect.

2.02 ACCESSORIES

A. All accessories from manufacturer’s standard aluminum shapes consistent with the system.

B. Fasteners shall be aluminum, non-corrosive screw shank, long enough to penetrate sheathing into stud or masonry construction.

PART 3 EXECUTION

3.01 EXAMINATION

A. Installer shall examine all substrates on which panel system and accessories are to be applied.
1. If surfaces are not suitable for application of panel system, installer shall notify the Architect of such in writing.
2. Installation shall not proceed until surface is acceptable to all parties involved in the project.
3. Installer must field verify all necessary dimensions prior to fabrication of materials.

3.02 INSTALLATION

A. Installer to comply with manufacturer’s installation instructions and shop drawings.

B. Entire system shall be installed plumb, level and true to line.

C. Panel system is not to come in contact with dissimilar materials which will cause a harmful reaction between the metals and/or finish.

D. Workmanship must conform to standards established within the industry.

E. Panels must be fully interlocked with its adjacent panel.

F. Sealants to be applied as necessary at flashing details to achieve a weathertight system.

G. Do not use an abrasive saw that causes the metal to heat up.

H. Care should be taken during handling of panels to prevent bending, twisting, abrasion, scratching, denting, etc.

I. Only minor scratches are to be touched-up in field.

J. Protective masking must be removed immediately after installation.

K. Sweep and remove chips, shavings and dust from roof on a daily basis.

3.03 CLEANING

A. Installer is to leave work areas clean, free from grease, finger marks and stains.

B. Remove scrap and debris from surrounding areas and grounds.

3.04 PROTECTION

A. Protect work area as required and protect from damage by other trades.

**END OF SECTION 095423**

**PAGE INTENTIONALLY BLANK**

PART I GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Rubber Wall Base.

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Section 096519 - Resilient Tile Flooring

1.03 STANDARDS

A. All work of this section shall conform to industry standards and/or manufacturer's recommendations.

B. RFCI Handbook.

1.04 SUBMITTALS

A. Pursuant to Section 013300 - Submittal Procedures.
   1. Product Data: Manufacturer's technical data for resilient base.
   2. Samples for Initial Selection Purpose: Manufacturer's standard and custom color samples in form of actual sections of rubber base, including accessories, showing full range of colors and patterns available for each type of resilient base required. The Architect shall select the colors, patterns, and textures from the manufacturer's complete range of standard and custom colors.

B. Maintenance Instructions: Submit two (2) Copies of manufacturer's recommended maintenance practices for each type of resilient flooring and accessory required.

C. Pursuant to Section 016000 - Product Requirements

1.05 QUALITY ASSURANCE

A. Experienced workers familiar with the work and according to manufacturers' recommendations and/or industry standards shall perform all work of this section.

B. Provide each type of resilient base and accessories as produced by a single manufacturer, including recommended primers, adhesive, sealants, and leveling compounds.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturer's published instructions.

B. Protect against moisture exposure and damage.

C. Store and install only where space temperatures are within resilient materials manufacturer's specified range. Thereafter, maintain resilient materials manufacturer's specified environmental conditions.

1.07 PROJECT CONDITIONS

A. Maintain minimum temperature of 65-degrees F (18 deg C) in spaces to receive resilient base for at least 48 hours prior to installation, during installation, and for not less than 48 hours after installation. Store resilient base materials in spaces where they will be installed for at least 48 hours before beginning installation. Maintain minimum temperature of 55 degrees F (13 deg C) in areas where work is completed.

B. Install resilient base and accessories after other finishing operations, including painting, have been completed.

1.08 EXTRA MATERIALS

A. Furnish an extra 3% of each base type, shape, size, gloss, and color in clearly marked containers for Owner’s use.

PART 2 PRODUCTS

2.01 RESILIENT BASE

A. Acceptable Manufacturers
   1. Armstrong World Industries, Inc.
   2. Roppe Corporation, USA
   3. Johnsonite.

B. Material: Rubber.

C. Height: 4 inch

D. Toe shape: Cove, with toe.

E. Thickness: 1/8 in.

F. Color: Selection by Architect from manufacturer's standard array.

2.02 ACCESSORY MATERIALS

A. Adhesive: Resilient base manufacturers recommended product that meets VOC requirements of the project.

PART 3 EXECUTION

3.01 INSPECTION

A. The Installer shall inspect subfloor & wall surfaces to determine that they are satisfactory. A satisfactory subfloor surface is defined as one that is smooth and free from cracks, holes, and ridges. Coatings preventing adhesive bond, and other defects that impair performance or appearance shall be corrected.

B. Vacuum surfaces to be covered and inspect floor.

3.02 INSTALLATION

A. Apply wall base to walls, columns, pilasters, casework and other permanent fixtures in rooms or areas where base is required. Install base in lengths as long as practicable, with preformed corner units, or fabricated from base materials with mitered or coped inside corners.
   1. Cove base shall not be cut on the line of an outside corner.

B. Tightly bond base to substrate throughout length of each piece, with continuous contact at horizontal and vertical surfaces.
   1. On masonry surfaces, or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.

C. Before starting installation, layout base material to provide the minimum number of joints with no strip less than 24 inches in length.

D. Roll base for complete adhesion.

3.03 CLEANING AND PROTECTION

A. Clean all exposed surfaces of base and adjoining areas of adhesive spatter before it sets.

B. Keep traffic off resilient material for at least 72 hours after installation.

C. Clean and polish materials in the following order:
   1. After two weeks, scrub resilient base with a minimum amount of water and a mild detergent. Leave surfaces clean and free of detergent residue.

D. When protective materials are removed and immediately prior to acceptance, replace damaged materials and re-clean resilient materials. Damaged materials are defined as having cuts, gouges, scrapes or tears and not fully adhered.

**END OF SECTION 096513**

**PAGE INTENTIONALLY BLANK**

PART I GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Rubber Stair Tread without Riser.
   2. Rubber Stair Landing and Ramp Surfacing, including other flooring areas as shown on Contract Drawings.
   3. Related Accessories.

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Section 033500 – Concrete Finishing
   2. Section 096513 – Resilient Base and Accessories

1.03 STANDARDS

A. All work of this section shall conform to industry standards and/or manufacturer's recommendations.

B. ASTM F710 – "Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring".

C. ASTM F2169 – "Standard Specification for Resilient Stair Treads".

1.04 SUBMITTALS

A. Pursuant to Section 013300 – Submittal Procedures.
   1. Product Data: Manufacturer's technical data for each type of stair tread, stair riser, stair landing and ramp flooring, adhesives and any other related accessories.
   2. Samples for Initial Selection Purpose: Manufacturer's standard and custom color samples in form of actual sections of rubber stair treads, risers, and stair landing surfacing, including accessories, showing full range of colors and patterns available for each type of resilient and rubber flooring required. The Architect shall select the colors, patterns, and textures from the manufacturer's complete range of standard and custom colors.
   3. Warranty: Submit manufacturer's standard limited commercial warranty.

B. Maintenance Instructions: Submit two (2) Copies of manufacturer's recommended maintenance practices for each type of stair tread and flooring required.

C. Pursuant to Section 016000 – Product Requirements

1.05 QUALITY ASSURANCE

A. Experienced workers familiar with the work and according to manufacturers' recommendations and/or industry standards shall perform all work of this section.

B. Manufacturer Qualifications: Provide resilient stair treads, risers and stair landing flooring materials manufactured in the United States of America by a firm with a minimum of 10 years' experience producing resilient stair flooring materials of type equivalent to those specified.

C. Provide each type of stair tread, riser if required, floor/ramp landing material and accessories as produced by a single manufacturer, including recommended primers, adhesive, and sealants.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturer’s published instructions.

B. Protect against moisture exposure and damage.

C. Store and install only where space temperatures are within stair covering manufacturer's specified range.

1.07 PROJECT CONDITIONS

A. Maintain minimum temperature of 65-degrees F (18 deg C) in spaces to receive stair covering materials for at least 48 hours prior to installation, during installation, and for not less than 48 hours after installation. Store stair covering materials in spaces where they will be installed for at least 48 hours before beginning installation. Maintain minimum temperature of 55 degrees F (13 deg C) in areas where work is completed.

B. Maintain relative humidity at service levels, or between 40% and 65% RH.

C. Install stair covering and ramp materials after other finishing operations, including painting, have been completed.

1.08 WARRANTY

A. Provide manufacturer’s standard limited commercial warranty covering manufacturing and material defects.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Roppe Corporation, 1602 N. Union St., Fostoria, OH 44830. Phone: 800-537-9527 (Basis of Specification)

B. Other acceptable manufacturers provided they meet or exceed all requirements of this specification:
   1. FLEXCO, Corporation, 1401 East 6th Street, Tuscumbia, AL 35674. Phone: 800-633-3151
   2. Johnsonite Inc., 16910 Munn Road, Chagrin Falls, Ohio 44023. Phone: 800-899-8916

2.02 STAIR COVERING MATERIALS:

A. Stair Treads and Riser: Molded rubber, 1/4-inch-thick at nose tapering to 1/8-inch-thick at back edge and riser; FS RR-T-650, Composition A, Type 2 - Designed; full width and depth of stair; provide tread and riser (if specified) in separate pieces; raised pattern design (tread); square nose returning down edge of tread 1-1/2 inches. Provide tread with self-illuminating abrasive glow strips at front edge of tread.
   1. Tread Raised Pattern Design: Roppe #94 Raised Square Design

B. Adhesive: As recommended by the stair covering material manufacturer for the type of substrate indicated.

C. Epoxy Void Filler: As recommended by the stair tread manufacturer to strengthen nosing, fill voids and open spaces at the nosing between the stair tread and stair substrate. Recommended void filler to be used also at junction of riser and tread, as chamfer support for rubber.

2.03 STAIR LANDING AND RAMP/LOBBY TILES

A. 1/8” thick, manufacturer’s standard tile size with raised square design to match stair treads.

B. At beginning of interior ramps (both top and bottom) provide a 6" wide (cut from full tile) accent tile full width of ramp. Accent tile shall be color #644 Sunbeam with raised square design.

2.04 ACCESSORY MATERIALS

A. Adhesive: Rubber Stair Treads, Risers and Landing/Ramp Tiles manufacturer’s recommended product that meets VOC requirements of the project.

PART 3 EXECUTION

3.01 INSPECTION

A. The Installer shall inspect stair tread, stair landing, ramps and other surfaces to determine that they are satisfactory. A satisfactory surface is defined as one that is clean, smooth, permanently dry, flat and free from cracks, holes, and ridges. Coatings preventing adhesive bond, and other defects that impair performance or appearance shall be corrected.

B. Perform bond and moisture tests on concrete substrates to determine if surfaces are sufficiently cured and dry as well to ascertain presence of curing compounds.

C. Do not allow stair tread/ramp flooring work to proceed until substrate surfaces are satisfactory.

D. Vacuum surfaces just prior to installation of treads, risers, and landing surfaces.

3.02 INSTALLATION

A. Install material in accordance with manufacturer’s instructions and recommendations.
   1. Select the appropriate, approved adhesive for the application and job conditions.
   2. A stair tread is to be placed at the edge of each landing at the top of the stairs.

B. Tightly bond treads, risers and flooring to substrate throughout length of each piece, with continuous contact at surfaces.

C. Roll treads, risers and flooring for complete adhesion.

D. Promptly remove any excess adhesive.

E. Rubber Stair Tread Accessories:
   1. Provide stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
   2. For treads installed as separate, equal-length units, install to produce a flush joint between units.

F. Install accent rubber tile strips at top and bottom of all interior ramps as specified.

3.03 CLEANING AND PROTECTION

A. Clean up installation area and sweep, vacuum dust or wipe material to remove any dirt, dust or debris.

B. Keep traffic off stair tread, stair landings, and ramps for at least 72 hours after installation.

C. When construction traffic is anticipated, cover stair tread, stair landing and ramp materials with reinforced kraft paper and plywood or hardboard properly secured and maintained until Substantial Completion.

D. When protective materials are removed and immediately prior to acceptance, replace damaged materials and re-clean stair treads, risers and landing flooring. Damaged materials are defined as having cuts, gouges, scrapes or tears and not fully adhered.

**END OF SECTION 096513.23**

PART I GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Vinyl Composition Tile (VCT).
   2. Transition Strips.
   3. Related Accessories.

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Section 033000 - Cast-In-Place Concrete
   2. Section 090561.13 - Moisture Vapor Emission Control
   3. Section 096513 - Resilient Base and Accessories
   4. Section 096513.23 - Resilient Stair Treads

1.03 STANDARDS

A. All work of this section shall conform to industry standards and/or manufacturer's recommendations.

B. Resilient Floor Covering Institute (RFCI) Handbook.

C. ASTM F710 "Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring".

D. ASTM F1066 "Standard Specification for Vinyl Composition Floor Tile".

1.04 SUBMITTALS

A. Pursuant to Section 013300 - Submittal Procedures.
   1. Product Data: Manufacturer's technical data for each type of resilient flooring and accessory.
   2. Samples for Initial Selection Purpose: Manufacturer's standard and custom color charts in form of actual sections of resilient flooring, including accessories, showing full range of colors and patterns available for each type of resilient and rubber flooring required. The Architect shall select the colors, patterns, and textures from the manufacturer's complete range of standard and custom colors.

B. Maintenance Instructions: Submit two (2) Copies of manufacturer's recommended maintenance practices for each type of resilient flooring and accessory provided.

C. Pursuant to Section 016000 - Product Requirements.

1.05 QUALITY ASSURANCE

A. Experienced workers familiar with the work and according to manufacturers' recommendations and/or industry standards shall perform all work of this section.

B. Provide each type of resilient flooring and accessories as produced by a single manufacturer, including recommended primers, adhesive, sealants, and leveling compounds.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturers published instructions.

B. Protect against moisture exposure and damage.

C. Store and install only where space temperatures are within resilient materials manufacturer's specified range. Thereafter, maintain resilient materials manufacturer's specified environmental conditions.

1.07 PROJECT CONDITIONS

A. Maintain minimum temperature of 65-degrees F in spaces to receive resilient flooring for at least 48 hours prior to installation, during installation, and for not less than 48 hours after installation. Store resilient flooring materials in spaces where they will be installed for at least 48 hours before beginning installation. Maintain minimum temperature of 55 degrees F in areas where work is completed.

B. Install resilient flooring and accessories after other finishing operations, including painting, have been completed. Do not install resilient flooring over concrete slabs until the installation of the moisture vapor emission control membrane is complete.

1.08 MANDATORY TESTING

A. Hardened concrete to receive resilient flooring shall be tested using anhydrous calcium chloride test for measurement of vapor emissions.
   1. Three (3) tests shall be required for initial 2,000 sq. ft. and one (1) additional test for each 1,000 sq. ft. of floor over 2,000 sq. ft.
   2. All tests must be done simultaneously.
   3. Resilient flooring shall not be installed unless tests meet or exceed manufacturer’s recommendations for their adhesive and flooring.
   4. Test must be performed by an independent testing agency.
   5. Testing agency shall supply three (3) copies of test results to the Architect.

1.09 EXTRA MATERIALS

A. Furnish an extra 3% of each tile type, shape, size, gloss, and color in clearly marked containers for Owner’s use.

PART 2 PRODUCTS

2.01 TILE, VINYL COMPOSITION

A. Acceptable Manufacturers
   1. Armstrong World Industries, Inc. (Basis of Specification)

B. Provide Imperial® Texture Standard EXCELON® Tile Flooring manufactured by Armstrong World Industries, Inc., having a nominal total thickness of 1/8”/0.125in., 12” x 12”, composed of polyvinyl chloride resin binder, plasticizers, fillers, and pigments with colors and texture dispersed uniformly throughout its thickness. Vinyl composition tile shall conform to the requirements of ASTM F 1066, Class 2 - through pattern.
   1. Surface Design: Smooth.
   2. Field and Accent Colors: As selected by the Architect from manufacturer’s full range of colors.

C. Pattern, if any, shown on drawings.

2.02 ACCESSORY MATERIALS

A. Adhesive: Resilient flooring manufacturers required for each product, substrate, and location; must meet manufacturer's warranty requirements.

B. Leveling and Underlayment Compound:
   1. Where required- as recommended by the moisture vapor emission control manufacturer.
   2. Latex cementitious type as required by moisture emission control manufacturer. Minimum 28-day compressive strength: 4000-lb./sq. ft.

C. Transition Strips
   1. ROPPE #22 Reducer Strip
   2. ROPPE #195 Feature Strip
   3. Colors as selected by Architect

PART 3 EXECUTION

3.01 INSPECTION

A. The Installer shall inspect subfloor surfaces to determine that they are satisfactory. A satisfactory subfloor surface is defined as one that is smooth and free from cracks, holes, and ridges. Coatings preventing adhesive bond, and other defects impair performance or appearance.

B. Perform bond and moisture tests on concrete subfloors to determine if surfaces are sufficiently cured and dry as well to ascertain presence of curing compounds.

C. Do not allow resilient flooring work to proceed until subfloor surfaces are satisfactory.

3.02 PREPARATION

A. Test substrate to ensure proper dryness.

B. Prepare subfloor surfaces as follows:
   1. Use leveling, and patching compounds as recommended by resilient flooring manufacturer for filling small cracks, holes, and depressions in subfloors. Maximum surface variation: 1/8-inch in 10-feet in any direction.
   2. Remove coatings from subfloor surfaces that would prevent adhesive bond, including curing compounds incompatible with resilient flooring adhesives, paint, oils, waxes and sealers.

C. Vacuum surfaces to be covered and inspect floor.

D. Apply vapor reduction membrane in accordance with Specification Section 090561.13 - Moisture Vapor Emission Control.

3.03 INSTALLATION

A. Standards: Manufacturer's published instructions taking special care to avoid damaging the moisture vapor emission membrane and tape system.

B. Lay tile and related materials so that fields or patterns center on areas, so that tile at opposite edges of room are of equal width.

1. Adjust pattern that edge pieces are not less than 1/2 tile size.
2. Lay tile square to room axis, unless otherwise shown.

C. Match tiles for color and pattern by using tile from cartons in same sequence as manufactured and packaged, if so numbered.

D. Lay materials true to line, level, and with tight joints. Scribe, cut, and tightly fit materials to and around permanent fixtures, equipment, pipes, and bases. Extend resilient flooring into toe spaces, door reveals, and into closets and similar openings.
1. Lay tile with grain running in opposite directions.

E. Tightly cement resilient flooring to subbase (using full spread of adhesive applied in compliance with flooring manufacturer's directions) without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, or other surface imperfections. Hand roll resilient flooring at perimeter of each covered area to assure adhesion.

F. Maintain reference markers, holes, or openings that are in place or plainly marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other non-permanent marking device.

G. After installation, remove excessive adhesive pursuant to resilient material manufacturer's published instructions.

3.04 INSTALLATION OF ACCESSORIES

A. Place resilient edge strips tightly butted to flooring and secure with adhesive. Install edging strips at edges of flooring which would otherwise be exposed and extends beyond.

B. Do not install VCT after wall tile installation.

C. Rubber Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor coverings that would otherwise be exposed.

3.05 CLEANING AND PROTECTION

A. Sweep and vacuum tile surfaces thoroughly.

B. Scrub the floor with a neutral detergent solution to remove black marks and excessive soil. Thoroughly rinse and allow to air dry. DO NOT wash floor until time period recommended by resilient flooring manufacturer and moisture vapor emission control manufacturer has elapsed to allow resilient flooring to become well sealed in adhesive.

C. Remove any excess adhesive or other surface blemishes, using appropriate cleaner recommended by resilient flooring manufacturers.

D. Apply three coats of a high-quality commercial floor polish. Follow manufacturer's printed instructions.

E. Protect flooring against damage during construction period to comply with resilient flooring manufacturer's directions.

F. Protect resilient flooring against damage from rolling loads for initial period following installation by covering with plywood or hardboard. Use dollies to move stationary equipment or furnishing across floors.

G. Cover resilient flooring with un-dyed, untreated building paper until inspection for Substantial Completion.

**END OF SECTION 096519**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Surface Preparation.
   2. Extent of painting work is shown on drawings and schedules, and as herein specified.
   3. The Work includes painting and finishing of all interior and exterior work, except as otherwise indicated.
   4. Special painting items include but are not limited to: exterior steel lintels; exposed ductwork, pipes, and conduits; and exposed structural and miscellaneous steel.
   5. The work incldues painting within the existing building of new infills', areas damaged by selective demolition and/or other construciton activities, new doors and frames installed in exsiting walls or openings.
   6. Stencil painting fire rated and/or smoke tight wall assembly identification.

B. Work Not Included
   1. Prefinished Materials: Including floor finishes, prefinished ceiling components, cement board siding, brick, ACMU, cast stone, metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, and bronze and other products furnished with factory finishes unless otherwise indicated.
   2. Concealed Surfaces: Unless otherwise indicated, painting is not required on surfaces such as walls or ceilings in concealed areas and generally inaccessible areas, foundation spaces, furred areas, utility tunnels, pipe spaces, duct shafts and elevator shafts.

C. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Section 033500 - Concrete Finishing
   2. Section 042200 - Concrete Unit Masonry.
   3. Division 05 - Metals
   4. Section 079200 - Sealants.
   5. Section 081113 - Hollow Metal Doors & Frames
   6. Section 083113 - Access Doors and Frames
   7. Section 092116 - Gypsum Board Assemblies.

1.03 STANDARDS

A. All work of this section shall conform to industry standards and/or manufacturer’s recommendations.

B. ASTM D16 "Standard Terminology for Paint, Related Coatings, Materials, and Applications".

C. ASTM D4214 "Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films".

D. ASTM D660 "Standard Test Method for Evaluating Degree of Checking of Exterior Paints".

E. ASTM D661 "Standard Test Method for Evaluating Degree of Cracking of Exterior Paints".

F. ASTM D714 "Standard Test Method for Evaluating Degree of Blistering of Paints".

G. ASTM D5324 "Standard Guide for Testing Water-Borne Architectural Coatings".

H. ASTM D3170 "Standard Test Method for Chipping Resistance of Coatings".

I. SSPC - SP 1 "Solvent Cleaning".

J. SSPC - SP 2 "Hand Tool Cleaning".

K. SSPC - SP 3 "Power Tool Cleaning".

L. SSPC - SP 13/NACE No. 6 "Surface Preparation for Concrete".

M. EPA-Method 24.

N. OTC (Ozone Transport Commission) Regulation No. 41.

1.04 SUBMITTALS

A. Submit pursuant to Section 013300 - Submittal Procedures:

B. Submit pursuant to Section 016000 - Product Requirements.

C. Manufacturer's Literature: Material description and application instructions for each type of material specified or required.

D. Coating Maintenance Manual: Upon conclusion of the project, the Contractor or paint manufacturer/supplier shall furnish a coating maintenance manual, such as Sherwin-Williams “Custodian Project Color and Product Information” report or equal. 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 Sheets, care and cleaning instructions, touch-up procedures, and color samples (“drops”) of each color and finish used.

E. Manufacturer’s latest array of full line of colors (color fans).

F. For materials to receive stain & polyurethane provide two samples of each selected stain color on each wood species being used.

G. Submit OTC (Ozone Transport Commission) lower VOC compliant products only. Colorant/Tint used in coatings shall add no additional VOC to final product.

H. Provide Manufacturer Safety Data Specs (MSDS).

1.05 QUALITY ASSURANCE

A. Experienced workers familiar with the work shall perform all work of this section according to manufacturers’ recommendations and/or industry standards.

B. Provide materials only in factory sealed and labeled containers. Reuse of any containers for any reason is prohibited and will result in work not being acceptable.

C. Unless specified, or Architect approved to the contrary, provide all coating materials from same manufacturer.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturers published instructions.

B. Protect against moisture exposure and damage.

C. Receive paint materials only in unopened, original containers with labels intact. Store materials on site in an approved location. When so ascertained, remove immediately from job site all damaged or otherwise defective material.

D. Provide labels on each container with the following information:
   1. Name or title of product.
   2. Manufacturer's color identification code
   3. Manufacturer's stock number.
   4. Manufacturer's name.
   5. VOC Content.
   6. Batch Date.
   7. Contents by volume, for major pigment and vehicle constituents.
   8. Thinning instructions.
   9. Application instructions.

1.07 PROJECT/SITE CONDITIONS

A. Environmental conditions can be modified only if such requirements are a part of manufacturer's published application instructions.

B. Apply paint materials only when surface and air temperatures are above 50 degrees F for 48 hours before, during, and after the paint application.

C. Do not apply exterior paint or stain during rain, snow, or damp weather.

D. Do not apply paint in direct sunlight.

E. Apply paint materials only when relative humidity is lower than 85% and surface temperature is at least 5 degrees F above dew point.
   1. Conditions must remain acceptable to manufacturer’s recommendations during drying time.

F. Apply paint only to surfaces that are free of surface moisture.

G. Do not apply paint in areas with airborne dust or where dust can be generated.

1.08 SAMPLING OF MATERIALS

A. Samples of materials being used on the job may be taken at any time at discretion of Architect and checked for compliance to these specifications.

1.09 EXTRA STOCK

A. Provide 1 gallon of each separate color and finish product used on Project.

B. Label each container with color, texture, sheen, and room designation, in addition to manufacturer's unobstructed label.

1.10 DEFINITIONS

A. Conform to ANSI/ASTM D16 for interpretation of terms used in this Section.

B. The term “Paint”, as used herein, includes enamels, paints, sealers, fillers, emulsions, stains, varnishes and other coatings whether used as prime, intermediate, or finish coats.

C. "MDF" equals minimum dry film thickness. The numbers specified denote the thickness of each coat.

D. “Properly Painted Surface” - A surface that is uniform in appearance, color, sheen, and without telegraphing of any portion of the substrate. It is one that is free of foreign material, lumps, skins, runs, sags, holidays, misses, strike-through, or insufficient coverage. It is a surface that is free of drips, spatters, spills, or overspray which a Contractor’s workforce may cause. Compliance to meeting the criteria of a “Properly Painted Surface” shall be determined by the Architect when viewed without magnification at a distance of five (5) feet or more under normal lighting (both daylight and artificial) conditions and from a normal viewing position.

1.11 EPOXY PAINT SAMPLE

A. Four samples of 8x16 CMU of the Type to be painted with epoxy wall paint shall be painted with the approved block filler to demonstrate the level of block filler to be applied. Two of the four CMU shall then be painted with the approved number of coats of epoxy paint in the color selected for the project. Architect and Owner shall approve painted block samples prior to beginning epoxy paint.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
   1. General Architectural Coatings
      a. Benjamin Moore & Co.
      b. Sherwin Williams Company.

B. Provide products specifically formulated for geographical area in which Project is located.

C. MPI Standards: Provide products that comply with MPI standards and that are listed in its “MPI Approved Products List”.

2.02 COLORS

A. Selection: by Architect from manufacturer’s full range.

B. Proprietary names used to designate colors or materials are not intended to imply that products of those manufacturers are required to the exclusion of Architect approved equivalent products of other manufacturers - unless noted otherwise.

2.03 COATING SYSTEMS

A. Gypsum board epoxy system (where called for in finish schedule)
   1. Sherwin Williams
      a. Primer: ProMar 200 Zero VOC Primer; MDF 1.5
      b. Two coats: Water Based Catalyzed Epoxy; MDF 2.5-3.0
      c. Total System: MDF 6.5-7.5.
   2. Benjamin Moore
      a. Primer: Fresh Start 100% Acrylic Primer (023) MDF 1.0-1.5
      b. Two Coats: Super Spec Acrylic Epoxy (256) MDF 1.5 per coat

B. Gypsum board - General Office Area (dry environment)
   1. Sherwin Williams

a. Drywall Primer: USG Sheetrock Brand First Coat Primer DFT 0.9-1.2
b. Paint Primer: ProMar 200 Zero VOC Primer; MDF 1.5
c. Two coats: ProMar 200 Zero VOC Low Sheen Eg-Shel; MDF 1.6
d. Total System: MDF 4.7

2. Benjamin Moore
a. Drywall Primer: USG Sheetrock Brand First Coat Primer DFT 0.9-1.2
b. Paint Primer: Eco Spec WB Latex Primer Sealer (372); MDF 1.2
c. Two coats: Eco Spec WB Latex Sheen Eggshell (374); MDF 1.4 per coat
d. Total System: DFT 3.5 - 4.0.

C. Ferrous metals, shop primed (flat and gloss, solvent base)
1. Sherwin Williams
a. Primer: Pro Industrial Pro-Cryl Universal Primer (B66-310);
b. MDF 2.0-4.0
c. Two coats: Pro Industrial Acrylic Semi-Gloss; MDF 2.5 per coat
d. Total System: MDF 7.0 - 9.0

2. Benjamin Moore
a. Primer: Alkyd Metal Primer (P04); MDF 2.0
b. Two coats: Super Spec HP DTM Acrylic High Gloss (P28); MDF 2.0 per coat
c. Total System: DFT 6.0

D. Wood, painted (semi-gloss, water base)
1. Sherwin Williams
a. Primer: PrepRite Premium Wall and Wood Primer MDF 1.4
b. Two coats: ProMar 200 Zero VOC Semi-Gloss MDF 1.6
c. Total System: MDF 4.6

2. Benjamin Moore
a. Primer: Eco Spec WB Latex Primer Sealer (372); MDF 1.2
b. Two coats: Eco Spec WB Latex Semi-Gloss (376); MDF 1.5 per coat
c. Total System: DFT 3.5 - 4.5

E. Wood, finished (semi-gloss, solvent base and stain)
1. Sherwin Williams
a. Primer: follow manufacturer's instructions for wood grain filler and/or wood conditioner
b. First Coat: Minwax 250 VOC Stains
c. Second & Third Coat: Wood Classics Waterborne Satin Varnish (A68) MDF 1.3 per coat
d. Total System: MDF 2.6

2. Benjamin Moore
a. Primer: follow manufacturer's instructions for wood grain filler and/or wood conditioner
b. First Coat: Benwood Interior Wood Finishes, Polyurethane Low Lustre (435); MDF 1.0 - 1.2
c. Second & Third Coat: Benwood Interior Wood Finishes, Polyurethane Low Lustre (435); MDF 1.0 - 1.2 per coat
d. Total System: MDF 3.0 - 3.6

F. Interior CMU (Paint)
1. Sherwin Williams
a. First Coat: Pro Industrial HD Block Filler (B42W00150) MDF 8.0
b. Two Coats: ProMar 200 Zero VOC Eg-shel (B20W12651); MDF 1.6
c. Total System: MDF 11.2-12.0

2. Benjamin Moore
a. First Coat: Moorecraft Super Craft Latex Block Filler (285), MDF 8.1-11.0

b. Two Coats: Eco Spec WB Latex Eggshell (374); MDF 1.4 per coat
c. Total System DFT: 12.0 - 13.5

G. Interior CMU (Epoxy, Semi-Gloss)
1. Sherwin Williams
a. First Coat: Loxon Block Surfacer (A24W200) MDF 8.0
b. Two Coats: Water Based Catalyzed Epoxy (B70W00211) MDF 2.8 per coat
c. Total System: MDF 13.0-14.0
2. Benjamin Moore
a. First Coat: Moorecraft Super Craft Latex Block Filler (285); MDF 9.0 - 11.00
b. Two Coats: Super Spec Acrylic Epoxy Semi Gloss (256-86) MDF 1.5 per coat
c. Total System: MDF 12.0 - 13.5

H. Metal Deck Ceiling for Exposed Structure and Accessories. Surface Prep SSPC-SP1
1. Sherwin Williams
a. First Coat: Waterborne Acrylic Dryfall Eg-shell (B42W2) MDF 3.0
b. Second Coat: Waterborne Acrylic Dryfall Eg-shell (B42W2) MDF 3.0
c. Total System: MDF 6.0 - 7.5
2. Benjamin Moore
a. First Coat: Acrylic Metal Primer (P04), MDF 1.5 - 2.5
b. Second Coat: Super Spec Sweep Latex Flat (153), MDF 2.0

I. Ferrous Metal hidden from view (e.g. - back side of door frames, lintels, etc.);
1. Sherwin Williams
a. One Coat: Pro Industrial Pro-Cryl Universal Primer (B66-310);
b. MDF 2.0-4.0
2. Benjamin Moore
a. One Coat: Acrylic Metal Primer (P04), MDF 1.5-2.5

J. Apparatus Bay and Exterior Apron Painted Guide Stripe on Concrete Floor, Hardened Concrete Floor, or Polished Concrete Floor (Must mechanically prep areas to receive traffic marking)
1. Watco
a. One Coat: Anti Slip Traffic Paint,

K. Exposed PVC Piping
1. Sherwin Williams
a. One Coat: DTM Bonding Primer Off White (B66A00050)
b. Two Coats: ProMar 200 Zero VOC Interior Latex Semi-Gloss (B31W02651)
2. Benjamin Moore
a. One Coat: STIX Waterborne Bonding Primer SXA-110
b. Two Coats: Ultra Spec 500 Interior Eggshell Finish (N538)

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been properly prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

D. Test shop-applied primer for compatibility with subsequent cover materials.

E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
   1. Gypsum Wallboard: 12 percent.
   2. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
   3. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 GENERAL PREPARATION (ALL SUBSTRATES)

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

3.03 CONCRETE AND CMU PREPARATION

A. Remove all surface dust, dirt and other contaminants by brooming, air blast, or vacuum cleaner.

B. Remove form release agents, laitance, dirt and other contamination, as required by coatings manufacturer, by using a light blast with fine silica sand.

C. Obtain allowable moisture content level from coatings manufacturer. Determine moisture content by means of a moisture meter designed specifically for concrete and operated by a qualified inspector. Apply coatings only after all conditions conform to published requirements of coating manufacturer.

3.04 GYPSUM BOARD SURFACE PREPARATION

A. Do not use linseed oil putty, glazing materials, patching pencils, caulking, or masking tape on surfaces to be painted.

B. Sand and dust as necessary.

C. Remove all dust, dirt, powdery residue, grease, oil, wax, or any other contaminants.

D. Spot prime defects after repair.

3.05 FERROUS METAL SURFACE PREPARATION

A. Shop Primed
   1. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
   2. Remove oils and lubricants by using mineral spirits or xylol solvents. Change applicators frequently to avoid recontamination. Execute pursuant to SSPC SP-1.

3.06 GALVANIZED METAL SURFACE PREPARATION

A. Remove oils, greases, and waxes by using appropriate solvents. Change applicators frequently to avoid recontamination. Execute pursuant to SSPC SP-1.

B. Remove water-soluble contaminants by washing with water.

3.07 WOOD SURFACE PREPARATION

A. Remove oil and grease by using mineral spirits or xylol. Change applicators frequently to avoid recontamination.

B. Seal defects such as knots, resins, gum pockets, or extractives by using a mixture of equal parts of shellac and alcohol.

C. Remove mildew by scrubbing with a solution of 1 tablespoon of dry powdered laundry detergent with 1 quart of hypochlorite type household bleach to 3 quarts of warm water. After scrubbing, rinse thoroughly with clean water

D. Fill nail holes, cracks, or other surface defects by using putty. Where stained or clear finishes will be applied, use putty that is colored to match natural color of the unfinished wood.

E. Back prime all trim, bases, casing, and finish lumber prior to installation.

F. Apply two (2) coats of primer on all redwood or cedar where paint will be applied.

G. Sand and dust as necessary.

3.08 INTERIOR POLYURETHANE MOLDINGS, TRIM AND EXTERIOR SYNTHETIC TRIM

A. Follow manufacturers recommended surface preparation requirements.

B. Fill nail holes, cracks, joints between pieces, or other surface defects by using putty or material as recommended by molding and/or trim manufacturer. Sand all patched areas smooth.

3.09 APPLICATION

A. Beginning of installation means acceptance of existing surfaces.

B. Apply paint pursuant manufacturer's directions. Use applicators and techniques best suited for type of material being applied.

C. Apply additional coats when undercoats, stains or other conditions show through final coat of paint, until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

D. On GWB walls with suspended acoustical ceilings, apply primer and first coat of finish paint prior to ceiling grid installation. Extend these two coats 4” above ceiling line.

E. Sand lightly between each succeeding enamel or varnish coat.

F. Spray Painting: allowable interiors to be approved by the Architect. Limit spray-painting on interior surface to acoustical plaster (if any) and service spaces such as mechanical equipment rooms.

G. Minimum coating thickness: apply each material at not less than manufacturer's recommended spreading rate.

H. Prime coats: apply a prime coat if specified to material which is required to be painted or finished, and which has not been prime coated.

I. Recoat primed and sealed walls and ceilings where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.

J. Roller Applications: roll and redistribute paint to an even and fine texture. Leave no evidence of rolling such as laps, irregularity in texture, skid marks, or other surface imperfections.

K. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness or other surface imperfections are not acceptable. Cut in sharp lines and color breaks.

L. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, or other surface imperfections.

M. Completed Work: Match approved samples for color, texture and coverage. Remove, refinish or repaint Work not in compliance with specified requirements.

3.10 INCLUSIONS

A. Paint all surfaces specified, scheduled, illustrated, and otherwise exposed to view except those items or surfaces specifically noted.

B. Paint all exposed exterior and interior piping, bollards, frames, conduit, ductwork, steel grilles, and related fittings identical with room or ceiling color or adjacent surfaces unless specifically noted otherwise. This includes all conduit, ductwork and piping in the Apparatus Bays and adjacent rooms.

C. Finish recesses same as adjoining rooms. Finish all other surfaces same as nearest or adjoining surfaces unless specifically noted otherwise.

D. Paint surfaces behind equipment and furniture same as equal or adjacent exposed surfaces.

E. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint.

F. Paint backsides of access panels and removable or hinged covers to match exposed surfaces.

G. Paint all hollow metal doors and frames that do not have a factory provided finish.
   1. As directed by Architect, hollow metal frames and doors may be different colors on each side of frame and/or door.
   2. Finish door tops, bottoms and side edges same as faces, unless otherwise indicated.
   3. Hollow metal doors and/or frames may be painted different colors from one side to the other.

H. Paint all steel bollards, overhead door steel jambs and lintels, all exposed metal stairs and railings, steel structure, galvanized decking, conduit, piping, ductwork and framing in the apparatus bay.

I. Paint all exterior and interior lintels.

J. Paint numbers on interior of each overhead door as detailed on Contract Drawings.

K. Paint metal louvers in wood doors to match door frame.

L. Paint any exterior trim that does not have a factory provided finish.

M. Stencil paint in contrasting color “FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS” at tops of all fire rated and/or smoke tight walls and or partitions. Lettering must be a minimum 3.0 inches in height, must appear within 15 feet of the end of each wall or partition and at intervals not exceeding 30 feet measured horizontally along the wall or partition.

3.11 EXISTING BUILDING INCLUSIONS

A. Where new infills have been installed, paint infill area and any ajoining area damaged by select demolition and/or infill installation shall be painted to match adjacent surfaces.

B. Anywhere selective demolition or other construction activity has damaged, marked, stained existing painted surfaces, restore and repaint to match surrounding surfaces.

C. New doors and frames installed in existing walls shall be painted.

D. Where new windows are installed in existing openings, re-paint existing steel lintels.

3.12 EXCLUSIONS

A. Exclude finishing of pre-finished items including but not limited to plastic laminate finished components, metal or plastic toilet partitions, factory finished equipment, acoustical materials, light fixtures, wiring devices, electrical device plates, and fire detection, alarm and suppression devices unless specifically noted otherwise.

B. Exclude finishing of chases, concealed wall or ceiling spaces, or similar inaccessible spaces unless specifically noted otherwise.

C. Exclude finishing of anodized or electrostatically painted aluminum, stainless steel, chrome plating, copper, brass, bronze, ceramic tile, quarry tile, stone products, or similar materials with an integral finish unless specifically noted otherwise.

D. Do not paint over labels or plates containing written or numerical information such as laboratory fire resistivity labels on rated doors and frames and the manufacturer's name and descriptive information on circuit breaker panel covers.

E. Do not paint over the moving portion of any mechanical or electrical assemblies, sensing devices, and/or fusible links.

3.13 PROTECTION OF OTHER WORK

A. Protect adjacent surfaces, whether to be painted or not, against damage by painting and finishing work. Correct any damages by cleaning, repairing or replacing, and repainting, as directed by Architect.

B. Coordinate the maintenance and subsequent removal of temporary protective wrappings.

3.14 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
   1. Contractor shall touch up and restore painted surfaces damaged by testing. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as

needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

B. Should telegraphing (photographing) of the substrate and or discoloration of the surface caused by the substrate appear within one (1) year from the date of substantial completion, the Contractor shall repaint the area with matching paint to resolve the telegraphing/discoloration. The Architect shall be the sole judge of the extent of telegraphing and or discoloration.

3.15 CLEANING

A. Daily clean up: During the progress of the Work, remove from the project daily, all discarded paint materials, rubbish, cans and rags.

B. Properly handle, store, and dispose of all hazardous materials.

C. Upon completion, clean all glass and other paint--spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage-finished surfaces. Restore all damaged surfaces to their original condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

**END OF SECTION 099100**

**PAGE INTENTIONALLY BLANK**

PART 1-GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This Section includes the following types of signs;
   1. ADA Compliant Interior Room/Door Signage & Specialty Signage.
   2. Cast Metal Dedication Plaque.
   3. Truss Identification Signage.

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Division 01 Section “Temporary Facilities and Controls” for temporary project identification signs.
   2. Section 061000 - Rough Carpentry.
   3. Division 22 for “Plumbing Identification” for labels, tags, and nameplates for mechanical equipment.
   4. Division 23 for “Mechanical Identification” for labels, tags, and nameplates for mechanical equipment.
   5. Division 26 for “Electrical Identification” for labels, tags, and nameplates for electrical equipment.
   6. Division 26 for “Interior lighting” for illuminated exit signs.
   7. Civil Drawings for exterior traffic control and parking space signage.

1.03 STANDARDS

A. All work of this section shall conform to industry standards and/or manufacturer’s recommendations.

B. 36 CFR 1191 - American with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines.

C. ADA Standards - American with Disabilities Act (ADA) Standards for Accessible Design.

D. ICC A117.1 - Accessible and Usable Buildings and Facilities.

1.04 SUBMITTALS

A. Pursuant to Section 013300 - Submittal Procedures.

B. Pursuant to Section 016000 - Product Requirements.

C. Submit samples of each color and finish of exposed materials and accessories required for specialty signs. Submit full range of available fonts for all signage. Architect’s review of samples will be for color, texture and fonts only.

D. Shop Drawings: Include plans, elevations, and large-scale sections of typical members and other components. Show mounting methods, grounds, mounting heights, layout, spacing, reinforcement, accessories, and installation details.
   1. Provide message list for each sign, including large-scale details of wording, lettering, and Braille layout.
   2. Any sign, plaque and or medallion containing artwork, it is the responsibility of the manufacturer to re-create artwork (vector graphics will not be provided).

1.05 QUALITY ASSURANCE

A. Experienced workers familiar with the work and according to manufacturer's recommendations and/or industry standards shall perform all work of this section.

B. Source Limitations: Obtain each sign type through one source from a single manufacturer.

C. Regulatory Requirements: Comply with the Americans with Disabilities Act (ADA) and with code provisions as adopted by authorities having jurisdiction.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturers published instructions.

B. Protect against moisture exposure and damage.

1.07 PROJECT CONDITIONS

A. Field Measurements: Where sizes of signs are determined by dimensions of surfaces on which they are installed, verify dimensions by field measurement before fabrication and indicate measurements on Shop Drawings.

1.08 COORDINATION

A. For signs supported by or anchored to permanent construction, advise installers of anchorage devices about specific requirements for placement of anchorage devices and similar items to be used for attaching signs and/or letters.
   1. For signs and letters supported by or anchored to permanent construction, furnish templates for installation of anchorage devices.

PART 2 PRODUCTS

2.01 MANUFACTURERS & MATERIALS

A. Interior Room Signs: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
   1. Interior Room Signs
      a. Mohawk Sign Systems, Series 200A, P.O. Box 966, Schenectady, NY 12301-0966. (T) (518) 842-5303; (F) (518) 842-5306.
      b. Architect Approved Equivalent meeting LEED Credit MR 5.1 requirements.
   2. All signs shall be manufactured using Graphic Process Series 200A-Sand Carved using Format D.
      a. Plastic or metal signs with tactile reflective routed lettering. Tactile characters shall be raised the required 1/32-inch from sign face. Glue-on letters or etched backgrounds are not acceptable.
      b. Grade 2 Braille shall accompany all text. Braille shall be separated ½-inch from the corresponding raised characters. Grade 2 Braille translations to be provided by signage manufacturer.
      c. Architect shall select colors from manufacturer's full range.
      d. Every door in the project shall have an identifying sign at every door or opening into the room/corridor.
      e. All signage shall meet ADA and ANSI requirements.
   3. Sign material shall be melamine plastic laminate, approximately 1/8-inch thick
      a. with contrasting core color. The melamine shall be non-static, fire-retardant and
      b. self-extinguishing. The plastic laminate shall be impervious to most acids,

c. alkalis, alcohol, solvents, abrasives and boiling water.

4. Size of letters and numbers shall be as follows:
   a. Room Number shall be 1-inch high.
   b. Lettering for Room ID signs shall be ¾-inch high.
   c. Symbol size shall be 4-inches high.
   d. Standard Grade 2 Braille shall be ½-inch below copy.
5. Letterform shall be Gill Sans upper case.
6. Copy Position: CC (centered/centered)
7. Sign Size:
   a. Room Function Signs: 6 inch x 6 inch unless text requires a longer sign.
   b. Restroom Signs; shall be design ADA-4 size 8-inches x 8-inches with a 4-inch accessibility symbol, gender symbol, and the verbal description placed directly below followed by Grade 2 Braille.
   c. Corners: Square Edge.

2.02 DEDICATION PLAQUE

A. Available Manufacturers:
   1. United States Bronze, 811 Second Avenue, New Hyde Park, NY 11040 Phone: (800) 872-5155
   2. Architect Approved Equivalent.

B. Plaque: Castings shall be free from pits, scale, sand holes, or other defects. Comply with requirements specified for metal, border style, background texture, and finish and with other requirements shown for thickness, size, shape, and copy. Hand-tool and buff corners and raised copy to produce the manufacturer's standard satin polished finish. Refer to the "Materials" Article for other finish requirements.

C. Material: Cast Bronze
   1. Lettering, border, texture and background color selected by Architect from manufacturer's full range.

D. Size: Minimum 864 Sq. In.

E. Lettering: Raised, Gill Sans upper case.

F. Mounting:
   1. Verify location with Owner and Architect.
   2. Method: Drilled thru to receive screws with rosettes

G. Names:
   1. Fire Company Name
   2. Fire Department Emblem
   3. H2M architects + engineers
   4. Other individuals and wording to be selected by Owner.
   5. Construction Manager
   6. Construction Contractor

H. Bronze Castings: Provide bronze castings, copper alloy UNS C83600, complying with the requirements of ASTM B 584.

2.03 TRUSS IDENTIFICATION SIGNAGE

A. Signs identifying the existence of truss construction shall consist of a circle 6" in diameter, with a stroke width of ½ inch. The sign background shall be reflective white in color. The circle and

contents shall be reflective red in color, conforming to Pantone matching system (PMS) #187. Signs directly applied to a door or sidelight may be a permanent non-fading sticker or decal. Signs not directly applied to doors or sidelights shall be of sturdy, non-fading, weather resistant material.

B. Quantity: Two decal type, One aluminum.

C. Copy: To be furnished

2.04 SPECIALTY SIGNS

A. Special Signs
   1. Provide the following special signs constructed in the same manner as room identification signage unless noted otherwise, in colors as selected by the Architect. Consult Architect for exact placement location of these signs.
      a. Two - 12 inch x 12 inch, “In Case of Fire-Use Stairs” with graphics to be located near elevator doors on each floor.
      b. One gate sign (16 inch x 16 inch). Provide means for attaching to gate mesh fabric or pickets.
         1) Copy: “Training Only--Gate must remain closed and locked at all times when not in use”.
      c. Six rappelling point load signs (4”x12”)
         1) Copy to be furnished.
      d. Twenty, “EXIT” (See Code Analysis Drawings for Locations)
      e. One white reflective aluminum exterior sign with red letters 12”x 12” “FDC” furnish with brass screws for exterior mounting.
         1) Sign to be composed of an inner polyethylene core sandwiched between two sheets of 0.0080 aluminum.
         2) Engineer-grade reflective vinyl overlay.
         3) Visible both day and night.
      f. One 12 inch x 12 inch, “No Storage Allowed”.
      g. Two - 16 inch x 16 inch, Text and location to be determined by the Architect
      h. One - 9" x 6", "Area of Refuge" sign constructed of photoluminescent vinyl material with Braille, secured to concrete wall with stainless steel expansion anchors.
      i. One - 8" x 12", "Authorized Personal Only" to be mounted on Door 103B.

2.05 FASTENERS AND ANCHORS

A. Fasteners: Use concealed fasteners fabricated from metals that are not corrosive to the sign material and mounting surface.

B. Anchors and Inserts: Use nonferrous metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

PART 3 EXECUTION

3.01 INSTALLATION

A. General: Locate sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer’s instructions and conformance with ADA.
   1. Install signs level, plumb, and at height indicated, with sign surfaces free from distortion or other defects in appearance.

B. Wall-Mounted Panel Signs: Attach panel signs to wall surfaces using the methods indicated below:
   1. Vinyl-Tape Mounting: Use double-sided foam tape to mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.
   2. Silicone-Adhesive Mounting: Use liquid silicone adhesive recommended by the sign manufacturer to attach sign units to irregular, porous, or vinyl-covered surfaces. Use double-sided vinyl tape where recommended by the sign manufacturer to hold the sign in place until the adhesive has fully cured.
   3. Exterior signs: Use brass screws with plastic shields or stainless steel expansion type anchors at all four corners.

C. Cast Metal Plaques: Mount plaques using the standard method recommended by the manufacturer for the type of wall surface indicated.
   1. Face Mounting: Mount plaques using exposed fasteners with rosettes attached through the face of the plaque into the wall surface.

D. All signage and subsequent mounting shall comply with ANSI and ADA.
   1. Tactile signage shall be located alongside the door on the latch side
   2. Tactile signage shall be mounted at 60” A.F.F. to the centerline of the sign.
   3. At locations of double doors, tactile signs shall be mounted to the right of the right-hand door.
   4. Where there is no available wall space at the latch side of the door, signs may be placed on the nearest adjacent wall.

E. Verify all mounting locations with the Architect prior to any work.

3.02 CLEANING AND PROTECTION

A. After installation, clean soiled sign surfaces according to manufacturer’s written instructions. Protect signs from damage until acceptance by Owner and Substantial Completion.

**END OF SECTION 101400**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Surface-Mounted Multi-Roll Toilet Tissue Dispensers.
   2. ADA Compliant Grab Bars.
   3. Shower Curtain Rods, Curtains and Hooks.
   4. Fold Down Shower Seat.
   5. Associated Fasteners

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Section 042200 – Concrete Unit Masonry for attachment to this material.
   2. Section 061000 – Rough Carpentry for wood blocking and nailers.
   3. Section 088300 – Mirrors.
   4. Section 093013 – Ceramic Tiling for attachment to this material.
   5. Section 102826 - Hygiene Accessories for Hand Sanitizer Dispensers.

1.03 STANDARDS

A. All work of this section shall conform to industry standards and/or manufacturer’s recommendations.

1.04 SUBMITTALS

A. Pursuant to Section 013300 – Submittal Procedures.

B. Pursuant to Section 016000 – Product Requirements

C. Product Data: Provide manufacturer's cut sheets for each different type or style of toilet and miscellaneous accessories required for the project.

D. Accessories schedule: Indicate manufacturer's name, product description, product model number, finish, mounting, special components, and location of each item.

1.05 QUALITY ASSURANCE

A. All work of this section shall be performed by experienced workers familiar with the work and according to manufacturer's recommendations and/or industry standards.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturers published instructions.

B. Protect against moisture exposure and damage.

C. Deliver to project site in manufacturer's original packaging with intended location marked on package. Include manufacturer's published installation instructions, fasteners, and installation tools.

D. Retain finish protective coverings until final cleanup.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers for Toilet Accessories: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
   1. Bradley Corporation (Basis of Specification – unless noted otherwise)
   2. Bobrick Washroom Equipment
   3. American Specialties, Inc.
   4. AJW Architectural Products
   5. Architect Approved Equivalent

B. Available Manufacturers for Miscellaneous Accessories: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include those listed below or Architect Approved Equivalents to the specified products.

2.02 TOILET COMPARTMENTS

A. Items
   1. Surface-mounted multi-roll toilet tissue dispenser - Bradley 5402.
   2. Grab Bars – Bradley 812-2 with peened gripping surface – where shown on contract drawings.
      a. Mounting: concealed with grab bar welded to the mounting flange, mounting flange secured to substrate with stainless steel screws.
      b. Escutcheon: Cover plate escutcheon is decorative only.
      c. Surface finish: satin.
      d. Diameter: 1-1/2 in.; uniform around curves.
      e. Configurations: shown on drawings.

2.03 SHOWER AREA

A. Items:
   1. Shower Curtain Rods: Bradley 9539
      a. Style: 1-1/4" diameter, straight--match shower width.
      b. Mounting: Concealed
   2. Microban anti-bacterial shower curtain: Bradley 9537 – shower width + 6" wide, white, custom length to overlap inside of terrazzo base by two inches.
   3. Curtain Hooks: Bradley 9536.
   4. Surface Mount Shower Soap Dish: Bradley 9014.

2.04 ADA SHOWER AREA

A. Items:
   1. Shower Curtain Rods:
      a. Rod size and material: 1-1/4 in. - Bradley 9539.
      b. Mounting: Concealed mounting with snap-on vandal resistant protective escutcheons.
   2. Microban anti-bacterial shower curtain: Bradley 9537 – shower width +6" wide, white
   3. Curtain Hooks: Bradley 9536.
   4. Grab Bars - Bradley 800 Series with peened gripping surface.

a. Mounting: concealed with grab bar welded to the mounting flange, mounting flange secured to substrate with stainless steel screws.
b. Escutcheon: Cover plate escutcheon is decorative only.
c. Surface finish: Satin.
d. Diameter: 1-1/2 in.; uniform around curves.
e. Configurations: shown on drawings.

5. Fold Down Shower Seat: Bradley 956 (9561) Configuration as shown on drawings.
6. Surface Mount Shower Soap Dish: Bradley 9014.

2.05 FASTENERS – ALL ACCESSORIES

A. Provide bolts, screws, plates, anchors, toggles, and other fastening devices for permanent and secure installation to produce loading requirements where applicable and which are designed specifically for adjoining construction.

B. All fasteners: Stainless steel.

PART 3 EXECUTION

3.01 INSTALLATION

A. Pursuant to manufacturers published instructions.

B. Install plumb, level, and square, free of bowing, warping, or racking.

C. Install at elevations pursuant to applicable codes, manufacturers published instructions, and as may be modified on Drawings.

D. All installations must fasten into solid structure or blocking.

E. Fit flanges, escutcheons, and edges tight against finish surface.

F. Provide all accessories keyed alike. Turn over all keys and/or access tools to the Owner.

G. Remove and discard finish protective coverings.

**END OF SECTION 102813**

**PAGE INTENTIONALLY BLANK**

PART 1- GENERAL

1.01 RELATED DOCUMENTS

A. Drawing and general provisions of the Agreement, including General and Division 01 of the Specifications, apply to work of this section.

1.02 SUMMARY

A. This Section includes the following:
   1. Emergency Self-Contained Eyewash Station.

B. Related Sections include the following:
   1. Section 042200 – Concrete Unit Masonry for attachment to this material.

1.03 STANDARDS

A. All work of this section shall conform to industry standards and/or manufacturer's recommendations.

1.04 SUBMITTALS

A. Submit following pursuant to Section 013300 - Submittal Procedures.

B. Submit pursuant to Section 016000 - Product Requirements.

C. Product Data: Indicate manufacturer's name, product model number, mounting, special components, and location of each item.

1.05 QUALITY ASSURANCE

A. All work of this section shall be performed by experienced workers familiar with the work and according to manufacturer's recommendations and/or industry standards.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturer's published instructions.

B. Protect against moisture exposure and damage.

C. Deliver to project site in manufacturer's original packaging with intended location marked on package. Include manufacturer's published installation instructions, fasteners, and installation tools.

D. Retain finish protective coverings until final cleaning.

PART 2 – PRODUCTS

2.01 EYEWASH STATION

A. Honeywell Fendall 2000™ series Sterile Eyewash Station Model #32-002000-0000 with sterile saline cartridge manufactured by Sperian Eye & Face Protection.
   1. Provide with four (4) (three (3) extra) eyewash station sterile saline refill cartridges #32-ST2050-0000.
   2. Provide with one Fendall 2000 Dust Cover #32-002015-0000 and emergency eyewash station sign.

3. Provide installation/training DVD to Owner as part of closeout documents.

2.02 FASTENERS – ALL ACCESSORIES

A. Provide bolts, screws, plates, anchors, toggles, and other fastening devices for permanent and secure installation to produce loading requirements where applicable and which are designed specifically for adjoining construction.

B. All fasteners: Stainless steel.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Pursuant to manufacturers published instructions.

B. Install plumb, level, and square, free of bowing, warping, or racking.

C. Install at elevations pursuant to applicable codes, manufacturer's published instructions, and as may be modified on Drawings.

D. Do not install eyewash station until just before Substantial Completion and all final cleaning has been performed. Install emergency eyewash station sign directly above unit with bottom of sign at 8'-0" A.F.F.

E. Turn over spare saline refill cartridges to Owner.

F. Remove and discard finish protective coverings.

**END OF SECTION 104319**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This Section includes:
   1. Fire Extinguishers
   2. Fire Extinguisher Signage

1.03 STANDARDS

A. All work of this section shall conform to industry standards and/or manufacturer's recommendations.

B. NFPA 10 "Standard for Portable Fire Extinguishers".

C. Fire extinguishers shall comply with all codes and requirements.

1.04 SUBMITTALS

A. Pursuant to Section 013300 - Submittal Procedures

B. Pursuant to Section 016000 - Product Requirements

C. Product Data: Submit manufacturer's product data and installation instructions including roughing-in dimensions, and details showing mounting methods, relationships to surrounding construction, cabinet type and materials, and trim style.

D. Shop drawings or manufacturer's literature showing size, configuration, capacity, contents and all additional pertinent information describing the equipment to be provided.

1.05 QUALITY ASSURANCE

A. All work of this section shall be performed by experienced workers familiar with the work and according to manufacturer's recommendations and/or industry standards.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturers published instructions.

B. Protect against moisture exposure and damage.

C. Do not test operate extinguishers.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:
   1. Amerex Corporation
   2. J. L. Industries, Inc.

3. Larsen's Manufacturing Co.
4. Potter Roemer
5. Kidde

2.02 PORTABLE FIRE EXTINGUISHERS

A. Type FE-1: Multi-purpose dry chemical type. Minimum 10-pound capacity, UL rating 4A: 80 B: C with hose, nozzle, and color-coded pressure gauge. Amerex Model B456 or equal.
   1. Supply mounting bracket for locations in apparatus bay and any other locations as shown on drawings and any other locations required by Codes.
   2. Provide rigid plastic 3-Way View Fire Extinguisher sign with arrow and graphic Style No. 84500 by Seton or Architect approved equivalent.

PART 3 EXECUTION

3.01 INSTALLATION:

A. Install extinguishers at locations indicated on the drawings.
   1. Top of individually mounted extinguishers shall not be more than 54” above finished floor.
   2. Bottom shall not be less than 15” above finished floor.

3.02 IDENTIFICATION

A. Provide each wall hung Type FE-1 fire extinguisher with a 3D plastic angle stand out sign mounted above each fire extinguisher. Top of sign to be placed 7’-6” AFF.

3.03 INSPECTION

A. Verify and ensure that all fire extinguishers are fully charged at the time of installation and that a current fire department inspection tag is prominently attached to each wall unit.
   1. Do not test discharge any fire extinguisher. If discharge occurs, recharge unit and secure and affix new inspection tag. Submit copy of new tag to Architect, identifying the affected unit and its installed location. Architect reserves the right to require recharging and inspection of any fire extinguisher which shows evidence of having been operated prior to acceptance.

**END OF SECTION 104400**

PART 1- GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Specifications, apply to work of this section.

1.02 SUMMARY

A. This Section includes:
   1. Locker Area Benches.

B. Related Sections:
   1. Section 093013 – Tile for attachment to this material.

1.03 STANDARDS

A. All work of this section shall conform to industry standards and/or manufacturer's recommendations.

1.04 SUBMITTALS

A. Submit following pursuant to Section 013300 - Submittal Procedures.

B. Submit pursuant to Section 016000 - Product Requirements.

C. Product Data: Indicate manufacturer's name, product model number, mounting, special components, and location of each item.

1.05 QUALITY ASSURANCE

A. All work of this section shall be performed by experienced workers familiar with the work and according to manufacturer's recommendations and/or industry standards.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturer's published instructions.

B. Protect against moisture exposure and damage.

C. Deliver to project site in manufacturer's original packaging with intended location marked on package. Include manufacturer's published installation instructions, fasteners, and installation tools.

D. Retain finish protective coverings until final cleaning.

PART 2 – PRODUCTS

2.01 ACCESSIBLE BENCHES

A. 5/4" Thick maple hardwood bench.
   1. Quantities and sizes: As per Contract Drawings.
   2. Pedestals 1-1/4" diameter steel tubing with 10 ga. Flanges, secured to bench tops with stainless steel tamper resistant Torx head screws and secured to the floor with lead expansion shields and 2" long stainless steel machine bolts.

3. Finish: Stained in a color as selected by Architect. After staining finish with three (3) coats satin polyurethane.

2.02 FASTENERS – ALL ACCESSORIES

A. Provide bolts, screws, plates, anchors, toggles, and other fastening devices for permanent and secure installation to produce loading requirements where applicable and which are designed specifically for adjoining construction.

B. All fasteners: Stainless steel.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Pursuant to manufacturers published instructions.

B. Install plumb, level, and square, free of bowing, warping, or racking.

C. Remove and discard finish protective coverings.

**END OF SECTION 105153**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Building supported, pre-engineered metal canopies including fascia channels, decking, tension rods, downspouts and attachment hardware.

B. Related Sections:
   1. Section 076200 - SHEET METAL FLASHING AND TRIM
   2. Section 079200 – SEALANTS

1.03 REFERENCES

A. Aluminum Association (AA) DAF 45 – Designation System for Aluminum Finishes.

B. American Architectural Manufacturers Association (AAMA)
   1. AAMA 2605 - "Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels".

C. American Society of Civil Engineers (ASCE) 7 – Minimum Design Loads for Buildings and Other Structures.

D. ASTM B221– "Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes".

1.04 SYSTEM DESCRIPTION

A. Design Requirements:
   1. Design canopy system to withstand: wind pressure, snow load, and drifting snow load in accordance with values shown on the Contract Drawings and with current adopted requirements of the International Building Code or accepted requirements of local authorities having jurisdiction.

1.05 SUBMITTALS

A. Pursuant to Section 013300 – Submittal Procedures.

B. Pursuant to Section 016000 – Product Requirements.

C. Submittals for Review:
   1. Shop Drawings: Indicate system components, dimensions, attachments, and accessories.
   2. Professional Engineering calculations are required and must be signed and sealed by an Engineer licensed in the State canopy is to be installed.
   3. Samples:
      a. 3 x 3 inch coating samples in specified color.
      b. 6 inch long fascia extrusion sample showing profile and standard finish.
      c. 6 inch decking samples showing profile and standard finish.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Minimum 5 years experience in installation of MASA products or other pre-engineered canopy systems.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store all canopy components in protected areas.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. MASA Architectural Canopies. 250 Stelton Road, Piscataway, NJ 08854, Phone: (800) 761-7446. Web site: www.architecturalcanopies.com.
   1. Extrudeck Series

2.02 MATERIALS

A. Aluminum Extrusions:
   1. ASTM B221 & ASTM B429/B429M 6063-T5 alloy and temper.

B. Hardware:
   1. All fasteners shall be stainless steel for corrosion resistance.

2.03 COMPONENTS

A. Framing:
   1. Type: Extruded aluminum “J” channel fascia.
   2. Size: 8" x 0.125

B. Canopy Supports: Extruded Aluminum Canopy Support “I” Beam.

C. Decking: 3” x 6” x0.090 Interlocking Extruded aluminum flat soffit decking.

D. Attachment: 1.050” diameter steel hanger rod with square wall plates, finished to match canopy.

E. Custom Fascia Profiles: Curved.

F. Other Components: other components as indicated or as required for system attachment and performance.

2.04 ACCESSORIES

A. Down Spouts 2” x 3”, 0.125 Heavy Extruded Finished to match canopy color.
   1. Extend downspouts to precast concrete splash blocks at grade.
   2. Secure downspouts to building with matching brackets.

2.05 FABRICATION

A. Fabricate canopy system in accordance with approved Shop Drawings.
   1. Pre-assembled canopies are shop welded by MASA approved personnel.
   2. Drainage system to be concealed type. Covered surfaces direct water to field drilled drain, to be coordinated at site.

2.06 FINISHES

A. AAMA 2605 Fluoropolymer coating containing a minimum 70% PVDF Resins.

B. Duranar by PPG Industries, Inc.

C. Color: As selected by Architect from MASA's full color range.

PART 3 EXECUTION

3.01 FIELD DIMENSIONS

A. Field verify dimensions of supporting structure at site of installation prior to fabrication.

3.02 INSTALLATION

A. Install in strict accordance with manufacturer’s instructions and approved Shop Drawings.

B. Protect the finish during handling and erection.

C. Install components plumb and level, in proper plane, free from warp and twist.

D. Anchor system to building components; provide adequate clearance for movement caused by thermal expansion and contraction and wind loads.

E. Provide compression spacers between canopy and veneer masonry.

F. Surround wall anchors with watertight sealant.

G. Embed all wall anchors washers in sealant to provide watertight seal.

H. To ensure proper drainage, install canopy with positive camber.

I. Seal all corners, edge seams, etc. Rain water must flow to gutter and downspout(s). Water shall not drip-thru canopy in any location.

3.03 ADJUSTING

A. Touch up minor scratches and abrasions on finished surfaces to match original finish.

B. Clean with mild, non-abrasive solution and a cotton cloth under low pressure.

**END OF SECTION 107316.13**

**PAGE INTENTIONALLY BLANK**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This Section includes TV mounting brackets.

B. Related Sections:
   1. Section 061000 - Rough Carpentry for wood blocking

1.03 STANDARDS

A. All work of this Section shall conform to industry standards and/or manufacturer's recommendations.

1.04 SUBMITTALS

A. Pursuant to Section 013300 - Submittal Procedures.

B. Pursuant to Section 016000 - Product Requirements.

C. Manufacturer's cut sheets for each different model.

1.05 QUALITY ASSURANCE

A. All work of this section shall be performed by experienced workers familiar with the work and according to manufacturer's recommendations and/or industry standards.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturers published instructions.

PART 2 - PRODUCTS

2.01 MANUFACTURER:

A. Legrand AV Inc., 6436 City West Parkway, Eden Prairie, MN 55344, Phone: 800-359-5520, www.sanus.com.
   1. Sanus Brand

2.02 TV TYPES

A. Articulating Flat Panel Wall Mounts
   1. SANUS Advanced Full-Motion Premium TV Mount, Model VLF728 - Black

PART 3 - EXECUTION

3.01 INSTALLATION

A. Coordinate installation with electrical and cable TV cabling.

B. Mount securely in strict accordance with manufacturer's instructions. Solid wood blocking must be provided in GWB walls at all TV location brackets.

C. Verify that mounting will support the maximum weight allowable for the unit by the manufacturer but not less than twice the weight of the television.

3.02 ADJUSTMENT AND CLEANING

A. Adjust for smooth operation. Thoroughly clean off all construction dirt and packaging. Do not remove manufacturer's instruction labels or maximum capacity warning labels.

**END OF SECTION 115223**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This section includes Specialized Equipment unique to the Fire Service.

1.03 RELATED REQUIREMENTS:

A. Section 055000 - Metal Fabrications: Rope Tie Offs, Face shield hooks and Metal training aids & accessories.

B. Division 22 - Plumbing

C. Division 26 - Electrical

1.04 STANDARDS

A. All work of this section shall confirm to industry standards and/or manufacturer's recommendations.

1.05 SUBMITTALS

A. Pursuant to Section 013000 - Submittals.

B. Pursuant to Section 016000 - Product Requirements

C. Product Data: Manufacturer's Data Sheets on each product specified herein.

1.06 QUALITY ASSURANCE

A. Experienced workers familiar with the work and according to manufacturer's recommendations and/or industry standards shall perform all work on this Section.

1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Pursuant to manufacturers published instructions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Footwear Sanitizing Systems
   1. Best Sanitizers Inc., PO Box 1360, Penn Valley, CA 95946. Phone: 888-225-3267 (Basis of Specification and Design).

2.02 FOOTWEAR SANITIZING SYSTEM

A. HACCP SmartStep Footwear Sanitizing System by Best Sanitizers Inc.
   1. Model ADB0002-BS SmartStep Sanitizing unit with scrubber and handle.
   2. One-Alpet D2 Surface Sanitizer 5 gallon pail (including insert, dip tube, and shipping cap).
   3. One - Instructional Poster for SmartStep Sanitizing Unit with scrubber.

PART 3 EXECUTION

3.01 ASSEMBLY

A. Assemble in accordance with manufacturer’s instructions.

3.02 INSTALLATION

A. Install and/or place Firematic Units as indicated on Contract Drawings.

3.03 CLEANING AND PROTECTION

A. Clean units prior to Substantial Completion.

**END OF SECTION 119600**

SHELVING AND CASEWORK

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This section includes, but not limited to, the following:
   1. Radio Room console

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Section 061000 - Rough Carpentry for blocking within walls to adequately support casework.
   2. Section 079200 - Sealants for caulking of casework and/or countertops to abutting walls.
   3. Section 092116 - Gypsum Board Assemblies.
   4. Division 26 Electrical - Furnishing, installation, and final connections of wiring, conduit, and/or electrical items within the plastic laminate shall be performed by the Electrical Contractor in accordance with IEC of New York State and local codes.

1.03 STANDARDS

A. All work of this section shall conform to industry standards and/or manufacturer’s recommendations.

B. Architectural Woodwork Institute (AWI) Quality Standard: "Architectural Woodwork Quality Standards".

C. AWI Custom grade.

D. ANSI/KCMA A161.1 "Recommended Performance and Construction Standards for Kitchen and Vanity Cabinets".

E. ANSI 161.2 "Performance Standards for Fabricated High Pressure Decorative Laminate Countertops".

1.04 SUBMITTALS

A. Division 01 Section “LEED Certification Procedures” for additional LEED requirements.

B. Division 01 Section “VOC Content Restrictions” for additional LEED requirements.

C. Submit pursuant to Section 013300 - Submittal Procedures.

D. Submit pursuant to Section 016100 - Product Requirements.

E. Product Data: Submit manufacturer's technical product data and installation instructions indicating materials, hardware, and finishes used in fabrication of cabinets, as required to show compliance with specifications.

F. Shop Drawings: Submit shop drawings indicating location and size of each type of cabinet and countertops, accessories, materials, finishes, hardware types and locations, fillers, etc. Include

fully dimensioned plans and elevations and indicate details of anchorage to countertop and to walls.

1.05 QUALITY ASSURANCE

A. All work of this section shall be performed by experienced workers familiar with the work and according to manufacturers' recommendations and/or industry standards.

B. Source limitations for cabinets: Obtain cabinets and vanity supports through one source from a single manufacturer/fabricator.

C. Verify casework dimensions to field measurements.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturer’s published instructions.

B. Protect against moisture exposure and damage.

C. Protect cabinets during transit, delivery, storage and handling to prevent damage, soiling and deterioration.

D. Do not deliver cabinets until painting, wet work, grinding and similar operations, which could be performed before installation of cabinets, have been completed in installation areas.

1.07 JOB CONDITIONS

A. Do not deliver or install any items of this specification until spaces are enclosed and weathertight. Comply with cabinet manufacturer's recommendations for temperature and humidity requirements in cabinet installation areas. Do not install cabinets and countertops until required temperature and relative humidity have been stabilized and will be maintained in installed areas.

B. Maintain temperature and humidity in installation areas as required to maintain moisture content of installed cabinet work within a tolerance range of the optimum moisture content acceptable to cabinet manufacturer, from date of installation through remainder of construction period.

PART 2 PRODUCTS

2.01 MATERIALS

A. Plastic laminates to be selected from Nevamar, Formica, Wilsonart or approval equivalent.
   1. 0.050 countertops, edge boards and backsplash.
   2. Shall have white melamine laminated backer sheets at underside.
   3. Colors to be selected by Architect.

B. Particle Board
   1. 45 lb. Density
   2. Other thickness as noted below

C. Plywood
   1. ¾” AC exterior Grade

D. Metal Brackets & Supports
   1. Countertop Brackets

a. 1/8” steel work station brackets as manufactured by A & M Hardware, Inc., 400 W. Gramby Street, Manheim, PA 17545, Phone (888) 647-0200 or Architect approved equivalent.
b. Size: as shown on Drawings.
c. Finish: pre-finished as selected by Architect from manufacturer’s standard colors.

2.02 COMPONENTS

A. Drawers
1. Boxes: Constructed of 1/2” pre-finished birch plywood components joined with blind rabbeted corners and galvanized brads with square drive, flat head and self-countersinking heads (Equality Screw Co. #7650).
2. Bottoms: 1/2” fiberboard with white melamine finish (trapped in grooves at all four sides).
3. Horizontal Frame Rails (If applicable): Between drawers to be 3/4” x 3 1/2” white melamine with high pressure plastic laminate (GP-50) edge banding.

2.03 HARDWARE

A. Drawer Slides: Accuride #3832; full-extension attached to cabinet with:

B. System Screws: Blum 5mm x 10mm zinc plated (Blum #661.1000) attached to drawer box with: flat head zinc screws #6 x ½” (Blum #6062).

C. Cabinet Handles: 3½” clear anodized satin-finished aluminum bent pulls (Hafele #116.39.446).

D. Door and Drawer Face Bumpers: Blum 4mm x 1.5mm resilient plastic bumper (Blum ETP1950).

E. Continuous Hinge: Stanley heavy gauge #314-1/4 solid brass, bright brass finish with solid brass screws.

F. Grommets: 2” round plastic grommets. Color as selected from Manufacturer’s standard colors.

PART 3 EXECUTION

3.01 INSPECTION

A. Inspect substrate and conditions under which cabinets are to be installed.

3.02 BLOCKING

A. Contractor shall provide blocking in walls for casework support.

3.03 INSTALLATION

A. Install plastic laminate plumb, level, true and straight with no distortions. Shim as required using concealed shims. Where plastic laminate abut other finished work, scribe and cut for accurate fit.

B. Complete hardware installation and adjust operating panels and drawers for proper operation.

3.04 CLEANING AND PROTECTION

A. Repair or remove and replace defective work as directed upon completion of installation.

B. Clean exposed and semi-exposed surfaces, touch-up as required. Remove and refinish damaged or soiled areas.

C. Make final adjustments to opeating panels and drawers. Operating panels shall swing freely, catches shall hold securely, and all operating panels shall be aligned both vertically and horizontally. Drawers shall open and close smoothly, without binding and without excessive side play.

**END OF SECTION 123216**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This Section includes, but is not limited to, the following:
   1. Radio Room countertops and console unless noted otherwise.
   2. Window sills.

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Section 061000 - Rough Carpentry
   2. Section 079200 - Sealants
   3. Section 092116 - Gypsum Board Assemblies.

1.03 STANDARDS

A. All work of this section shall conform to industry standards and/or manufacturer's recommendations.

B. ANSI/NSF 51 -"Food Equipment Materials"

C. ASTM C170 – "Standard Test Method for Compressive Strength of Dimension Stone".

D. ASTM E84 – "Standard Test Method for Surface Burning Characteristics of Building Materials".

1.04 SUBMITTALS

A. Pursuant to Section 013300 - Submittal Procedures.

B. Pursuant to Section 016000 - Product Requirements.

C. Manufacturer Certifications:
   1. Signed by manufacturers certifying that they comply with the following requirements:
      a. NSF/ANSI Standard 51: Food Contact
      b. UL 723 (ASTM E84): Surface Burning Characteristics

D. Product Data:
   1. Submit manufacturer's technical product data on material characteristics, performance properties, fabrication instructions and installation instructions.

E. Shop Drawings:
   1. Show location of each item; provide complete detailed and dimensioned plans and elevations, large-scale details, attachment devices and other components.
      a. Show the following:
         1) Full-size details, edge details, attachments, backsplashes, side splashes, aprons, etc.
         2) Locations and sizes of furring, blocking, including concealed blocking and reinforcement specified in other Sections.
         3) Fabrication details for brackets.
         4) Details of anchorage to cabinets and to walls.

5) Locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers, waste receptacle and other items installed in quartz surface.
6) Type of sealant.
7) Type of adhesive.
8) Seam locations.
9) Show direction of directional pattern, if any.

F. Samples:
1. 2” x 2” sample for each of Manufacturer’s full line of colors, pattern, and finishes for initial selection.
2. Two (2) 6" x 6" samples of each color selected.
3. 4” long samples of each style of Custom Edging.

G. Maintenance Data:
1. Submit manufacturer’s care and maintenance data, including repair and cleaning instructions.
2. Include in project closeout documents.

1.05 QUALITY ASSURANCE

A. Provide Certified Statement by technical representative of the solid surfacing manufacturer that the fabricator and installer are certified or approved.

B. Applicable Standards:
1. Standards of the following, as referenced herein:
a. American National Standards Institute (ANSI)
b. American Society for Testing and Materials (ASTM)
c. NSF International
2. Fire test response characteristics:
a. Provide with the following Class A (Class 1) surface burning characteristics as determined by testing identical products per UL 723 (ASTM E84) or another testing and inspecting agency acceptable to authorities having jurisdiction:
1) Flame Spread Index: 25 or less
2) Smoke Developed Index: 450 or less

C. Verify all dimensions in field.

D. Allowable Tolerances:
1. +/- 1/8” in component size over a 10 foot length.
2. +/- 1/8” in location of openings from indicated location.
3. Minimum of 1/16 inch and a maximum of 1/8 inch clearance between quartz surfaces and each wall.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pursuant to manufacturers published instructions.

B. Protect countertops during transit, delivery, storage and handling to prevent moisture exposure, damage, soiling and deterioration.

C. Store components indoors in clean and dry area prior to installation.

D. Do not deliver until painting, wet work, grinding and similar operations, which could be performed before installation of casework, have been completed in installation areas.

1.07 WARRANTY

A. Provide manufacturer's 10-year warranty against defects in materials. Warranty shall provide material and labor to repair or replace defective materials. Warranty shall begin at date of substantial completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers:
   1. Silestone by Cosentino SA, Apdo No. 1 Macael 04867, Almeria, Spain. (Basis of Physical Characteristics)
   2. Cambria USA, 11000 West 78th Street, Suite 220, Eden Prairie, MN 55344 Phone: 866-226-2742.
   3. Corian® Design, Corian® Quartz (formerly known as Zodiaq®), Chestnut Run Plaza, 974 Centre Road, P.O. Box 2915, Wilmington, DE 19805, Phone: 800-426-7426.

2.02 COUNTERTOP MATERIALS

A. Engineered Stone Countertops
   1. Composition: Quartz aggregate, resin, and color pigments formed into flat slabs.
   2. Physical Characteristics:
      a. Water absorption: Maximum 0.04 percent, tested per ASTM C 97
      b. Bond strength: Average of 211 PSI (1.4 MPa), tested per ASTM C482
      c. Modulus of rupture: Average of 6200 PSI (5.11 MPa), tested per STAM C99
      d. Flexural strength: 5620 PSI (50.3 MPa), tested per ASTM C 880
      e. Abrasion index: Minimum 62, tested per ASTM C 241
      f. Thermal shock: Pass 5 cycles, tested per ASTM C 484
      g. Thermal expansion: 1.747 x 10-5, tested per ASTM C 531
      h. Freeze thaw: Class MR3+, tested per ASTM 1026
      i. Deicing: Pass ASTM C 672
      j. Flame spread: Class 1 (FS-25 or less), tested per ASTM E84
      k. Mohs hardness: 6 to 6.5
      l. Stain resistance: Stains completely removed, tested per ASTM C 650, excluding hydroxide.
   3. Thickness: 3/4"
   4. Edge detail: Laminated Bullnose or miter edge.
   5. Color: To be selected from manufacturer's colors in ALL price groups.
   6. Surface finish: Polished.
   7. Provide ¾" x 4" backsplash with profiled edges on all countertops unless noted otherwise. Provide ¾" x 4" side splashes with profiled edges where shown on the Contract Drawings.

2.03 SETTING MATERIALS

A. Adhesive: Liquid nails or other approved by countertop manufacturer.

2.04 ACCESSORIES

A. Epoxy Adhesive: K-bond epoxy type provided by countertop manufacturer.

B. Joint Sealant: Single component silicone sanitary sealant and backing materials; specified in Section 079200 - Sealants.

2.05 FABRICATION

A. Fabricate components to greatest extent practical to sizes and shapes indicated, in accordance with approved shop drawings and manufacturer's printed instructions and technical bulletins.

B. Form joints between components using manufacturer's standard joint adhesive.
   1. Reinforce as required.
   2. Provide factory cutouts for plumbing fittings and bath accessories as indicated on the drawings.
   3. Rout and finish component edges with clean, sharp returns.
   4. Rout cutouts, radii and contours to template.

C. Smooth edges.

PART 3 EXECUTION

3.01 JOB CONDITIONS

A. Conditioning: Comply with manufacturer's recommendations for temperature and humidity requirements in installation areas. Do not install countertops until required temperature and relative humidity have been stabilized and will be maintained in installed areas.

B. Do not install countertops and window sills until walls and ceilings of the spaces to receive the Work have been finished.

3.02 INSTALLATION

A. Fabricate components in shop to greatest extent practical to sizes and shapes indicated, in accordance with approved shop drawings and manufacturers requirements.

B. Install in accordance with manufacturer's instructions.

C. Provide factory cutouts for plumbing fittings and accessories.

D. Provide surfaces with a uniform finish.

E. Install countertop and window sills plumb, level, true and straight with no distortions. Shim as required using concealed shims.
   1. Tops:
      a. Flat and true to within 1/8 inch of a flat surface over a 10-foot length.
      b. Allow a minimum of 1/16 inch to a maximum of 1/8 inch clearance between surface and each wall.
      c. Form field joints using manufacturer's recommended adhesive, with joint widths no greater than 1/16 inch in finished work.
      d. Keep components and hands clean when making joints.

F. Where Quartz sufacing abuts other finished work, scribe and cut for accurate fit.

G. The party responsible for provision of Quartz surfacing is also responsible for provision of penetrations through countertop; penetrations include but are not limited to cutouts for sinks, faucets, and soap dispenser. Coordinate receipt of templates and penetration locations required by other Trades accordingly.

H. Form field joints using manufacturer's recommended adhesive, with joints inconspicuous in finished work. Reinforce joints as required.

I. Anchor Quartz surfacing securely in place with concealed fasteners and adhesives as recommended by manufacturer.

3.03 CLEANING AND PROTECTION

A. Repair or remove and replace defective work as directed upon completion of installation.

B. Do NOT allow harsh chemicals, such as lacquer thinner, turpentine, nail polish remover (acetone) or stove and drain cleaners, to REMAIN in contact with the surface. Hot pans and heat-producing appliances should be placed on heat shields or hot pads.

C. Clean exposed and semi-exposed surfaces, touch-up as required. Remove and refinish damaged or soiled areas.

D. Apply heavy kraft paper or other heavy protective coating masked in place to prevent surface damage. Remove kraft paper at building turn over to Owner and clean countertops.

**END OF SECTION 123661**

**PAGE INTENTIONALLY BLANK**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Agreement, including General and Division 01 Project Manual, apply to work of this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Recessed Aluminum Floor Mats and Frames. Locations and sizes indicated on the Contract Drawings.

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Division 03 Section "Cast-in-Place Concrete" for concrete work, including forming, placing, and finishing concrete floor slabs, and for concrete materials for grouting and filling around and under recessed mats and frames.
   2. Section 093013 - Ceramic Tiling for abutting adjoining materials.

1.03 SUBMITTALS

A. Pursuant to Section 013300 - Submittal Procedures.

B. Pursuant to Seciton 016000 - Product Requirements.

C. Product Data: Include manufacturer's specifications and installation instructions, construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of floor mat and frame specified.

D. Shop Drawings: For floor mats and frames. Show assembly, joint locations, installation details, layout, plans, elevations, sections, details of patterns or designs, accessories, anchors, and attachments to other Work.

E. Samples for Initial Selection: For each type of floor mat and frame indicated.

F. Samples for Verification: 12-inch-square assembled sections of floor mats, frame members, and tread rails with selected tread surface showing each type of metal finish and color of exposed floor mats, tread rails, frames, and accessories required.

G. Maintenance Data: For cleaning and maintaining floor mats to include in maintenance manuals.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain floor mats and frames through one source from a single manufacturer.

1.05 PROJECT CONDITIONS

A. Field Measurements: Verify blocked-out openings in floors by field measurements before fabrication and indicate measurements on Shop Drawings.

1.06 COORDINATION

A. Coordinate size and location of oversized recesses in concrete work to receive floor mats and frames. Defer frame installations until building enclosure is completed and related interior finish

work is in progress. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate integral installation of recessed frames and anchors with placing of concrete slab so frames are positioned accurately.

1.07 WARRANTY

A. Floor mats and frames shall be fabricated free of defects in materials and workmanship in accordance with the General Conditions, and the manufacturer shall offer a 2-year warranty against defects in materials and workmanship.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Roll-Up Aluminum Rail Hinged Mats:
      a. Babcock-Davis (Basis of Specification)
      b. Balco, Inc.
      c. KADEE Industries, Inc.

2.02 MATERIALS

A. Aluminum Frames: Extruded Aluminum; ASTM B221, alloy 6063-T5, with butted corners and factory coated with zinc chromate or manufacturer's standard protective paint where surfaces will be in contact with concrete.
   1. Finish: As selected by Architect from manufacturer's standard colors and finishes.

B. Mat Description:
   1. Apparatus Bay Transition Zone Locations:
      a. QuietFlex® Roll up mat with alternating treads finishes.

C. Rail Support and leveling Device: Manufacturer's standard device to support the rails from excessive deflection, spaced 24-inches o.c., and to provide adjustment for level installation.

D. Construction: Hollow extrusion (not U shape) rails joined by low-density polyethylene (LDPE) hinge and cushion retained in "captive" aluminum tread port, with drainage to allow debris and moisture to flow through grate. Tread hinges to be secured with rigid PVC end cap. Fillers shall be serrated black vinyl for use in creating a snug fit for the grate.

E. Apparatus Bay Transition Zone Tread Inserts: Provide alternating tread inserts of rugged scrub insert and serrated rail.
   1. Tread colors: As selected by Architect from manufacturer's standard colors.

F. Fasteners: Non-corrosive screws and anchors for securing frames together and to floors.

2.03 FABRICATION

A. General: Verify sizes by field measurement before shop fabrication.

B. Floor Mats: Shop fabricate units to greatest extent possible in sizes as indicated. If not otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes.

Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.

C. Recessed Metal Mat Frames: Extruded aluminum of size and style to fit floor mat type specified, for permanent recessed installation, complete with corner pins or reinforcement and anchorage devices.
   1. Fabricate edge-frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible, with hairline joints equally spaced and pieces spliced together by straight connecting pins.

D. With manufacturer's standard protective coating, coat surfaces of aluminum frames that will contact cementitious material.

2.04 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, floor conditions, and floor recesses for compliance with requirements for location, sizes, minimum recess depth, and other conditions affecting installation of floor mats and frames.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install recessed mat frames to comply with manufacturer's written instructions. Set mat tops at height recommended by manufacturer for most effective cleaning action; coordinate top of mat surfaces with bottom of doors that swing across mats to provide clearance between door and mat.
   1. Install necessary shims, spacers, and anchorages for proper location and secure attachment of frames.
   2. Install grout and fill around frames and, if required to set mat tops at proper elevations, in recesses under mats. Finish grout and fill smooth and level.

3.03 PROTECTION

A. After completing frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

B. Install tread mat only when no further wheeled construction traffic will occur and wet type operations including painting and decorating are complete.

**END OF SECTION 124813**

**PAGE INTENTIONALLY BLANK**

PART- 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Agreement, including General and Division 01 of the Project Manual, apply to work of this Seciton.

1.02 SUMMARY

A. Work Required:
   1. The work required under this section consists of all labor, materials and services required for the complete installation (including operational verification) of all the equipment required for the elevator as herein specified.

B. Related Sections
   1. Section 033000 - Cast-In-Place Concrete.
   2. Section 036000 - Grouting.
   3. Section 042200 - Concrete Unit Masonry (CMU).
   4. Section 055000 - Metal Fabrications.
   5. Section 055133 - Metal Ladders.
   6. Section 071116 - Cementitious Waterproofing.
   7. Division 26 - Electrical.
   8. Division 28 - Electronic Safety and Security.

1.03 REFERENCE STANDARDS:

A. ICC A117.1, Buildings and Facilities, Providing Accessibility and Usability for Physically Handicapped People.

B. ADA Standards: Americans with Disabilities Act Accessibility Guidelines.

C. NFPA 70: National Electrical Code.

D. NFPA 80: Fire Doors and Windows.

E. ASME A17.1, Safety Code for Elevators and Escalators.

F. ASME A17.7, Performance - Based Safety Code for Elevators and Escalators.

G. UL 10B: Fire Tests of Door Assemblies.

H. Local Building Codes.

I. All other local jurisdictional applicable codes.

1.04 SYSTEM DESCRIPTION

A. Equipment Description: Hole-less Hydraulic elevator with Machine-Room less application.

B. Equipment Control: Elevonic R Control System.

C. Quantity of Elevators: 1

D. Elevator Stop Designations: 1 and 2

E. Stops : 2

F. Openings: In-Line

G. Travel: 9'-2"

H. Rated Capacities:
   1. 2,100 lbs Passenger

I. Rated Speed: 125 fpm

J. Platform Size: 5'-9 1/2" wide x 4'-3 9/16" deep.

K. Clear Inside Dimensions: 5'-8 5/16" wide x 4'-3 9/16" deep.

L. Clear Cab Height: 7'-8 11/16"

M. Entrance Type and Width: Single-slide door, 36".

N. Entrance Height: 7'-0".

O. Main Power Supply: 208 Volts + or - 5% of normal, three-Phase, with a separate equipment grounding conductor.

P. Car Lighting Power Supply: 120 Volts, Single-phase, 15 Amp, 60 Hz.

Q. Machine Location: Tank and controller in pit.

R. Signal Fixtures: Manufacturer's standard with metal button targets.

S. Stopping Accuracy: ±1/4" under any loading condition or direction of travel.

T. Operation: Simplex Collective Operation- Using a microprocessor-based controller, operation shall be automatic by means of the car and hall buttons. If all calls in the system have been answered, the car shall park at the last landing served.

U. Operating Features - Standard
   1. Full Collective Operation.
   2. Fan and Light Protection.
   3. Independent Service.
   4. Anti-nusance.
   5. Firefighters' Service Phase I and Phase II.
   6. Top of Car Inspection.
   7. Zoned Access at Bottom Landing.
   8. Zoned Access at Upper Landing.
   9. Car Secure Access
   10. Independent Service.

V. Door Control Features:
   1. Door control to open doors automatically when car arrives at a landing in response to a normal hall or car call.
   2. Elevator doors shall be provided with a reopening device that will stop and reopen the car door(s) and hoistway door(s) automatically should the door(s) become obstructed by an object or person.
   3. Door protection shall consist of a two dimensional, multi-beam array projecting across the car door opening.

4. Door nudging operation to occur if doors are prevented from closing for an adjustable period of time.

W. Seismic Conditions do not exist.

1.05 SUBMITTALS

A. Product Data: Submit manufacturer's product data for each system proposed for use. Include the following:
1. Signal and operating fixtures, operating panels and indicators.
2. Cab design, dimensions and layout.
3. Hoistway-door and frame details.
4. Electrical characteristics and connection requirements.
5. Expected heat dissipation of elevator equipment in hoistway (BTU).
6. Color selection chart for Cab and Entrances.

B. Shop Drawings: Submit approval layout drawings. Include the following:
1. Car, guide rails, buffers and other components in hoistway.
2. Maximum rail bracket spacing.
3. Maximum loads imposed on guide rails requiring load transfer to building structure.
4. Clearances and travel of car.
5. Clear inside hoistway and pit dimensions.
6. Location and sizes of access doors, hoistway entrances and frames.

C. Operations and Maintenance Manuals: Provide manufacturer's standard operations and maintenance manual.

1.06 QUALITY ASSURANCE

A. Manufacturer: Elevator manufacturer shall be ISO 9001 certified.

B. Installer: Elevators shall be installed by the manufacturer.

C. Permits, Inspections and Certificates: The Elevator Contractor shall obtain and pay for necessary Municipal or State Inspection and permit as required by the elevator inspection authority, and make such tests as are called for by the regulations or such authorities. These tests shall be made in the presence of such authorities or their authorized representatives.

1.07 DELIVERY, STORAGE AND HANDLING

A. Should the building or the site not be prepared to receive the elevator equipment at the agreed upon date, the General Contractor will be responsible to provide a proper and suitable storage area on or off the premises.

B. Should the storage area be off-site and the equipment not yet delivered, then the elevator contractor, upon notification from the General Contractor, will divert the elevator equipment to the storage area. If the equipment has already been delivered to the site, then the General Contractor shall transport the elevator equipment to the storage area. The cost of elevator equipment taken to storage by either party, storage, and redeliver to the job site shall not be at the expense of the elevator contractor.

1.08 WARRANTY

A. The elevator contractor's acceptance is conditional on the understanding that their warranty covers defective material and workmanship. The warranty period shall not extend longer than

one (1) year from the date of completion or acceptance thereof by beneficial use, whichever is earlier, of each elevator. The warranty excludes: ordinary wear and tear, improper use, vandalism, abuse, misuse, or neglect or any other causes beyond the control of the elevator contractor and this express warranty is in lieu of all other warranties, express or implied, including any warranty of merchantability or fitness for a particular purpose.

1.09 MAINTENANCE AND SERVICE

A. Maintenance service consisting of regular examinations and adjustments of the elevator equipment shall be provided by the elevator contractor for a period of 12 months after the elevator has been turned over for the customer's use. This service shall not be subcontracted but shall be performed by the elevator contractor. All work shall be performed by competent employees during regular working hours of regular working days. This service shall not cover adjustments, repairs or replacement of parts due to negligence, misuse, abuse or accidents caused by persons other than the elevator contractor. Only genuine parts and supplies as used in the manufacture and installation of the original equipment shall be provided.

B. The elevator control system must:
   1. Provide in the controller the necessary devices to run the elevator on inspection operation.
   2. Provide on top of the car the necessary devices to run the elevator in inspection operation.
   3. Provide in the controller an emergency stop switch. This emergency stop switch when opened disconnects power from the brake and prevents the motor from running.

C. Provide system capabilities to enable a remote expert to create a live, interactive connection with the elevator system to enable the following functions:
   1. Remotely diagnose elevator issues with a remote team of experts.
   2. Remotely return an elevator to service.
   3. Provide real-time status updates via email.
   4. Remotely make changes to selected elevator functions including:
      a. Control building traffic: Restrict floor access, remove car from group operation, shut down elevator, select up peak / down peak mode, activate independent service.
      b. Conserve energy: Activate cab light energy save mode, activate fan energy save mode, shut down car.
      c. Improve passenger experience: Extend door open times, change parking floor, activate auto car full, activate anti-nuisance, advance door opening, door nudging, extend specific floor extended opening time, release trapped passengers.

PART- 2 PRODUCTS

2.01 MANUFACTURER

A. Manufacturer: Design based upon Otis HydroFit™ machine room-less elevator system.

2.02 DESIGN AND SPECIFICATIONS

A. Provide machine-roomless 2,100 lb. hole-less hydraulic elevator from Otis Elevator Company. The control system and car design based on materials and systems manufactured by Otis Elevator Company. Specifically, the system shall consist of the following components:
   1. The entire hydraulic system and the controller shall be located inside the hoistway. No extra machine room or control closet space is required.
   2. Sleep mode operation for LED ceiling lights and car fan.
   3. LED lighting standard in ceiling lights and elevator fixtures.

B. Approved Installer: Otis Elevator.

2.03 EQUIPMENT: MACHINE COMPONENTS

A. The hydraulic system shall be of compact design suitable for operation under the required pressure. The power component shall be mounted in the hydraulic-fluid storage tank. The control valve shall control flow for up and down directions hydraulically and shall include an integral check valve. A control section including control solenoids shall direct the main valve and control: up and down starting, acceleration, transition from full speed to leveling speed, up and down stops, pressure relief and manual lowering. All of these functions shall be fully adjustable for maximum smoothness and to meet contract conditions. System to be provided with a low-pressure switch and a shut-off valve.

B. The entire hydraulic system with hydraulic-fluid storage tank, power component and valves shall be located in the hoistway pit and be easily accessible for maintenance through an access door in the hoistway wall.

C. A microprocessor-based controller shall be provided, including necessary starting switches together with all relays, switches, solid-state components and hardware required for operation, including door operation, as described herein. A three (3) phase overload device shall be provided to protect the motor against overloading.

D. Controller Location: The controller shall be located together with the hydraulic system in the hoistway pit and be easily accessible for maintenance through the same access door that is also used for the hydraulic system.

E. A manual lowering feature shall permit lowering the elevator at slow speed for adjusting purposes.

F. Emergency Rescue Unit (Battery Lowering): When the loss of normal power is detected, a battery lowering feature is to be activated. the elevator will lower to a predetermined level and open the doors. After passengers have exited the car, the doors will close and shutdown. When normal power becomes a available, the elevator will automatically resume operation.

G. Pressure Switch

H. Low-oil control.

2.04 EQUIPMENT: HOISTWAY COMPONENTS

A. Plungers and Cylinders: Each cylinder shall be constructed of steel pipe of sufficient thickness and suitable for the operating pressure. The top of each cylinder shall be equipped with a cylinder head with a drip ring to collect any oil seepage as well as an internal guide ring and self-adjusting packing. Each plunger shall be constructed of selected steel tubing or pipe of proper diameter machined true and smooth with a fine polished finish. Each plunger shall be provided with a stop ring electrically welded to it to prevent the plunger from leaving the cylinder. Each plunger and cylinder shall be installed plumb and shall operate freely with minimum friction.

B. Car Guide Rails: Tee-section steel rails with brackets and fasteners.

C. Buffers: Polyurethane.

D. Wiring: Wiring for hoistway electrical devices included in scope of the elevator system, hall panels, pit emergency stop switch, and the traveling cable for the elevator car.

E. Hoistway Entrances:

1. Frames: Entrance frames shall be of bolted construction for complete one-piece unit assembly. All frames shall be securely fastened to fixing angles mounted in the hoistway and shall be of UL fire rated steel.
2. Sill Finish:
   a. Extruded Aluminum at 1 and 2
3. Doors: Entrance doors shall be of metal construction with vertical channel reinforcements.
4. Fire Rating: Entrance and doors shall be UL fire rated for 1-1/2 hour (for M1, M2, M3, D1, and D2 Entrance Arrangements or 1 hour for D3 Entrance Arrangement.
5. Entrance Finish(es):
   a. Powder coat paint: Black.
6. Frame Finish(es):
   a. Powder coat paint: Black.
7. Entrance marking plates: Entrance jambs shall be marked with 4” x 4” (102 mm x 102 mm) plates having raised floor markings with Braille located adjacent to the floor marking. Marking plates shall be provided on both sides of the entrance.
8. Sight Guards: Black sight guards will be furnished with all doors.

2.05 EQUIPMENT: CAR COMPONENTS

A. Cab Options:
   1. Steel Shell Cab with raised vertical laminate wall panels.
   2. Black vertical trim pieces.
   3. Paints and laminate to be selected from manufacturer’s catalog of choices.
   4. Brushed Stainless Steel finished base plate located at top and bottom.

B. Car Front Finish: Brushed Stainless Steel.

C. Car Door Finish: Brushed Stainless Steel.

D. Ceiling Type: Flat Ceiling with 4 LED Lights.

E. Ceiling Finish: Black (EW5).

F. Emergency Car Lighting: An emergency power unit employing a 6-volt sealed rechargeable battery and totally static circuits shall be provided to illuminate the elevator car in the event of building power failure.

G. Fan: A one-speed 120 VAC fan will be mounted to the structural ceiling to facilitate in-car air circulation, meeting A17.1 code requirements. The fan shall be rubber mounted to prevent the transmission of structural vibration and will include a baffle to diffuse audible noise. A switch shall be provided in the car-operating panel to control the fan.

H. Handrails: Handrails shall be provided on the side and rear walls of the car enclosure. Handrails shall be 1 1/2" diameter Round Bar Handrail with a Brushed Stainless Steel Finish.

I. Extruded Threshold: Aluminum.

J. Emergency Exit Contact: An electrical contact shall be provided on the car-top exit.

K. Guides: Car roller type guides at the top and the bottom.

L. Platform: Car platform shall be constructed of metal.

M. Certificate frame - Provide a Certificate frame with a satin stainless steel finish.

N. The LED ceiling lights and the fan should automatically shut off when the system is not in use and be powered back up after a passenger calls the elevator and pushes a hall button.

2.06 EQUIPMENT: SIGNAL DEVICES AND FIXTURES

A. Car Operating Panel: A car operating panel shall be provided which contains all push buttons, key switches, and message indicators for elevator operation. The car operating panel shall have a satin stainless steel finish.
   1. A car operating panel shall be furnished. It shall contain a bank of round stainless steel, mechanical LED illuminated buttons. Flush mounted to the panel and marked to correspond to the landings served. All buttons to have raised numerals and Braille markings with:
      a. Flat Flush Mounted satin stainless steel button with blue or white LED illuminating halo.
   2. The car operating panel shall be equipped with the following features:
      a. Raised markings and Braille to the left-hand side of each push-button.
      b. Car Position Indicator at the top of and integral to the car operating panel.
      c. Door open and door close buttons.
      d. Inspection key-switch.
      e. Elevator Data Plate marked with elevator capacity and car number.
      f. Help Button: The help button shall initiate two-way communication between the car and a location inside the building, switching over to another location if the call is unanswered, where personnel are available who can take the appropriate action. Visual indicators are provided for call initiation and call acknowledgement.
      g. Landing Passing Signal: A chime bell shall sound in the car to signal that the car is either stopping at or passing a floor served by the elevator.
      h. In car stop switch (toggle or key unless local code prohibits use).
      i. Firefighter’s hat.
      j. Firefighter’s Phase II Key-switch.
      k. Call Cancel Button.
      l. Firefighter's Phase II Emergency In-Car Operating Instructions: worded according to ASME A17.1, Article 2.27.7.2.

B. Car Position Indicator: A digital, LED car position indicator shall be integral to the car operating panel.

C. Hall Fixtures: Hall fixtures shall be provided with necessary push buttons and key switches for elevator operation.
   1. Hall fixtures shall feature:
      a. Stainless Steel Hall Position Indicators at Floors 1 and 2.
   2. Integral Hall fixtures shall feature:
      a. Round stainless steel, mechanical buttons marked to correspond to the landings.
      b. Hall fixtures to be located in the entrance frame face. Therefore, separate wiring and installation of electrical boxes inside the wall for the hall buttons are not required.
      c. Buttons shall be in vertically mounted fixture.
      d. Fixture shall be satin stainless steel finish.
   3. Buttons:
      a. Flat Flush Mounted satin stainless steel button with blue or white LED illuminating halo.

D. Car Lantern and Chime: A directional lantern visible from the corridor shall be provided in the car entrance. When the car stops and the doors are opening, the lantern shall indicate the direction in which the car is to travel and a chime will sound.

E. Access key-switch at top floor in entrance jamb.

F. Access key-switch at bottom floor in entrance jamb.

PART- 3 EXECUTION

3.01 PREPARATION

A. Take field dimensions and examine conditions of substrates, supports, and other conditions under which this work is to be performed. Do not proceed with work until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Installation of all elevator components except as specifically provided for elsewhere by others.

3.03 DEMONSTRATION

A. The elevator contractor shall make a final check of each elevator operation with the Owner or Owner's representative present prior to turning each elevator over for use. The elevator contractor shall determine that control systems and operating devices are functioning properly.

**END OF SECTION 142410.13**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the Related Documents identified in Division 00 Sections and Division 01 Sections.

1.02 DESCRIPTION

A. The General Conditions and Supplementary General Conditions are a part of this Division and are to be considered a part of this Contract.

B. Where items of the General Conditions and Supplementary General Conditions are repeated in other Sections of the Specifications, it is merely intended to qualify or to call particular attention to them. It is not intended that any other parts of the General Conditions and Supplementary General Conditions shall be assumed to be omitted if not repeated therein.

C. This Section applies equally and specifically to all Contractors supplying labor and/or equipment and/or materials as required under each Section of this Division.

D. The following information contains specifications of Work in connection with, and in addition to, this Division:
   1. All drawings associated with the project.
   2. All specifications associated with the project.

E. Division of work responsibilities shall be as defined and directed by the Bidding Agent and/or the Bidding General Contractor.

1.03 INTENT

A. It is the intent of the Specifications and Drawings to call for finished work, tested and ready for operation.

B. Furnish, deliver and install any apparatus, appliance, material or Work not shown on Drawings but mentioned in the Specifications, or vice versa, or any incidental accessories necessary to make the Work complete and perfect in all respects and ready for operation, even if not particularly specified, under their respective Section without additional expense to the Owner.

C. Include in the work minor details not usually shown or specified but necessary for proper installation and operation, as though they were hereinafter shown or specified.

D. Provide Engineer written notice of any materials or apparatus believed inadequate or unsuitable; in violation of laws, ordinances, rules or regulations of authorities having jurisdiction; and any necessary items of Work omitted. In the absence of such written notice, it is mutually agreed that Work under each Section has included the cost of all required items for the accepted, satisfactory functioning of the entire system without extra compensation.

E. The Work indicated is diagrammatic. The Architect and/or Engineer may require as part of this Contract, the relocation of devices to reasonable distances from the general locations shown.

F. Verbal clarifications of the Drawings or Specifications during the bid period are not to be relied upon. Refer any questions or clarifications to the Engineer at least five Working days prior to bidding to allow for issuance of an addendum. After the five-day deadline, Bidder must make a decision and qualify the Bid, if the Bidder feels it necessary.

1.04 DRAWINGS

A. Drawings are diagrammatic and indicate the general arrangement of systems and work included in the Contract. (Do not scale the Drawings.) Consult the Architectural Drawings and Details for exact location of fixtures and equipment; where same are not definitely located, obtain this information from the Architect.

B. Closely follow Drawings in layout of Work; check Drawings of other Divisions to verify spaces in which work will be installed. Maintain maximum headroom. Where space conditions appear inadequate, Engineer shall be notified before proceeding with installations.

C. Engineer may, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades and/or for proper execution of the work.

D. Where variances occur between the Drawings and Specifications or within either of the Documents, include the item or arrangement of better quality, greater quantity or higher cost in the Contract price. The Engineer shall decide on the item and the manner in which the work shall be installed.

1.05 SURVEYS AND MEASUREMENTS

A. Before submitting a Bid, the Contractor shall visit the site and shall become thoroughly familiar with all conditions under which the work will be installed. Contractor will be held responsible for any assumptions, omissions or errors made as a result of failure to become familiar with the site and the Contract Documents.

B. Base all measurements, both horizontal and vertical, from established bench marks. All Work shall agree with these established lines and levels. Verify all measurements at the site and check the correctness of same as related to the Work.

C. Should the Contractor discover any discrepancies between actual measurements and those indicated which prevent following good practice or the intent of the Drawings and Specifications, notify the Engineer do not proceed with that Work until instructions have been received from the Engineer.

1.06 CODES AND STANDARDS

A. The Codes and Standards listed below apply to all Work. Where Codes or Standards are mentioned in these Specifications, follow the latest edition or revision.

B. The current adopted editions of the following State or local Codes apply:
   1. 2020 New York Uniform Code (Supplement to 2018 IBC).
   2. 2018 International Building Code with Amendments.
   3. 2018 International Mechanical Code with Amendments.
   4. 2018 International Plumbing Code with Amendments.
   5. 2017 National Electrical Code (NFPA 70).
   6. 2018 International Fire Code with Amendments.
   7. 2018 International Fuel Gas Code with Amendments.
   8. 2018 International Energy Conservation Code with Amendments.
   9. 2009 ICC/ANSI A117.1-2009 Accessible and Usable Buildings and Facilities.

C. All materials furnished and all work installed shall comply with the rules and recommendations of the NFPA, the requirements of the local utility companies, the recommendations of the fire insurance rating organization having jurisdiction and the requirements of all Governmental departments having jurisdiction.

D. Include in the Work, without extra cost to the Owner, any labor, materials, testing, services, apparatus and Drawings in order to comply with all applicable laws, ordinances, rules and regulations, whether or not shown on Drawings and/or specified.

1.07 PERMITS AND FEES

A. Give all necessary notices, obtain all permits; pay all Government and State sales taxes and fees where applicable, and other costs, including utility connections or extensions in connection with the Work. File all necessary Drawings, prepare all Documents and obtain all necessary approvals of all Governmental and State departments having jurisdiction, obtain all required certificates of inspections for Work and deliver a copy to the Engineer before request for acceptance and final payment for the Work.

1.08 SEISMIC RESTRAINT

A. General: This project is in a seismic zone per State and/or Local Codes and Ordinances and all materials and equipment shall be installed, supported, and seismically restrained accordingly. Verify current seismic requirements based on project location and with Code requirements.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where the 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 vibration isolation bases and seismic restraints that are similar to those required for this Project in material, design, and extent.

C. Shop Drawings: Show designs and calculations, certified by a professional engineer, for the following:
   1. Design Calculations: Calculations for selection of vibration isolators, design of vibration isolation bases, design of seismic supports and selection of seismic restraints for all equipment and materials.
   2. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to the structure and to the supported equipment. Include auxiliary motor slides and rails, and base weights.
   3. Seismic Restraint Details: Detail fabrication and attachment of restraints, supports and snubbers.
   4. Seismic Separation Assemblies: Refer to the Architectural and/or Structural drawings for locations of seismic joints.

D. Installation: Installation shall be carried out in strict accordance with the Seismic Engineer's submittal, current Code, accepted standards and the equipment and material manufacturers' recommendations.

1.09 COORDINATION

A. Carry out all work in conjunction with other trades and give full cooperation in order that all work may proceed with a minimum of delay and interference. Particular emphasis is placed on timely installation of major apparatus and furnishing other Contractors, especially the General Contractor, with information as to openings, chases, sleeves, bases, inserts, equipment locations, panels, access doors, etc. required by other trades, and to allow for serviceable access to equipment.

B. Mechanical contractors' shall initiate coordination drawings and sections clearly showing how the work is to be installed in relation to the work of other trades, at no extra charge to the Owner. The Contractors' shall prepare coordination drawings at a scale no less than 1/4"=1'-0", showing the work of all trades, including but not limited to, the following: proposed ductwork installation in detail, including ceiling heights, approved structural steel shop drawings, duct heights, access doors, light fixtures, registers and diffusers, sprinkler piping, electrical distribution conduits, wires, panels and any other electrical work which may conflict with the sheet metal ducts or piping, waste and vent piping, water piping, storm piping, and rain leaders. Provide elevation details showing connections and equipment layout and configuration based on approved submittals. Each shall use a different color code. A coordination meeting of all Contractors involved is then to be held and all possible conflicts are to be resolved. All trades shall sign acceptance of the drawings and then shall submit two (2) prints of each drawing to the Engineer for record.

C. Contractors are required to examine all of the Project Drawings and mutually arrange Work so as to avoid interference. In general, ductwork, heating piping, sprinkler piping and drainage lines take precedence over water, gas and electrical conduits. The Engineer regarding the arrangement of Work, which cannot be agreed upon by the Contractors, will make final decisions. Service of equipment will take precedence.

D. Where the Work of the Contractor will be installed in close proximity to or will interfere with Work of other trades, assist in working out space conditions to make a satisfactory adjustment.

E. If Work is installed before coordinating with other Divisions or so as to cause interference with Work of other Sections, the Contractor causing the interference will make necessary changes to correct the condition without extra charge to the Owner.

F. Initial contact and coordination has been conducted with utility entities for the purpose of the preparation of Bid Documents. The Contractor shall coordinate all final specific utility

requirements.

1.10 ACCEPTANCES

A. The equipment, materials, Workmanship, design and arrangement of all Work installed are subject to the review of the Engineer.

B. Within 30 days after the awarding of a Contract, submit to the Engineer for review a list of manufacturers of equipment proposed for the Work. The intent to use the exact makes specified does not relieve the Contractor of the responsibility of submitting such a list.

C. If extensive or unacceptable delivery time is expected on a particular item of equipment specified, notify the Engineer, in writing, within 30 days of the awarding of the Contract. In such instances, deviations may be made pending acceptance by the Engineer or the Owner's representative.

D. Where any specific material, process or method of construction or manufactured article is specified by reference to the catalog or model number of a manufacturer, the Specifications are to be used as a guide and are not intended to take precedence over the basic duty and performance specified or noted on the Drawings. In all cases, verify the duty specified with the specific characteristics of the equipment offered for review. Equipment characteristics are to be used as mandatory requirements where the Contractor proposes to use an acceptable equivalent.

E. If material or equipment is installed before shop drawing review, liability for its removal and replacement is assumed by the Contractor, at no extra charge to the Owner, if, in the opinion of the Engineer, the material or equipment does not meet the intent of the Drawings and Specifications.

F. Failure on the part of the Engineer to reject shop drawings or to reject Work in progress shall not be interpreted as acceptance of Work not in conformance with the Drawings and/or Specifications. Correct Work not in conformance with the Drawings and/or Specifications whenever non-conformance is discovered.

1.11 EQUIPMENT DEVIATIONS

A. Where the Contractor proposes to deviate (substitute or provide an equivalent) from the equipment or materials as hereinafter specified, he shall do so by making a request in writing. The Contractor shall state in his request whether it is a substitution or an equivalent to that specified, and the amount of credit involved. A copy of said request shall be included in the Base Bid with manufacturer's equipment cuts. The Base Bid shall be based on using the materials and equipment as specified and scheduled with no exceptions. Equipment Manufacturers Scheduled on Drawings are considered Base Bid and any other acceptable manufacturers listed in the specifications is considered a substitution and equipment deviation and subject to the requirements for equipment substitution and deviation. When any alternate manufacturer does not qualify acceptable, as determined by the Engineer, provide the Base Bid manufacturer at no additional cost to Owner.

B. In these Specifications and on the accompanying Drawings, one or more makes of materials, apparatus or appliances may have been specified for use in this installation. This has been done for convenience in fixing the standard of workmanship, finish and design required for installation. In the event that only one (1) manufacturer of a product is specified and it is found that the manufacturer has discontinued the product, the Contractor shall use an acceptable equivalent product that meets the requirements of an equivalent product, as noted below, and has all the features of the originally specified product. The details of workmanship, finish and design, and the guaranteed performance of any material, apparatus or appliance which the Contractor desires to deviate for those mentioned herein shall also conform to these standards.

C. Where no specific make of material, apparatus or appliance is mentioned, any first-class product made by a reputable manufacturer may be submitted for the Engineer's review.

D. Where two or more names are given as equivalents, the Contractor must use the specified item or one of the named equivalents. Where one name only is used and is followed by the words

"or acceptable equivalent", the Contractor must use the item named or he may apply for an equipment deviation through the prescribed manner in accordance with this Specification. Refer to Section 00 16 00 - Product Requirements for substitutions.

E. Equipment, material or devices submitted for review as an "accepted equivalent" shall meet the following requirements:
   1. The equivalent shall have the same construction features such as, but not limited to:
   2. Material thickness, gauge, weight, density, etc.
   3. Welded, riveted, bolted, etc., construction
   4. Finish, undercoatings, corrosion protection
   5. The equivalent shall perform with the same or better operating efficiency.
   6. The equivalent shall have equal or greater reserve capacity.
   7. The equivalent shall be locally represented by the manufacturer for service, parts and technical information.
   8. The equivalent shall bear the same labels of performance certification as is applicable to the specified item, such as UL or FM labels.

F. Where the Contractor proposes to use an item of equipment other than specified or detailed on the Drawings which requires any redesign of the structure, partitions, foundations, piping, wiring or any other part of the mechanical, electrical or architectural layout, all such redesign and all new drawings and detailing required therefore shall be prepared by the Designers of Record at the expense of the Contractor and at no additional cost to the Owner.

G. Where such accepted deviation or substitution requires a different quantity and arrangement of piping, ductwork, valves, pumps, insulation, wiring, conduit and equipment from that specified or indicated on the Drawings, the Contractor shall, with the acceptance by the Engineer, furnish and install any such additional equipment required by the system at no additional cost to the Owner, including any costs added to other trades due to the substitution.

H. The Engineer shall determine if an "accepted equivalent" to a manufacturer listed in the Specifications is considered acceptable.

1.12 SHOP DRAWINGS

A. Refer to individual specification sections for additional submittal information.

B. The Contractor shall submit for review detailed shop drawings of all equipment and material specified in each section and coordinated ductwork layouts. No material or equipment may be delivered to the job site or installed until the Contractor has received shop drawings for the particular material or equipment which have been properly reviewed.

C. Shop drawings shall be submitted within 60 days after award of Contract before any material or equipment is purchased. The Contractor shall submit for review copies of all shop drawings to be incorporated in the Contract. Refer to the General Conditions and Supplementary General Conditions for the quantity of copies required for submission. Where quantities are not specified, provide seven (7) copies for review.

D. Provide shop drawings for all devices specified under equipment specifications for all systems, materials, equipment and/or devices. Shop drawings shall include manufacturers' names, catalog numbers, cuts, diagrams and other such descriptive data as may be required to identify and accept the equipment. A complete list in each category (example: all fixtures) of all shop drawings, catalog cuts, material lists, etc., shall be submitted to the Engineer at one time. No consideration will be given to a partial shop drawing submittal. Partial submissions shall be rejected.

E. Equipment shop drawings shall contain full range performance curves, graphs, tables or other pertinent data which clearly indicates operational range of a given unit size. Computer generated/plotted curves, based solely on design performance, will not be accepted.

F. All specific options and/or alternatives shall be clearly indicated. Failure to do so shall be grounds for rejection.

G. Submittals shall be marked with the trade involved, i.e., HVAC, plumbing, fire protection, etc. and the specific associated specification section.

H. Where multiple quantities or types of equipment are being submitted, provide a cover sheet (with a list of contents) on the submittal identifying the equipment or material being submitted.

I. Failure to submit shop drawings in ample time for review shall not entitle the Contractor to an extension of Contract time. Contractor must allow for a one week review at the Engineer's office plus normal delivery time to the G.C., Architect, Engineer, and return to the Architect, and G.C. No claim for extension by reason of such default will be allowed, nor shall the Contractor be entitled to purchase, furnish and/or install equipment which has not been reviewed by the Engineer. The Contractor shall incur all costs associated with delay of construction due to equipment and/or materials arriving late due to late or improper shop drawing submittal.

J. The Contractor shall furnish all necessary templates, patterns, etc., for installation work and for the purpose of making adjoining work conform; furnish setting plans and shop details to other trades as required.

K. Acceptance rendered on shop drawings shall not be considered as a guarantee of measurements or building conditions. Where drawings are reviewed, review does not indicate that drawings have been checked in detail; said approval does not in any way relieve the Contractor from his responsibility or necessity of furnishing material or performing work as required by the Contract Drawings and Specifications. Verify available space prior to submitting shop drawings.

L. Acceptance of shop drawings shall not apply to quantity nor relieve Contractor of his responsibility to comply with intent of Drawings and Specifications.

M. Acceptance of shop drawings is final and no further changes will be allowed without the written consent of the Engineer.

N. Shop drawing submittal sheets which may show items that are not being furnished shall have those items crossed off to clearly indicate which items will be furnished.

O. Bidders shall not rely on any verbal clarification of the Drawings and/or Specifications. Any questions shall be referred to the Engineer at least five (5) working days prior to Bidding to allow for issuance of an Addendum. After the five (5) day deadline, Bidder shall make a decision and qualify the Bid, if the Bidder deems if necessary.

P. Contractor shall make any corrections required by Engineer and shall resubmit required number of corrected copies of shop drawings or new samples until accepted. Contractor shall direct specific attention in writing or on resubmitted shop drawings to revisions other than corrections requested by Engineer on previous submissions. Engineer shall review no more than one resubmittal of any shop drawing or sample at Owner's expense. The fees for review of additional resubmittals shall be paid by the Contractor at the Engineer's standard rates.

1.13 CHANGES IN WORK

A. A Change Order is a written order to the Contractor signed by the Owner and the Architect, issued after Contracts have been awarded, authorizing a change in the work or an adjustment in the Contract sum or the Contract time. A Change Order signed by the Contractor indicates his agreement therewith, including the adjustment in the Contract sum or the Contract time.

B. All changes in the work shall follow the requirements of the AIA "General Conditions of the Contract for Construction", Article 7 (see Section 00 70 00).

1.14 MANUFACTURER'S IDENTIFICATION

A. All component parts of each item of equipment or device shall bear the manufacturer's nameplate giving name of manufacturer, description, size, type, serial and model number, electrical characteristics, etc., in order to facilitate maintenance or replacement. Nameplate data shall not be obstructed. The nameplate of a Contractor or distributor will not be acceptable.

B. All material and equipment for the electrical portion of the mechanical systems shall bear the label of or be listed by UL, or other accredited authoritative agencies or testing organizations approved by the authority having jurisdiction.

1.15 RECORD DRAWINGS

A. Maintain at the job site a record set of Project Drawings on which any changes in location or routing of all equipment, materials and access panels shall be recorded.

B. At the end of construction, the Contractor shall provide the Owner with a complete set of As-Built Drawings, including all updated coordination drawings, ductwork and piping plans. As-Builts shall be drawn on the latest version of Autocad or compatible software, approved in writing, prior to submittal. The Owner shall be provided with a "CD Rom" disk and one set of reproducible mylar sepias.

1.16 MATERIALS AND WORKMANSHIP

A. All materials and apparatus required for the work, except as otherwise specifically indicated, shall be new, of first-class quality, and shall be furnished, delivered, erected, connected and finished in every detail and be so selected and arranged as to fit properly into the building spaces. Where no specific type or quality of material is given, a first-class standard article as accepted by industry standards shall be furnished.

B. The Contractor shall furnish the services of an experienced superintendent who shall be constantly in charge of the installation of the work together with all skilled workmen, fitters, metal workers, welders, helpers and laborers required to unload, transfer, erect, connect, adjust, start, operate and test each system.

C. Unless otherwise specifically indicated on the Drawings or Specifications, all equipment and materials shall be installed with the acceptance of the Engineer and in accordance with the recommendations of the manufacturer. This includes the performance of such tests as the manufacturer recommends.

D. All labor for installation of mechanical systems shall be performed by experienced, skilled tradesmen under the supervision of a licensed journeyman foreman. All work shall be of a quality consistent with good trade practice and shall be installed in a neat, workmanlike manner. The Engineer reserves the right to reject any work which, in his opinion, has been installed in a substandard, dangerous or unserviceable manner. The Contractor shall replace said work in a satisfactory manner at no extra cost to the Owner.

1.17 PROTECTION OF MATERIALS AND EQUIPMENT

A. Work under each Section shall include protecting the work and material of all other Sections from damage by work or workmen and shall include making good all damage thus caused.

B. The Contractor shall be responsible for work and equipment until the facility has been accepted by the Owner. Protect work against theft, injury or damage and carefully store material and equipment received on site which is not immediately installed. Close open ends of work with temporary covers or plugs during construction to prevent entry of foreign material.

C. Work under each Section includes receiving, unloading, uncrating, storing, protecting, setting in place and completely connecting equipment supplied under each Section. Work under each Section shall also include exercising special care in handling and protecting equipment and fixtures, and shall include the cost of replacing any of the equipment and fixtures which are missing or damaged.

D. Equipment and material stored on the job site shall be protected from the weather, vehicles, dirt and/or damage by workmen or machinery. Insure that all electrical or absorbent equipment or material is protected from moisture during storage.

1.18 BASES AND SUPPORTS

A. Unless otherwise specifically noted, the Contractor shall furnish all necessary supports, rails, framing, bases and piers required for all equipment furnished under this Division.

B. Unless otherwise indicated in individual trade Sections, pumps, fans, air handlers, boilers, chillers, tanks, compressors and other rotating machinery shall be mounted on a minimum of six (6") inch high concrete pads which shall be furnished and installed per Division 3. All pads shall be extended six (6") inches beyond machine base in all directions with top edge chamfered. Shop drawings of all foundations and pads shall be submitted to the Engineer for review before they are constructed. The Mechanical Contractor shall field coordinate all required dimensional and necessary loading information.

C. Construction of foundations, supports, pads, bases and piers where mounted on the floor shall be of the same finish quality as the adjacent and surrounding flooring material.

D. Unless otherwise shown, all equipment shall be securely attached to the building structure in an acceptable manner. Attachments shall be of a strong and durable nature; any attachments that are insufficient, in the opinion of the Engineer, shall be replaced as directed without extra cost to the Owner.

E. All equipment supports shall be designed and constructed such that the equipment will be capable of resisting both vertical and horizontal movement. The equipment shall be positively anchored to the bases or supports to resist vertical movement. The equipment and its supports shall be provided with suitable restraints to resist horizontal movement from any direction as dictated by applicable seismic Codes.

1.19 **MISCELLANEOUS IRON AND STEEL**

A. Each trade shall provide all primary and secondary steel supports and hangers as shown on the drawings and/or as required to support equipment, piping, or any other materials provided under the work of this Division.

B. The work of this Section is for designing, furnishing and installing all miscellaneous metal work associated with the system, and related items as indicated on the drawings and/or as specified herein, and includes, but is not limited to the items listed herein below.

C. The scope of work shall include:
   1. Intermediate beams to hang piping from the roof. All piping must be hung from beam or supported from the floor. Provide supplemental steel for support of equipment.
   2. Support of piping in shafts in addition to support provided by structure.
   3. Support of piping via floor stands as required.
   4. Pipe anchors in the building.
   5. Hangers, brackets, angel irons or rods required for the support and protection of Fire Protection piping and equipment.

D. Shop Drawings for General Miscellaneous Items:
   1. Submit Shop Drawings of all miscellaneous metal items to Architect for approval, showing sizes and thickness of all members, types of materials, methods of connection and assembly, complete dimensions, clearances, anchorage, relationship to surrounding work by other Trades, shop paint, and other pertinent details of fabrication and installation.

E. The Subcontractor shall engage the services of a Professional Engineer registered within the state wherein the project is located to prepare complete Design Drawings and structural design computations based on, and closely following, the design and details on the Drawings. The Design Drawings and structural design computations, with the Engineer's seal affixed thereto, shall be submitted to the Architect for review. The structural design computations shall provide a complete structural analysis, including anchors and fastening devices, and shall certify as to conformation to governing laws and codes. These submittals, upon review, must be sufficient, when taken in conjunction with this Specification to provide the complete basis of the fabrication and erection.

F. Samples:
   1. Submit duplicate samples of all materials to be furnished under this Division; in size and form, requested by Architect.

G. Do not order materials or begin fabrication until Architect's approval of submittals has been obtained.

H. In addition to the governing laws and codes, the following Specifications and Codes form a part of this Specification:
   1. American Iron and Steel Institute applicable standards.
   2. American Institute of Steel Construction "Code of Standard Practice for Steel Buildings and Bridges" and "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings".
   3. American Welding Society Code: Standard Code for Arc and Gas.

1.20 SLEEVES, INSERTS AND ANCHOR BOLTS

A. The Contractor shall provide, set in place and be held responsible for the location of all sleeves, inserts and anchor bolts required for the work. In the event that failure to do so requires cutting and patching of finished work, it shall be done at the Contractor's expense.

B. It is the responsibility of the Contractor to furnish cast-in-place steel sleeves, inserts and anchors in sufficient time to be installed during initial concrete pours. Where job schedules make this impossible, coordinate and obtain acceptance from the Structural Engineer for alternate installation methods.

C. All pipes and conduits passing through floors, walls or partitions shall be provided with sleeves having an inside diameter one (1") inch larger than the outside diameter of the pipe, conduit or insulation enclosing the pipe.

D. Penetrations pipe through fire-rated walls, ceilings and all floors (except slab on grade) in shall be filled solidly with acceptable fire-stopping material. Sleeves shall be steel or a UL / FM listed and approved assembly.

E. When piping or conduit penetrate the floor of a mechanical room located above an occupied space, such penetrations shall be made completely watertight, such that a liquid leak shall not pass through the penetration.

1.21 FIRE-STOPS AND SEALS

A. Refer to Division 7 Specification for additional and more specific information.

B. Fire-stopping systems shall be submitted as shop drawing.

C. Penetrations through fire-rated walls, ceiling or floors shall be sealed with a UL approved fire-stop fitting classified for an hourly rating equivalent to the fire rating of the wall, ceiling or floor.

D. Thruwall and floor seals shall be used to provide a positive means of sealing pipes which pass through the concrete foundation of a structure below grade or below ground water level. Seals shall also be used at entry points through concrete walls or floors which must be sealed.

1.22 CUTTING AND PATCHING

A. All cutting and patching shall be done per Division 1 requirements. The Contractor shall furnish sketches showing the location and sizes of all openings, chases, etc., required for the installation of work.

B. Work under this Division shall include furnishing, locating and setting inserts and/or sleeves required before the floors and walls are built or be responsible for cutting, drilling or chopping where sleeves and inserts were not installed or correctly located. The Contractor shall do all drilling required for the installation of hangers.

C. Exercise extreme caution when core drilling or punching openings in concrete floor slabs in order to avoid cutting or damaging structural members. No structural members or structural slabs/floors shall be cut without the written acceptance of the Structural Engineer and all such cutting shall be done in a manner directed by him.

1.23 SCAFFOLDING, RIGGING, HOISTING

A. The Contractor shall furnish all scaffolding, rigging, hoisting and services necessary for erection and delivery into the premises any equipment and apparatus furnished under this Division.

Remove same from premises when no longer required.

1.24 EXCAVATION AND BACKFILLING

A. Excavation and backfilling shall be done per Division 31 and 33 of the Specifications.

B. It is the responsibility of the Contractor to coordinate sizes, depths, fill and bedding requirements and any other excavation work required under this Division per code and local utility requirements.

1.25 WATERPROOFING

A. Where any work pierces waterproofing, including waterproof concrete and floors in wet areas, the method of installation shall be reviewed by the Engineer before work is done. The Contractor shall furnish all necessary sleeves, caulking and flashing required to make openings absolutely watertight.

1.26 ACCESSIBILITY AND ACCESS PANELS

A. The Contractor shall be responsible for the sufficiency of the size of shafts and chases, the adequate thickness of partitions, and the adequate clearance in double partitions and hung ceilings for the proper installation of the work.

B. Locate all equipment which must be serviced, operated or maintained in fully accessible positions. Equipment shall include, but not be limited to: motors, controllers, valves, switchgear, drain points, etc. Access doors shall be furnished if required for better accessibility. Minor deviations from the Drawings may be made to allow better accessibility, but changes of magnitude or which involve extra cost shall not be made without the acceptance of the Engineer.

C. Access doors in walls, ceilings, floors, etc., shall be field coordinated. It is the responsibility of the Contractor to coordinate and provide information regarding the sizes and quantities of access doors required for his work. Refer to Secton 08 31 13 - Access Doors and Frames for requirements. The Contractor shall arrange his work in such a manner as to minimize the quantity of access doors required, such as grouping shutoff valves in the same area. Where possible, locate valves in already accessible areas, such as lay-in ceilings, etc.

D. On a clean set of prints, the Contractor shall mark in red pencil the location of each required access door, including its size and fire rating (if any), and shall submit the print to the Architect for review before access doors are purchased or installed.

E. Upon completion of the Project, the Contractor shall physically demonstrate that all equipment and devices installed have been located and/or provided with adequate access panels for repair, maintenance and/or operation. Any equipment not so furnished shall be relocated or provided with additional access panels by the installing Contractor at no additional cost to the Owner. All access panel or door locations shall be indicated on Owner's final as-built record drawings.

1.27 TEMPORARY OPENINGS

A. The Contractor shall ascertain from an examination of the Drawings whether any special temporary openings in the building will be required for the admission of apparatus provided under this Division and shall coordinate the requirements accordingly. In the event of failure of the Contractor to give sufficient notice in time to arrange for these openings during construction, the Contractor shall assume all costs of providing such openings thereafter.

1.28 TAGS AND CHARTS

A. Each valve and piece of apparatus under this Division shall be provided with suitable brass or laminated plastic tags securely fastened with brass chains, screws or rivets. Equipment shall be numbered with laminated plastic tags or neatly stenciled letters two (2") inches high using designations in equipment schedules and/or shall conform to a directory indicating number, location and use of each item. Directories shall be prepared under each Section and shall be glass framed.

B. Directory shall indicate valve tag number and the unit number, floor/area branch line, main line, service or other pertinent data to quickly and easily identify the valve's purpose.

1.29 ESCUTCHEONS

A. The Contractor shall provide escutcheons on pipes wherever they pass through floors, ceilings, walls or partitions in finished visible locations.

1.30 PAINTING

A. All finish painting in completed areas shall be performed per other divisions of the Specifications.

B. All materials shipped to the job site under this Division, such as piping, fittings, equipment, valves, etc., shall have standard manufacturer's finish, unless otherwise specified by Architect.

C. All piping, fittings and hangers installed in damp area or outdoors shall be properly primed with zinc-rich primer and finished with a minimum of two (2) coats of high grade exterior enamel.

1.31 PIPE EXPANSION

A. All pipe connections shall be installed to allow for freedom of movement of the piping during expansion and contraction without springing. Provide engineered design, layout, details and fabrication, submitted with registered professional engineer sign and seal, of swing joints, expansion loops and expansion joints with proper anchors and guides. Pay particular attention to plastic piping with high coefficients of expansion.

B. Consideration of required seismic lateral restraints shall be given when anchoring piping and making provision for expansion.

1.32 ELECTRICAL CONNECTIONS

A. Unless otherwise specified, all wiring shall be furnished and installed per Division 26 Specifications.

B. All motor controllers not factory mounted on mechanical equipment shall be furnished, mounted, and installed by the Division 26 contractor, and shall be coordinated with this contractor. Provide properly sized overload heaters and all required accessories with all motor controllers. See Division 26 Motor Controllers for motor controller requirements.

C. All power wiring shall be furnished and installed per Division 26 complete from power source to motor or equipment junction box including power wiring through the motor controller and proper means of disconnect per NEC and Division 26. The Division 26 Contractor shall provide all disconnects, unless noted otherwise.

1.33 MAINTENANCE

A. The Contractor shall provide the necessary skilled labor to assure the proper operation and to provide all required current and preventative maintenance for all equipment and controls provided under this Division until final acceptance of the building by the Owner. The Contractor shall not assume acceptance of the building by the Owner until he receives written notification.

B. The Contractor shall receive calls for any and all problems experienced in the operation of the equipment provided under this Division and he shall take steps to immediately correct any deficiencies that may exist.

C. The Contractor shall provide a check list and shall put a copy of it in the boiler or main mechanical room. The check list shall itemize each piece of equipment furnished under his Section.

D. The Contractor shall certify on this check list that he has examined each piece of equipment and that, in his opinion, it is operating as intended by the manufacturer, it has been properly lubricated, and that all necessary current and preventative maintenance has been performed as recommended by the manufacturer and by good and accepted practice.

E. The Contractor shall check all controls in the building to ascertain that they are functioning as designed. This shall apply to all pressure switches, flow switches, tamper switches, control

panel interfaces, detectors, relays, actuators, valves, etc. This portion of the work shall be performed by the Contractor who installed the controls.

F. Where normal preventative maintenance for any piece of equipment requires special tools, the Contractor shall furnish the appropriate tools for that piece of equipment (i.e., special filter removal hooks, valve wrenches, etc.).

1.34 LUBRICATION

A. All equipment installed under this Contract having moving parts and requiring lubrication shall be properly lubricated according to manufacturer's recommendations prior to testing and operation. Any such equipment discovered to have been operated before lubrication by the Contractor is subject to rejection and replacement at no additional cost to the Owner. Units furnished with sealed bearings are exempted.

1.35 CLEANING

A. The Contractor shall be responsible for keeping the jobsite clean, safe and neat throughout the duration of construction. The Contractor shall clean up his own debris daily and shall coordinate removal of rubbish and debris with the General Contractor.

B. No debris, construction materials, cigarette butts, coffee cups, etc., shall be left above suspended ceilings.

C. Terminal equipment and plumbing fixtures shall cleaned at substantial completion.

D. If any part of a system should be stopped or damaged by any foreign matter after being placed in operation, the system shall be disconnected, cleaned and reconnected wherever necessary to locate and/or remove obstructions. Any work damaged in the course of removing obstructions shall be repaired or replaced when the system is reconnected at no additional cost to the Owner.

E. During the course of construction, all ducts and pipes shall be capped in an acceptable manner to insure adequate protection against the entrance of foreign matter.

F. Upon completion of all work under the Contract, the Contractor shall remove from the premises all rubbish, debris and excess materials left over from his work. Any oil or grease stains on floor areas caused by the Contractor shall be removed and floor areas left clean.

1.36 OPERATING INSTRUCTIONS

A. Upon completion of all work and tests, the Contractor shall furnish the necessary skilled labor and helpers for operating his system and equipment for a period specified under each applicable Section of this Division. During this period, he shall fully instruct the Owner or the Owner's representative in the operation, adjustment and maintenance of all equipment furnished. The Contractor shall give at least 72 hours notice to the Owner and the Engineer in advance of this period.

B. The Contractor shall formally submit for delivery to the Engineer three (3) complete bound sets of typewritten or blueprinted instructions for operating and maintaining all systems and equipment included in this Division. All instructions shall be submitted in draft for review prior to final issue. Manufacturer's advertising literature or catalogs will not be acceptable for operating and maintenance instruction.

C. The Contractor, in the above-mentioned instructions, shall include the maintenance schedule for the principal items of equipment furnished under this Division.

D. The appropriate Contractor shall physically demonstrate procedures for all routine maintenance of all equipment furnished under each respective Section to assure accessibility to all devices.

E. An authorized manufacturer's representative shall attest in writing that the equipment has been properly installed prior to startup of any major equipment. The following equipment will require this inspection: Clean Agent Fire Extinguishing System and Fire Detection System for Pre-action Sprinkler System. These letters will be bound into the operating and maintenance books.

F. Refer to individual trade Sections for any other particular requirements related to operating instructions.

1.37 ADJUSTING AND TESTING

A. After all the equipment and accessories to be furnished are in place, they shall be put in final adjustment and subjected to such operating tests so as to assure the Engineer that they are in proper adjustment, the control operate as described in the sequence of operation and all systems are in satisfactory, permanent operating condition.

B. Where requested by the Engineer, a factory-trained service engineering representative shall inspect the installation and assist in the initial startup and adjustment to the equipment. The period of these services shall be for such time as necessary to secure proper installation and adjustments. After the equipment is placed in permanent operation, the service engineering representative shall supervise the initial operation of the equipment and instruct the personnel responsible for operation and maintenance of the equipment. The service engineering representative shall notify the Contractor in writing that the equipment was installed according to manufacturer's recommendations and is operating as intended by the manufacturer.

1.38 GUARANTEES

A. The Contractor shall guarantee all equipment, material and workmanship under these Specifications and the Contract for a period of one (1) year from the date of final acceptance by Owner, unless otherwise noted.

B. During this guarantee period, all defects developing through faulty equipment, materials or workmanship shall be corrected or replaced immediately by the Contractor without expense to the Owner. Such repairs or replacements shall be made to the Engineer's satisfaction.

PART 2 PRODUCTS - NOT USED.

PART 3 EXECUTION - NOT USED.

**END OF SECTION**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Pipe, fittings, sleeves, escutcheons, seals, and connections for sprinkler systems.

1.03 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.

B. Section 211300 - Fire Suppression Sprinklers: Sprinkler system design.

C. Section 210548 - Seismic Controls for Fire Suppression Systems: Earthquake protection.

D. Section 220553 - Identification for Plumbing Piping and Equipment: Piping identification.

1.04 REFERENCE STANDARDS

A. ASME BPVC-IX - Qualification Standard for Welding, Brazing, and Fuzing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators - Welding Brazing and Fusing Qualifications 2019.

B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250 2020.

C. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300 2016.

D. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250 2016.

E. ASME B16.9 - Factory-Made Wrought Buttwelding Fittings 2018.

F. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings 1999, with Editorial Revision (2018).

G. ASTM A197/A197M - Standard Specification for Cupola Malleable Iron; 2000 (Reapproved 2015).

H. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use 2021.

I. NFPA 13 - Standard for the Installation of Sprinkler Systems Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. UL (DIR) - Online Certifications Directory Current Edition.

1.05 SUBMITTALS

A. See Section 013300 - Submittial Procedures, for submittal procedures.

B. Product Data: Provide manufacturer's catalog information. Indicate valve data and ratings.

C. Shop Drawings: Indicate pipe materials used, jointing methods, supports, and floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.

D. Project Record Documents: Record actual locations of components and tag numbering.

E. Operation and Maintenance Data: Include installation instructions and spare parts lists.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. Conform to UL requirements.

C. Valves: Bear UL label or marking. Provide manufacturer's name and pressure rating marked on valve body.

1.07 CONTRACTOR'S RESPONSIBILITIES

A. All permits and fees.

B. Hoisting, rigging, transportation costs and installation of necessary appurtenances.

C. The Contractor shall visit the premises and note all pertinent facts and details including conditions under which the work must be carried out. No allowance will be made for failure to have done so.

D. Holes - Cutting and Patching: Cutting will be by core boring, patch will require both waterproofing and fireproofing.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store valves in shipping containers, with labeling in place.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

PART 2 PRODUCTS

2.01 FIRE PROTECTION SYSTEMS

A. Sprinkler Systems: Conform to NFPA 13.

B. Welding Materials and Procedures: Conform to ASME BPVC-IX.

2.02 ABOVE GROUND PIPING

A. Steel Pipe: ASTM A795 Schedule 10 or ASTM A795 Schedule 40, black.
   1. Standard weight Schedule 40 with grooved coupling in sizes 1-1/2" and 2". Standard square cut grooves to coupling manufacturer's specifications.
   2. Standard weight Schedule 40 with threaded coupling and fittings in sizes 2" and smaller.
   3. Light wall Schedule 10 with grooved couplings in sizes 2-1/2" and larger. Rolled grooves; no cut grooves or threading will be allowed on Schedule 10.

B. Fittings
   1. Steel Fittings: ASME B16.9 wrought steel, buttwelded.
   2. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings and ASME B16.4, threaded fittings.
   3. Malleable Iron Fittings: ASME B16.3, threaded fittings, ASTM A47 and ASTM A197.
   4. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.

2.03 PIPE HANGERS AND SUPPORTS

A. Hangers for Pipe Sizes 3/8 to 3 inch: Malleable iron, split ring extension hanger.

B. Hangers for Pipe Sizes 1 inch and Over: Carbon steel, adjustable ring, with knurled swivel. NFPA threaded rod sizes.

C. Hanger attachment to structural steel beam: Universal or wide mouth malleable iron C-type beam clamp with locknut, U.L. Listed. Secure with retaining strap hammered tight to beam flange.

D. Hanger attachment to concrete: Set-in expansion anchors to rated capcity or self drilling anchors where weight of piping does not exceed half of rated capcity.

E. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

F. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.

G. Vertical Support: Steel riser clamp.

H. Floor Support: Cast iron adjustable pipe saddle with U-bolt, threaded pipe adjuster, cast iron floor flange, and steel pipe support.

2.04 BALL VALVES

A. Up to and including 2 inches:
   1. Bronze two piece body, brass, chrome plated bronze, or stainless steel ball, teflon seats and stuffing box ring, lever handle , threaded ends .

2.05 BUTTERFLY VALVES

A. Bronze Body:
   1. Stainless steel disc, resilient replaceable seat, threaded or grooved ends, extended neck, handwheel and gear drive and integral indicating device , and built-in tamper proof switch rated 10 amp at 115 volt AC. U.L. listed and F.M. approved.

B. Ductile Iron Body:
   1. Epoxy coated ductile iron, chrome or nickel plated ductile iron or aluminum bronze disc, resilient replaceable EPDM seat, wafer, lug, or grooved ends, extended neck, handwheel and gear drive, 175 PSI non-shock water pressure. Integral indicating device, and internal tamper switch rated 10 amp at 115 volt AC. U.L. listed and F.M. approved.

2.06 CHECK VALVES

A. Up to and including 2 inch:
   1. Bronze body and swing disc, rubber seat, threaded ends.

B. 4 inch and Over:
   1. Iron body, bronze mounted, swing check with rubber disc, renewable disc and seat, flanged maintenance port, grooved or flanged ends with automatic ball check. 175 PSI non-shock water pressure. U.L. listed and F.M. aproved.

2.07 DRAIN VALVES

A. Ball Valve:
   1. Brass with cap and chain, 3/4 inch hose thread.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and foreign material, from inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

A. Fire protection piping shall be seismically restrained per the current Building Code.

B. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

C. Install piping to conserve building space, to not interfere with use of space and other work.

D. Group piping whenever practical at common elevations.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

F. 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.

3.03 HANGERS AND SUPPORTS

A. Pipe Hangers and Supports:
   1. Place hangers within 12 inches of each horizontal elbow. Any sprinkler pipe over 1'-6" in length requires a hanger and the maximum overhang beyond the last hanger shall not exceed 1'-6". Hangers are to be installed on both sides of grooved pipe couplings.

2. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe. End of line hangers for pendent sprinklers shall prevent upward movement of pipe.
3. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
4. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

3.04 PIPING SYSTEM

A. The piping system shall be arranged so that the entire system can be flushed and drained through accessable low points. Slope piping towards main drain or provide auxiliary drains for water in trapped sections of pipe.

B. Pipe and fittings for drain lines shall be galvanized.

C. Do not penetrate building structural members unless indicated.

D. Provide sleeves when penetrating footings and seal pipe and sleeve penetrations to achieve fire resistance equivalent to fire separation required.

E. Escutcheons:
1. Install and firmly attach escutcheons at piping penetrations into finished spaces.
2. Provide escutcheons on both sides of partitions separating finished areas through which piping passes.
3. Use chrome plated escutcheons in occupied spaces and to conceal openings in construction.

F. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, unions, and couplings for servicing are consistently provided.

G. Grooved fittings and couplings shall be installed in accordance with the manufacturer's recommendations. Piping shall be cut and prepared per the coupling manufacturer's standards.

H. Threaded joints shall be made with teflon liquid joints compound applied to male threads only.

3.05 VALVES

A. Provide drain valves at main shut-off valves, low points of piping and apparatus. All drain piping shall be galvanized.

**END OF SECTION**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Wet-pipe sprinkler system.

B. System design, installation, and certification.

C. Fire department connections.

1.03 RELATED REQUIREMENTS

A. Section 210500 - Fire Protection Basic Materials and Methods: Pipe, fittings, and valves.

B. Section 220553 - Identification for Plumbing Piping and Equipment.

C. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

D. Section 284600 - Fire Detection and Alarm.

1.04 SYSTEM DESCRIPTION

A. Systems to provide coverage for the addition to Fire Station.

B. Provide hydraulically designed automatic wet pipe sprinkler system. The new sprinkler system shall be a new zone connected to the existing Fire Protection Riser. Water supply is from the existing 6" water service connected to town water main.

C. Modifications to existing sprinkler systems include: Relocation of the existing second floor riser; relocation and addition of new sprinkler on both levels of the existing building to accommodate connection with addition.

D. Furnish all necessary labor, materials, tool, equipment, appurtenances, instruments, etc. necessary to fully complete the Fire Protection System in accordance with the plans and specifications and both local and state fire codes and NFPA 13.

1.05 REFERENCE STANDARDS

A. NFPA 13 - Standard for the Installation of Sprinkler Systems Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

B. UL (DIR) - Online Certifications Directory Current Edition.

1.06 SUBMITTALS

A. See Section 013300 - Submittial Procedures, for submittal procedures.

B. Product Data: Provide data on sprinklers, valves, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

C. Shop Drawings:

1. Submit preliminary layout of finished ceiling areas indicating only sprinkler locations coordinated with ceiling installation.
2. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, sprinklers, components, and accessories. Indicate system controls.
3. Submit shop drawings and hydraulic calculations to authority having jurisdiction, Rating Bureau and RZ Design Associates, Inc. for approval.

D. Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, Test Certificates, replacement part numbers and availability, and location and numbers of service depot.

1.07 QUALITY ASSURANCE

A. Conform to UL requirements.

B. Design by a NICET Level IV Certified Sprinkler Technician or under direct supervision of a Professional Fire Protection Engineer experienced in design of this type of work and licensed in Connecticut.

C. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

D. Installer Qualifications: Company specializing in performing the work of this section with minimum three years experience approved by manufacturer.

E. Equipment and Components: Provide products that bear UL label or marking.

1.08 CONTRACTOR'S RESPONSIBILITIES

A. The Fire Protection Contractor shall provide notification of outage and impairment to the existing fire protection systems to general contractor, building owner and local authorities.

B. Expenses for Fire Watches are the responsiblity of the Fire Protection Contractor.

C. Drawings are diagrammatic; do not rely on scaling of drawings. Make such deviations and offsets as necessary to meet the space requirements.

D. The contractor shall be responsible for water damage to the property of the owner, the work of other trades, and existing building systems during all phases of the work.

E. Coordination Drawings: The Fire Protection Contactor shall incorporate the shop drawing sprinkler design into the master coordination drawings and work with the other trade contractors to resolve conflicts.

1.09 EXTRA MATERIALS

A. Provide extra sprinklers of type and size matching those installed, in quantity required by referenced NFPA design and installation standard.

B. Provide suitable wrenches for each sprinkler type.

C. Provide red enamel finished steel sheetmetal storage cabinet in location designated.

PART 2 PRODUCTS

2.01 SPRINKLERS

A. Suspended Ceiling Type: Recessed pendent type with matching push on escutcheon plate.
   1. Finish: Chrome plated.
   2. Escutcheon Plate Finish: Chrome plated.
   3. Fusible Link: Glass bulb type, quick response, temperature rated for specific area hazard.

B. Hard-Lid Ceiling Type: Concealed pendent with white cover plate.
   1. Fusible Link: Glass bulb type or fusible link type, quick response, temperature rated for specific area hazard.

C. Exposed Area Type: Standard upright type .
   1. Finish: Brass.
   2. Fusible Link: Glass bulb type, quick response, temperature rated for specific area hazard.

D. Sidewall Type: Standard horizontal sidewall type with matching push on escutcheon plate .
   1. Escutcheon Plate Finish: Chrome plated.
   2. Fusible Link: Glass bulb type, quick response, temperature rated for specific area hazard.

E. Dry Sprinklers: Recessed dry sidewall type with matching push on escutcheon plate.
   1. Finish: Chrome plated.
   2. Escutcheon Plate Finish: Chrome plated.
   3. Fusible Link: Glass bulb type, quick response, temperature rated for specific area hazard.

2.02 SPRINKLER SPECIALTIES

A. Inspector's Test Connection: Section drain valve with integral test port, single bronze body ball valve with minimum 1" NPT inlet and outlet, chromium plated bronze ball, glass impregnated teflon valve seat, two fused tempered sight glasses and 1/2" test orifice. U.L. listed and F.M.

approved.

B. Air Venting Valves: Equip wet-pipe sprinkler systems with automatic float type air vent. Provide AGF Model M7900AAV; forged brass body assembly with integrated ball valve, stainless steel strainer and purge valve with hose fitting. Install at remote end of Apparatus Bay.

2.03 ACCESSORIES

A. Water Flow Switch: Vane type switch, aluminum pipe saddle mount, polyethyene paddle, adustable retard and tamper-proof housing, with two SPDT contacts; rated 10 amp at 125 volt AC and 2.5 amp at 24 volt DC. As manufactured by Potter Electric, Model VSR-F or equal by System Sensor or Notifier.

2.04 FIRE DEPARTMENT CONNECTIONS

A. Type: Two way projecting mounted wall type inlet.

B. Cast brass body with individual drop clapper valves. Crome plated brass double female snoots with rigid end 2-1/2" NPT X 2-1/2" pin lug hose thread swivel, pin lug plug and chain. Threads to local fire department specifications.

C. Escutcheon: Rectangular chrome plated, lettering "AUTO. SPKR.".

D. Drain: 3/4 inch automatic drip, outside.
   1. Product: Potter Roemer Fig. 5751 or equal by Elkhart Brass or Croker.

PART 3 EXECUTION

3.01 GENERAL

A. The complete system shall be installed in accordance with Rules and Regulations pertaining to Light and Ordinary Hazard Group 1(not to exceed 130 sq. ft. per head - system hydraulically calculated; not sized per pipe schedule) occupancies and comply with the full requirements of the regulatory agencies.

B. The Fire Protection Contractor shall have hydrant flow tests conducted on the fire hydrants hydraulically closest to the existing water service entrance. Conduct test and record test data in accordance with NFPA 291.
   1. Obtain flow test data, attested to by Clerk of the Works, which is adequate to base the design on. Data will be judged adequate if the actual flow values measured during flow test equal or exceed total demand. Flow values extrapolated from measured flow values may not be used as a basis for design.

C. The Fire Protection Contractor shall have prepared by a NICET Level IV Certified Sprinkler Technician or under a P.E. work installation drawings (Shop Drawings) and shall submit them to the engineer and Rating Bureau for approval.

D. Shop Drawings shall include all hydraulic calculations prepared on forms similar to those in NFPA 13 Appendix A.

E. Design Criteria: (Adjust as appropriate for pitched roofs, dry pipe system, etc.)

F. Light Hazard - 0.10 GPM/Sf density over the most remote 1500 sq.ft. for offices and corridors. Protection area limitation 168 sq.ft. with standard coverage sprinklers.

G. Ordinary Hazard Group 1 - 0.15 GPM/SF density over the most remote 1500 sq.ft. for Apparatus Bays, Storage, and Training Areas. Protection area limitation 130 sq.ft.

3.02 INSTALLATION

A. Install in accordance with referenced NFPA design and installation standard.

B. Install equipment in accordance with manufacturer's instructions.

C. Place pipe runs to minimize obstruction to other work. Special care must be taken to insure that piping above hung ceilings is run to maintain maximum headroom and clearance for access to equipment of other trades and to avoid conflict with electrical conduits, light fixtures, other piping, ductwork etc.

D. Pipe shall be run concealed throughout finished spaces. Place above finished ceilings or in chases, shafts, wall cavities or soffits.

E. In gridded sprinkler systems, the water velocity shall not exceed 20 ft./sec. in branch lines 2" and smaller.

F. Pipe size for drops to sprinkler heads located below suspended ceilings shall be 1 inch minimum.

3.03 SPRINKLER HEADS

A. Sprinkler heads of the proper configration and numbers are to be installed as required in accordance with regulations pertaining to Light and Ordinary Hazard Occupancies and meet the full requirements of the NFPA, Local Fire Department, State Fire Marshal, Fire Insurance Company, Rating Bureau and other agencies having jurisdiction.

B. Center sprinklers in ceiling tiles except where indicated otherwise. Provide and adjust arm over assemblies as necessary.

C. Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.

D. Install heads with Teflon liquid joint compound applied to male threads only.

E. Install guards on sprinklers in locations subject to mechanical damage.

F. Mount sprinkler head cabinet in the location directed by the Owner Representative. Stock with spare sprinkler heads of each type and or temperature rating and a sprinkler head wrench per NFPA 13.

3.04 FIRE DEPARTMENT CONNECTION

A. The fire department connection shall be made on the system side of the alarm valve. There shall not be a shut-off valve in the fire department line.

B. The pipeline between the check valve and the outside hose coupling shall be equipped with an approved automatic drip.

C. Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent siamese connectors to allow full swing of fire department wrench handle.

D. Installation shall conform with the requirements of the local Fire Department, and the Rating Bureau in accordance with NFPA.

3.05 INSPECTOR'S TEST CONNECTIONS

A. Install at end of most remote branch line , valve shall not be over 7'-0" above floor. Terminate connection outside building with 1 inch 45 degree elbow. Flow shall be equivalent to one sprinkler head.

3.06 TESTING

A. Hydrostatically test entire system. Test system at no less than 200 psi for two (2) hours after completion, in accordance with NFPA 13 Chapter 25 - System Acceptance.
   1. The new sprinkler system shall be tested prior to connection with the existing sprinkler system. If the construction phasing requires activation in advance of completion system shall be disconnected temporarily to retest with the additional completed work.
   2. Changes to the existing sprinkler system shall tested in segments based on the arrangement of the piping and available locations to isolate the work area by making temporary disconnects in mains and/or cross mains.
   3. Only areas undergoing very limited modification will be approved for exemption from testing in excess of 50 psi above the working pressure or the 200 psi.

B. Flush entire piping system of foreign matter. Furnish to the insurance carrier, Contractor's Material and Test Certificate. Fill in and sign form as outlined in NFPA 13.

C. During and after completion, the entire installation shall be subject to inspection and testing by the insurance carrier.

D. Notify authority having jurisdiction of testing.

3.07 INTERFACE WITH OTHER PRODUCTS

A. Ensure required devices are installed and connected as required to fire alarm system.

**END OF SECTION**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.02 DESCRIPTION

A. The General Conditions and Supplementary General Conditions are a part of this Division and are to be considered a part of this Contract.

B. Where items of the General Conditions and Supplementary General Conditions are repeated in other Sections of the Specifications, it is merely intended to qualify or to call particular attention to them. It is not intended that any other parts of the General Conditions and Supplementary General Conditions shall be assumed to be omitted if not repeated therein.

C. This Section applies equally and specifically to all Contractors supplying labor and/or equipment and/or materials as required under each Section of this Division.

D. The following information contains specifications of Work in connection with, and in addition to, this Division:
   1. All drawings associated with the project.
   2. All specifications associated with the project.

E. Division of work responsibilities shall be as defined and directed by the Bidding Agent and/or the Bidding General Contractor.

1.03 INTENT

A. It is the intent of the Specifications and Drawings to call for finished work, tested and ready for operation.

B. Furnish, deliver and install any apparatus, appliance, material or Work not shown on Drawings but mentioned in the Specifications, or vice versa, or any incidental accessories necessary to make the Work complete and perfect in all respects and ready for operation, even if not particularly specified, under their respective Section without additional expense to the Owner.

C. Include in the work minor details not usually shown or specified but necessary for proper installation and operation, as though they were hereinafter shown or specified.

D. Provide Engineer written notice of any materials or apparatus believed inadequate or unsuitable; in violation of laws, ordinances, rules or regulations of authorities having jurisdiction; and any necessary items of Work omitted. In the absence of such written notice, it is mutually agreed that Work under each Section has included the cost of all required items for the accepted, satisfactory functioning of the entire system without extra compensation.

E. The Work indicated is diagrammatic. The Architect and/or Engineer may require as part of this Contract, the relocation of devices to reasonable distances from the general locations shown.

F. Verbal clarifications of the Drawings or Specifications during the bid period are not to be relied upon. Refer any questions or clarifications to the Engineer at least five Working days prior to bidding to allow for issuance of an addendum. After the five-day deadline, Bidder must make a decision and qualify the Bid, if the Bidder feels it necessary.

1.04 DRAWINGS

A. Drawings are diagrammatic and indicate the general arrangement of systems and work included in the Contract. (Do not scale the Drawings.) Consult the Architectural Drawings and Details for exact location of fixtures and equipment; where same are not definitely located, obtain this information from the Architect.

B. Closely follow Drawings in layout of Work; check Drawings of other Divisions to verify spaces in which work will be installed. Maintain maximum headroom. Where space conditions appear inadequate, Engineer shall be notified before proceeding with installations.

C. Engineer may, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades and/or for proper execution of the work.

D. Where variances occur between the Drawings and Specifications or within either of the Documents, include the item or arrangement of better quality, greater quantity or higher cost in the Contract price. The Engineer shall decide on the item and the manner in which the work shall be installed.

1.05 SURVEYS AND MEASUREMENTS

A. Before submitting a Bid, the Contractor shall visit the site and shall become thoroughly familiar with all conditions under which the work will be installed. Contractor will be held responsible for any assumptions, omissions or errors made as a result of failure to become familiar with the site and the Contract Documents.

B. Base all measurements, both horizontal and vertical, from established bench marks. All Work shall agree with these established lines and levels. Verify all measurements at the site and check the correctness of same as related to the Work.

C. Should the Contractor discover any discrepancies between actual measurements and those indicated which prevent following good practice or the intent of the Drawings and Specifications, notify the Engineer do not proceed with that Work until instructions have been received from the Engineer.

1.06 CODES AND STANDARDS

A. The Codes and Standards listed below apply to all Work. Where Codes or Standards are mentioned in these Specifications, follow the latest edition or revision.

B. The current adopted editions of the following State or local Codes apply:
   1. 2020 New York State Building Code
   2. 2018 International Building Code
   3. 2018 International Mechanical Code
   4. 2018 International Plumbing Code
   5. 2018 International Energy Conservation Code

C. All materials furnished and all work installed shall comply with the rules and recommendations of the NFPA, the requirements of the local utility companies, the recommendations of the fire insurance rating organization having jurisdiction and the requirements of all Governmental departments having jurisdiction.

D. Include in the Work, without extra cost to the Owner, any labor, materials, testing, services, apparatus and Drawings in order to comply with all applicable laws, ordinances, rules and regulations, whether or not shown on Drawings and/or specified.

1.07 PERMITS AND FEES

A. Give all necessary notices, obtain all permits; pay all Government and State sales taxes and fees where applicable, and other costs, including utility connections or extensions in connection with the Work. File all necessary Drawings, prepare all Documents and obtain all necessary approvals of all Governmental and State departments having jurisdiction, obtain all required certificates of inspections for Work and deliver a copy to the Engineer before request for acceptance and final payment for the Work.

1.08 COORDINATION

A. Carry out all work in conjunction with other trades and give full cooperation in order that all work may proceed with a minimum of delay and interference. Particular emphasis is placed on timely installation of major apparatus and furnishing other Contractors, especially the General Contractor or Construction Manager, with information as to openings, chases, sleeves, bases, inserts, equipment locations, panels, access doors, etc. required by other trades, and to allow for serviceable access to equipment.

B. Mechanical contractors' shall initiate coordination drawings and sections clearly showing how the work is to be installed in relation to the work of other trades, at no extra charge to the

Owner. The Contractors' shall prepare coordination drawings at a scale no less than 1/4"=1'-0", showing the work of all trades, including but not limited to, the following: proposed ductwork installation in detail, including ceiling heights, approved structural steel shop drawings, duct heights, access doors, light fixtures, registers and diffusers, sprinkler piping, electrical distribution conduits, wires, panels and any other electrical work which may conflict with the sheet metal ducts or piping, waste and vent piping, water piping, storm piping, and rain leaders. Provide elevation details showing connections and equipment layout and configuration based on approved submittals. Each shall use a different color code. A coordination meeting of all Contractors involved is then to be held and all possible conflicts are to be resolved. All trades shall sign acceptance of the drawings and then shall submit two (2) prints of each drawing to the Engineer for record.

C. Contractors are required to examine all of the Project Drawings and mutually arrange Work so as to avoid interference. In general, ductwork, heating piping, sprinkler piping and drainage lines take precedence over water, gas and electrical conduits. The Engineer regarding the arrangement of Work, which cannot be agreed upon by the Contractors, will make final decisions. Service of equipment will take precedence.

D. Where the Work of the Contractor will be installed in close proximity to or will interfere with Work of other trades, assist in working out space conditions to make a satisfactory adjustment.

E. If Work is installed before coordinating with other Divisions or so as to cause interference with Work of other Sections, the Contractor causing the interference will make necessary changes to correct the condition without extra charge to the Owner.

F. Initial contact and coordination has been conducted with utility entities for the purpose of the preparation of Bid Documents. The Contractor shall coordinate all final specific utility requirements.

1.09 ACCEPTANCES

A. The equipment, materials, Workmanship, design and arrangement of all Work installed are subject to the review of the Engineer.

B. Within 30 days after the awarding of a Contract, submit to the Engineer for review a list of manufacturers of equipment proposed for the Work. The intent to use the exact makes specified does not relieve the Contractor of the responsibility of submitting such a list.

C. If extensive or unacceptable delivery time is expected on a particular item of equipment specified, notify the Engineer, in writing, within 30 days of the awarding of the Contract. In such instances, deviations may be made pending acceptance by the Engineer or the Owner's representative.

D. Where any specific material, process or method of construction or manufactured article is specified by reference to the catalog or model number of a manufacturer, the Specifications are to be used as a guide and are not intended to take precedence over the basic duty and performance specified or noted on the Drawings. In all cases, verify the duty specified with the specific characteristics of the equipment offered for review. Equipment characteristics are to be used as mandatory requirements where the Contractor proposes to use an acceptable equivalent.

E. If material or equipment is installed before shop drawing review, liability for its removal and replacement is assumed by the Contractor, at no extra charge to the Owner, if, in the opinion of the Engineer, the material or equipment does not meet the intent of the Drawings and Specifications.

F. Failure on the part of the Engineer to reject shop drawings or to reject Work in progress shall not be interpreted as acceptance of Work not in conformance with the Drawings and/or Specifications. Correct Work not in conformance with the Drawings and/or Specifications whenever non-conformance is discovered.

1.10 EQUIPMENT DEVIATIONS

A. Where the Contractor proposes to deviate (substitute or provide an equivalent) from the equipment or materials as hereinafter specified, he shall do so by making a request in writing within 60 days from the Award of Contract. The Contractor shall state in his request whether it is a substitution or an equivalent to that specified, and the amount of credit involved. A copy of said request shall be included in the Base Bid with manufacturer's equipment cuts.
   1. The Base Product Specification shall be based on using the materials and equipment as specified and scheduled with no exceptions. Equipment Manufacturers Scheduled on Drawings are considered Base Product Specification and any other acceptable manufacturers listed in the specifications is considered an equivalent manufacturer to the Base Product Specification. Unlisted manufacturers are considered a substitution and equipment deviation and subject to the requirements for equipment substitution and deviation. When any alternate manufacturer does not qualify acceptable, as determined by the Engineer, provide the Base Bid manufacturer at no additional cost to Owner.
   2. Where an equivalent manufacturer is listed in the specifications, it may or may not indicate that there is an equal product available. Any products must meet all criteria of the Base Product Specification as determined by the Engineer.

B. Substitutions and Equipment Deviations will not be considered if they have a direct bearing on the changing or revising of Contract Documents or if it involves other Contractor's scope of work or thier equipment. Coordination with all trades is required and must be acceptable to all other involved Contractors.

C. Substitutions may be considered for one of the following:
   1. Substitution for Cause: Changes proposed by the Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of warranty terms.
   2. Substitutions for Convenience: Changes proposed by the Contractor or Owner that are not required in order to meet other Project requirements, but may offer advantage to either the Owner or Contractor.

D. In these Specifications and on the accompanying Drawings, one or more makes of materials, apparatus or appliances may have been specified for use in this installation. This has been done for convenience in fixing the standard of workmanship, finish and design required for installation. In the event that only one (1) manufacturer of a product is specified and it is found that the manufacturer has discontinued the product, the Contractor shall use an acceptable equivalent product that meets the requirements of an equivalent product, as noted below, and has all the features of the originally specified product. The details of workmanship, finish and design, and the guaranteed performance of any material, apparatus or appliance which the Contractor desires to deviate for those mentioned herein shall also conform to these standards.

E. Where no specific make of material, apparatus or appliance is mentioned, any first-class product made by a reputable manufacturer may be submitted for the Engineer's review.

F. Where two or more names are given as equivalents, the Contractor must use the specified item or one of the named equivalents. Where one name only is used and is followed by the words "or acceptable equivalent", the Contractor must use the item named or he may apply for an equipment deviation through the prescribed manner in accordance with this Specification.

G. Equipment, material or devices submitted for review as an "accepted equivalent" shall meet the following requirements:
   1. The equivalent shall have the same construction features such as, but not limited to:
   2. Material thickness, gauge, weight, density, etc.
   3. Welded, riveted, bolted, etc., construction
   4. Finish, undercoatings, corrosion protection
   5. The equivalent shall perform with the same or better operating efficiency.
   6. The equivalent shall have equal or greater reserve capacity.

7. The equivalent shall be locally represented by the manufacturer for service, parts and technical information.
8. The equivalent shall bear the same labels of performance certification as is applicable to the specified item, such as AMCA or ARI labels.

H. Where the Contractor proposes to use an item of equipment other than specified or detailed on the Drawings which requires any redesign of the structure, partitions, foundations, piping, wiring or any other part of the mechanical, electrical or architectural layout, all such redesign and all new drawings and detailing required therefore shall be prepared by the Designers of Record at the expense of the Contractor and at no additional cost to the Owner.

I. Where such accepted deviation or substitution requires a different quantity and arrangement of piping, ductwork, valves, pumps, insulation, wiring, conduit and equipment from that specified or indicated on the Drawings, the Contractor shall, with the acceptance by the Engineer, furnish and install any such additional equipment required by the system at no additional cost to the Owner, including any costs added to other trades due to the substitution.

J. The Engineer shall determine if an "accepted equivalent" to a manufacturer listed in the Specifications is considered acceptable.

1.11 SHOP DRAWINGS

A. Refer to individual specification sections for additional submittal information.

B. The Contractor shall submit for review detailed shop drawings of all equipment and material specified in each section and coordinated ductwork layouts. No material or equipment may be delivered to the job site or installed until the Contractor has received shop drawings for the particular material or equipment which have been properly reviewed.

C. Shop drawings shall be submitted within 60 days after award of Contract before any material or equipment is purchased. The Contractor shall submit for review copies of all shop drawings to be incorporated in the Contract. Refer to the General Conditions and Supplementary General Conditions for the quantity of copies required for submission. Where quantities are not specified, provide seven (9) copies for review.

D. Provide shop drawings for all devices specified under equipment specifications for all systems, materials, equipment and/or devices. Shop drawings shall include manufacturers' names, catalog numbers, cuts, diagrams and other such descriptive data as may be required to identify and accept the equipment. A complete list in each category (example: all fixtures) of all shop drawings, catalog cuts, material lists, etc., shall be submitted to the Engineer at one time. No consideration will be given to a partial shop drawing submittal. Partial submissions shall be rejected.

E. Equipment shop drawings shall contain full range performance curves, graphs, tables or other pertinent data which clearly indicates operational range of a given unit size. Computer generated/plotted curves, based solely on design performance, will not be accepted.

F. All specific options and/or alternatives shall be clearly indicated. Failure to do so shall be grounds for rejection.

G. Submittals shall be marked with the trade involved, i.e., HVAC, plumbing, fire protection, etc. and the specific associated specification section.

H. Where multiple quantities or types of equipment are being submitted, provide a cover sheet (with a list of contents) on the submittal identifying the equipment or material being submitted.

I. Failure to submit shop drawings in ample time for review shall not entitle the Contractor to an extension of Contract time. Contractor must allow for a one week review at the Engineer's office plus normal delivery time to the G.C., Architect, Engineer, and return to the Architect, and G.C. No claim for extension by reason of such default will be allowed, nor shall the Contractor be entitled to purchase, furnish and/or install equipment which has not been reviewed by the Engineer. The Contractor shall incur all costs associated with delay of construction due to equipment and/or materials arriving late due to late or improper shop drawing submittal.

J. The Contractor shall furnish all necessary templates, patterns, etc., for installation work and for the purpose of making adjoining work conform; furnish setting plans and shop details to other trades as required.

K. Acceptance rendered on shop drawings shall not be considered as a guarantee of measurements or building conditions. Where drawings are reviewed, review does not indicate that drawings have been checked in detail; said approval does not in any way relieve the Contractor from his responsibility or necessity of furnishing material or performing work as required by the Contract Drawings and Specifications. Verify available space prior to submitting shop drawings.

L. Acceptance of shop drawings shall not apply to quantity nor relieve Contractor of his responsibility to comply with intent of Drawings and Specifications.

M. Acceptance of shop drawings is final and no further changes will be allowed without the written consent of the Engineer.

N. Shop drawing submittal sheets which may show items that are not being furnished shall have those items crossed off to clearly indicate which items will be furnished.

O. Contractor shall make any corrections required by Engineer and shall resubmit required number of corrected copies of shop drawings or new samples until accepted. Contractor shall direct specific attention in writing or on resubmitted shop drawings to revisions other than corrections requested by Engineer on previous submissions. Engineer shall review no more than one resubmittal of any shop drawing or sample at Owner's expense. The fees for review of additional resubmittals shall be paid by the Contractor at the Engineer's standard rates.

1.12 CHANGES IN WORK

A. A Change Order is a written order to the Contractor signed by the Owner and the Architect, issued after Contracts have been awarded, authorizing a change in the work or an adjustment in the Contract sum or the Contract time. A Change Order signed by the Contractor indicates his agreement therewith, including the adjustment in the Contract sum or the Contract time.

B. All changes in the work shall follow the recommendations of the AIA "General Conditions of the Contract for Construction", Article 12.

1.13 MANUFACTURER'S IDENTIFICATION

A. All component parts of each item of equipment or device shall bear the manufacturer's nameplate giving name of manufacturer, description, size, type, serial and model number, electrical characteristics, etc., in order to facilitate maintenance or replacement. Nameplate data shall not be obstructed. The nameplate of a Contractor or distributor will not be acceptable.

B. All material and equipment for the electrical portion of the mechanical systems shall bear the label of or be listed by UL, or other accredited authoritative agencies or testing organizations approved by the authority having jurisdiction.

1.14 RECORD DRAWINGS

A. Maintain at the job site a record set of Project Drawings on which any changes in location or routing of all equipment, materials and access panels shall be recorded.

B. At the end of construction, the Contractor shall provide the Owner with a complete set of As-Built Drawings, including all updated coordination drawings, ductwork and piping plans. As-Builts shall be drawn on the latest version of Autocad or compatible software, approved in writing, prior to submittal. The Owner shall be provided with a "CD Rom" disk and one set of reproducible mylar sepias.

1.15 MATERIALS AND WORKMANSHIP

A. All materials and apparatus required for the work, except as otherwise specifically indicated, shall be new, of first-class quality, and shall be furnished, delivered, erected, connected and finished in every detail and be so selected and arranged as to fit properly into the building spaces. Where no specific type or quality of material is given, a first-class standard article as

accepted by industry standards shall be furnished.

B. The Contractor shall furnish the services of an experienced superintendent who shall be constantly in charge of the installation of the work together with all skilled workmen, fitters, metal workers, welders, helpers and laborers required to unload, transfer, erect, connect, adjust, start, operate and test each system.

C. Unless otherwise specifically indicated on the Drawings or Specifications, all equipment and materials shall be installed with the acceptance of the Engineer and in accordance with the recommendations of the manufacturer. This includes the performance of such tests as the manufacturer recommends.

D. All labor for installation of mechanical systems shall be performed by experienced, skilled tradesmen under the supervision of a licensed journeyman foreman. All work shall be of a quality consistent with good trade practice and shall be installed in a neat, workmanlike manner. The Engineer reserves the right to reject any work which, in his opinion, has been installed in a substandard, dangerous or unserviceable manner. The Contractor shall replace said work in a satisfactory manner at no extra cost to the Owner.

E. Year-2000 Compliant: All digitally controlled/monitored equipment and systems shall be certified "Year 2000 Compliant". Computer hardware and software shall be capable of accurately processing, providing, and receiving date data from, into, and between the twentieth and twenty-first centuries, including leap-year calculations. All program codes shall be "non-date sensitive" codes that will not cause an automatic program malfunction, stop command, miscalculation or similar function stopping continued and proper operation upon a sequence of numbers that occur by date.

1.16 PROTECTION OF MATERIALS AND EQUIPMENT

A. Work under each Section shall include protecting the work and material of all other Sections from damage by work or workmen and shall include making good all damage thus caused.

B. The Contractor shall be responsible for work and equipment until the facility has been accepted by the Owner. Protect work against theft, injury or damage and carefully store material and equipment received on site which is not immediately installed. Close open ends of work with temporary covers or plugs during construction to prevent entry of foreign material.

C. Work under each Section includes receiving, unloading, uncrating, storing, protecting, setting in place and completely connecting equipment supplied under each Section. Work under each Section shall also include exercising special care in handling and protecting equipment and fixtures, and shall include the cost of replacing any of the equipment and fixtures which are missing or damaged.

D. Equipment and material stored on the job site shall be protected from the weather, vehicles, dirt and/or damage by workmen or machinery. Insure that all electrical or absorbent equipment or material is protected from moisture during storage.

1.17 BASES AND SUPPORTS

A. Unless otherwise specifically noted, the Contractor shall furnish all necessary supports, rails, framing, bases and piers required for all equipment furnished under this Division.

B. Unless otherwise indicated in individual trade Sections, pumps, fans, air handlers, boilers, chillers, tanks, compressors and other rotating machinery shall be mounted on a minimum of six (6") inch high concrete pads which shall be furnished and installed per Division 3. All pads shall be extended six (6") inches beyond machine base in all directions with top edge chamfered. Shop drawings of all foundations and pads shall be submitted to the Engineer for review before they are constructed. The Mechanical Contractor shall field coordinate all required dimensional and necessary loading information.

C. Construction of foundations, supports, pads, bases and piers where mounted on the floor shall be of the same finish quality as the adjacent and surrounding flooring material.

D. Unless otherwise shown, all equipment shall be securely attached to the building structure in an acceptable manner. Attachments shall be of a strong and durable nature; any attachments that

are insufficient, in the opinion of the Engineer, shall be replaced as directed without extra cost to the Owner.

E. All equipment supports shall be designed and constructed such that the equipment will be capable of resisting both vertical and horizontal movement. The equipment shall be positively anchored to the bases or supports to resist vertical movement. The equipment and its supports shall be provided with suitable restraints to resist horizontal movement from any direction as dictated by applicable seismic Codes.

1.18 SLEEVES, INSERTS AND ANCHOR BOLTS

A. The Contractor shall provide, set in place and be held responsible for the location of all sleeves, inserts and anchor bolts required for the work. In the event that failure to do so requires cutting and patching of finished work, it shall be done at the Contractor's expense.

B. It is the responsibility of the Contractor to furnish cast-in-place steel sleeves, inserts and anchors in sufficient time to be installed during initial concrete pours. Where job schedules make this impossible, coordinate and obtain acceptance from the Structural Engineer for alternate installation methods.

C. All pipes and conduits passing through floors, walls or partitions shall be provided with sleeves having an inside diameter one (1") inch larger than the outside diameter of the pipe, conduit or insulation enclosing the pipe.

D. Piping insulation shall run continuous through sleeve.

E. Penetrations through fire-rated walls, ceilings and all floors (except slab on grade) in which piping or ducts pass shall be filled solidly with acceptable fire-stopping material. Sleeves shall be steel or a UL / FM listed and approved assembly.

F. When ducts, piping or conduit penetrate the floor of a mechanical room located above an occupied space, such penetrations shall be made completely watertight, such that a liquid leak shall not pass through the penetration.

1.19 FIRE-STOPS AND SEALS

A. Refer to Division 7 Specification for additional and more specific information.

B. Fire-stopping systems shall be submitted as shop drawing.

C. Penetrations through fire-rated walls, ceiling or floors shall be sealed with a UL approved fire-stop fitting classified for an hourly rating equivalent to the fire rating of the wall, ceiling or floor.

D. Thruwall and floor seals shall be used to provide a positive means of sealing pipes or ducts which pass through the concrete foundation of a structure below grade or below ground water level. Seals shall also be used at entry points through concrete walls or floors which must be sealed.

1.20 CUTTING AND PATCHING

A. All cutting and patching shall be done per Division 1 requirements. The Contractor shall furnish sketches showing the location and sizes of all openings, chases, etc., required for the installation of work.

B. Work under this Division shall include furnishing, locating and setting inserts and/or sleeves required before the floors and walls are built or be responsible for cutting, drilling or chopping where sleeves and inserts were not installed or correctly located. The Contractor shall do all drilling required for the installation of hangers.

C. Exercise extreme caution when core drilling or punching openings in concrete floor slabs in order to avoid cutting or damaging structural members. No structural members or structural slabs/floors shall be cut without the written acceptance of the Structural Engineer and all such cutting shall be done in a manner directed by him.

D. SCAFFOLDING, RIGGING, HOISTING

1. The Contractor shall furnish all scaffolding, rigging, hoisting and services necessary for erection and delivery into the premises any equipment and apparatus furnished under this

Division. Remove same from premises when no longer required.

1.21 EXCAVATION AND BACKFILLING

A. Excavation and backfilling shall be done per Division 2 of the Specifications.

B. It is the responsibility of the Contractor to coordinate sizes, depths, fill and bedding requirements and any other excavation work required under this Division per code and local utility requirements.

1.22 WATERPROOFING

A. Where any work pierces waterproofing, including waterproof concrete and floors in wet areas, the method of installation shall be reviewed by the Engineer before work is done. The Contractor shall furnish all necessary sleeves, caulking and flashing required to make openings absolutely watertight.

1.23 ACCESSIBILITY AND ACCESS PANELS

A. The Contractor shall be responsible for the sufficiency of the size of shafts and chases, the adequate thickness of partitions, and the adequate clearance in double partitions and hung ceilings for the proper installation of the work.

B. Locate all equipment which must be serviced, operated or maintained in fully accessible positions. Equipment shall include, but not be limited to: motors, controllers, coil, valves, switchgear, drain points, etc. Access doors shall be furnished if required for better accessibility. Minor deviations from the Drawings may be made to allow better accessibility, but changes of magnitude or which involve extra cost shall not be made without the acceptance of the Engineer.

C. Access doors in walls, ceilings, floors, etc., shall be field coordinated. It is the responsibility of the Contractor to coordinate and provide information regarding the sizes and quantities of access doors required for his work. The Contractor shall arrange his work in such a manner as to minimize the quantity of access doors required, such as grouping shutoff valves in the same area. Where possible, locate valves in already accessible areas, such as lay-in ceilings, etc.

D. On a clean set of prints, the Contractor shall mark in red pencil the location of each required access door, including its size and fire rating (if any), and shall submit the print to the Architect for review before access doors are purchased or installed.

E. Upon completion of the Project, the Contractor shall physically demonstrate that all equipment and devices installed have been located and/or provided with adequate access panels for repair, maintenance and/or operation. Any equipment not so furnished shall be relocated or provided with additional access panels by the installing Contractor at no additional cost to the Owner. All access panel or door locations shall be indicated on Owner's final as-built record drawings.

F. Permanent ladders for access to equipment when shown on Plans shall be furnished and installed. Coordinate exact requirements in field.

1.24 TEMPORARY OPENINGS

A. The Contractor shall ascertain from an examination of the Drawings whether any special temporary openings in the building will be required for the admission of apparatus provided under this Division and shall coordinate the requirements accordingly. In the event of failure of the Contractor to give sufficient notice in time to arrange for these openings during construction, the Contractor shall assume all costs of providing such openings thereafter.

1.25 TAGS AND CHARTS

A. Each valve and piece of apparatus under this Division shall be provided with suitable brass or laminated plastic tags securely fastened with brass chains, screws or rivets. Equipment shall be numbered with laminated plastic tags or neatly stenciled letters two (2") inches high using designations in equipment schedules and/or shall conform to a directory indicating number, location and use of each item. Directories shall be prepared under each Section and shall be glass framed.

B. Directory shall indicate valve tag number and the unit number, floor/area branch line, main line, service or other pertinent data to quickly and easily identify the valve's purpose.

1.26 ESCUTCHEONS

A. The Contractor shall provide escutcheons on pipes wherever they pass through floors, ceilings, walls or partitions in finished visible locations.

1.27 PAINTING

A. All finish painting in completed areas shall be performed per other divisions of the Specifications.

B. All materials shipped to the job site under this Division, such as piping, fittings, plumbing fixtures, valves,etc., shall have standard manufacturer's finish, unless otherwise specified by Architect.

C. All outdoor piping, fittings and hangers shall be properly primed with zinc-rich primer and finished with a minimum of two (2) coats of high grade exterior enamel.

1.28 PIPE EXPANSION

A. All pipe connections shall be installed to allow for freedom of movement of the piping during expansion and contraction without springing. Provide engineered design, layout, details and fabrication, submitted with registered professional engineer sign and seal, of swing joints, expansion loops and expansion joints with proper anchors and guides. Pay particular attention to plastic piping with high coefficients of expansion.

B. Consideration of required seismic lateral restraints shall be given when anchoring piping and making provision for expansion.

1.29 ELECTRICAL CONNECTIONS

A. Unless otherwise specified, all wiring shall be furnished and installed per Division 26 Specifications.

B. All motor controllers not factory mounted on mechanical equipment shall be furnished, mounted, and installed by the Division 26 contractor, and shall be coordinated with this contractor. Provide properly sized overload heaters and all required accessories with all motor controllers. See Division 26 Motor Controllers for motor controller requirements.

C. All power wiring shall be furnished and installed per Division 26 complete from power source to motor or equipment junction box including power wiring through the motor controller and proper means of disconnect per NEC and Division 26. The Division 26 Contractor shall provide all disconnects, unless noted otherwise.

1.30 QUIET OPERATION

A. Equipment and material used in the various systems described herein shall not produce a sound level greater than 55 decibels in the area served. If noise level is deemed objectionable by the Owner/Engineer, the Contractor shall test and record sound levels in the presence of the Owner/Engineer. The sound level shall be observed on the "A" weighting network of a sound level or sound survey meter. The ASHRAE "Guide and Data Book" provides a means to determine sound level of mechanical equipment when the total of background plus equipment sound levels exceeds the minimum acceptable equipment sound level.

B. If objectionable noises or vibrations of any magnitude are produced and transmitted to occupied portions of the building by apparatus, piping, ducts or other parts of the mechanical work, the Contractor shall make such changes or additions as necessary without extra cost to the Owner.

1.31 MAINTENANCE

A. The Contractor shall provide the necessary skilled labor to assure the proper operation and to provide all required current and preventative maintenance for all equipment and controls provided under this Division until final acceptance of the building by the Owner. The Contractor shall not assume acceptance of the building by the Owner until he receives written notification.

B. The Contractor shall receive calls for any and all problems experienced in the operation of the equipment provided under this Division and he shall take steps to immediately correct any deficiencies that may exist.

C. The Contractor shall provide a check list and shall put a copy of it in the boiler or main mechanical room. The check list shall itemize each piece of equipment furnished under his Section.

D. The Contractor shall certify on this check list that he has examined each piece of equipment and that, in his opinion, it is operating as intended by the manufacturer, it has been properly lubricated, and that all necessary current and preventative maintenance has been performed as recommended by the manufacturer and by good and accepted practice.

E. The Contractor shall check all controls in the building to ascertain that they are functioning as designed. This shall apply to all thermostats, aquastats, humidistats, freezestats and firestats, etc. This portion of the work shall be performed by the Contractor who installed the controls.

F. During construction, the Contractor shall ensure that all filters are in place on all equipment. If the equipment is operated during construction (see restrictions section of this specification), strict attention shall be paid to maintaining clean and effective filters and cleaning ductwork and equipment. Filters shall be new and/or clean when the system testing and balancing takes place. The Contractor shall bear the cost of all filters and media during construction until final acceptance by the Owner. This requirement shall apply equally to fluid filters and strainers.

G. Where normal preventative maintenance for any piece of equipment requires special tools, the Contractor shall furnish the appropriate tools for that piece of equipment (i.e., special filter removal hooks, valve wrenches, etc.).

1.32 DEMOLITION

A. All required demolition work shall be performed by the Contractor. All demolition work shall be performed in a neat and orderly fashion.

B. Demolition work, if indicated on the drawings, is intended for general information only and is not intended to describe the full extent of demolition work required under this Contract. All existing plumbing work and systems, including but not limited to piping, equipment, wiring, controls, hangers, and supports, made obsolete by this project, shall be removed in their entirety under this Contract, unless noted otherwise.
   1. Existing plumbing fixtures, water piping, sanitary/waste piping, storm piping as indicated on the plans, decribed in notes or implied by nature of the work.
      a. All plumbing water piping removed from active lines to remain shall be capped watertight.
         1) Remove abandoned piping to source of supply, provide isolation valve and cap at mains.
      b. All sanitary branch piping removed from active systems to remain shall either have a new cleanout provided at termination or the branch line shall be removed to within 24" of the active main and capped.
      c. Removal shall be complete to behind finished surfaces.
      d. Contractor shall make safe all work associated with this division.

C. After piping, equipment, etc., has been removed, neatly cap remaining piping, and insulate caps to match the existing adjacent piping. In finished areas, all piping shall be cut back to a concealed location, i.e., within walls, above ceilings, etc., before capping.

D. Before submitting his Bid, the Contractor shall visit the site with the Contract Documents in hand, and shall inspect all existing systems to determine the extent of demolition work involved. Particular attention is drawn to the removal of existing walls or portions of existing walls. In those areas, all exposed and concealed piping, equipment, etc., running across or through affected areas shall be removed as required. Piping shall then be either capped, or, if required for the proper continuing operation of an existing system or portions to remain, piping shall be rerouted around the affected areas and reconnected as required.

E. In general, it shall be the responsibility of the Contractor to remove demolished equipment, piping, etc., from the site and properly dispose of it. If the Owner shall so request, however, the Contractor shall turn over demolished equipment, etc., to the Owner for the Owner's use. Unless otherwise noted, demolished work shall not be abandoned in place. Contractor shall make safe all utilities pertaining to this section.

F. Demolition shall include the removal of all hangers and supports, anchors and other items not required for the new work.

G. EXAMINATION
   1. Verify existing conditions in the field. Note which items are to remain and which items are to be removed as indicated on drawings.
   2. Verify that abandoned wiring and equipment serve only abandoned facilities.
   3. Demolition drawings are based on casual field observation and existing record documents.
   4. Report discrepancies to Engineer before disturbing existing installation, i.e. asbestos. Where asbestos materials are deemed to be part of the equipment, the abatement contractor shall be responsible for demolition and proper removal and disposal of equipment.
   5. Beginning of demolition means installer accepts existing conditions.

H. PREPARATION
   1. Disconnect electrical systems in walls, floors, and ceilings to be removed. Coordinate with Electrical Contractor for extent of work to be performed.
   2. Provide temporary piping and connections if required to maintain existing systems in service during construction. When work must be performed on energized equipment or piping, coordinate shut-down time with owner.
   3. Existing Domestic Cold Water System: Maintain existing systems in service. Disable systems only to make switchovers and/or connections. Minimize outage duration.
      a. Obtain permission from Owner at least 24 hours before partially or completely disabling system.
   4. Existing Sanitary System: Maintain existing system in service. Disable system only to make switchovers and/or connections. Minimize outage duration.
   5. Contractor shall coordinate demolition work in any occupied areas so as to cause the least interuption or disruption to normal routines.
      a. All demolition work shall be scheduled and coordinated in order to accommodate construction phasing schedule.

I. DEMOLITION AND EXTENSION OF EXISTING WORK
   1. Remove, relocate, and extend existing installations to accommodate new construction.
   2. Contractor shall make safe all work associated with this division.
   3. Disconnect and remove piping and fittings serving equipment that has been removed .
   4. Disconnect and remove existing equipment, piping and fittings as indicated on the drawings.

1.33 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment which remain or are to be reused in accordance with manufacturer's reccommended maintenance procedures.

1.34 LUBRICATION

A. All equipment installed under this Contract having moving parts and requiring lubrication shall be properly lubricated according to manufacturer's recommendations prior to testing and operation. Any such equipment discovered to have been operated before lubrication by the Contractor is subject to rejection and replacement at no additional cost to the Owner.

B. The Contractor shall furnish and install, as appropriate on all equipment requiring lubrication, Zerk pressure gun grease fittings or sight gravity-feed oilers equipped with shutoff and needle valve adjustment.

1. Units furnished with sealed bearings and lifetime lubrication are exempted.
2. All fittings and oilers are to be fully accessible for lubrication with equipment which does not require special adapters.
3. Where fittings would be otherwise inaccessible, furnish and install extended grease lines.

1.35 CLEANING

A. The Contractor shall be responsible for keeping the jobsite clean, safe and neat throughout the duration of construction. The Contractor shall clean up his own debris daily and shall coordinate removal of rubbish and debris with the General Contractor/Construction Manager.

B. No debris, construction materials, cigarette butts, coffee cups, etc., shall be left above suspended ceilings.

C. Terminal equipment and plumbing fixtures shall cleaned at substantial completion.

D. If any part of a system should be stopped or damaged by any foreign matter after being placed in operation, the system shall be disconnected, cleaned and reconnected wherever necessary to locate and/or remove obstructions. Any work damaged in the course of removing obstructions shall be repaired or replaced when the system is reconnected at no additional cost to the Owner.

E. During the course of construction, all pipes shall be capped in an acceptable manner to insure adequate protection against the entrance of foreign matter.

F. Upon completion of all work under the Contract, the Contractor shall remove from the premises all rubbish, debris and excess materials left over from his work. Any oil or grease stains on floor areas caused by the Contractor shall be removed and floor areas left clean.

1.36 OPERATING INSTRUCTIONS

A. Upon completion of all work and tests, the Contractor shall furnish the necessary skilled labor and helpers for operating his system and equipment for a period specified under each applicable Section of this Division. During this period, he shall fully instruct the Owner or the Owner's representative in the operation, adjustment and maintenance of all equipment furnished. The Contractor shall give at least 72 hours notice to the Owner, Engineer, and Commissioning Agent in advance of this period.
   1. Prior to the instruction period, the contractor shall have approved Owner's Manuals on site for aiding in the instructions.

B. The Contractor shall formally submit for delivery to the Engineer a minimum of three (3) Owner's Manuals, to be complete bound sets of typewritten or blueprinted instructions for operating and maintaining all systems and equipment included in this Division. All instructions shall be submitted in draft for review prior to final issue. Manufacturer's advertising literature or catalogs will not be acceptable for operating and maintenance instruction.

C. The Contractor, in the above-mentioned instructions, shall include the maintenance schedule for the principal items of equipment furnished under this Division.

D. The appropriate Contractor shall physically demonstrate procedures for all routine maintenance of all equipment furnished under each respective Section to assure accessibility to all devices.

E. An authorized manufacturer's representative shall attest in writing that the equipment has been properly installed prior to startup of any major equipment. These letters will be bound into the operating and maintenance books.

F. Refer to individual trade Sections for any other particular requirements related to operating instructions.

1.37 ADJUSTING AND TESTING

A. Prior to factory star-up procedures, the Contractor shall perform prefunctional checks and procedures to ensure that the equipment is installed properly and are operational.
   1. The prefunctional checklists and procedures are to be provided by the Commisioning Agent. These forms must be filled out and approved before final start-up and adjustments are made by the factory representative.

B. After all the equipment and accessories to be furnished are in place, they shall be put in final adjustment and subjected to such operating tests so as to assure the Engineer and the Commissioning Agent that they are in proper adjustment, the controls operate as described in the sequence of operation and all systems are in satisfactory, permanent operating condition.

C. A factory service engineering representative shall inspect the installation and assist in the initial startup and adjustment to the equipment. The period of these services shall be for such time as necessary to secure proper installation and adjustments. After the equipment is placed in permanent operation, the service engineering representative shall supervise the initial operation of the equipment and instruct the personnel responsible for operation and maintenance of the equipment.
   1. The following equipment will require this inspection: pumps, equipment, water temperature controls and valves, water heaters, specialized plumbing fixtures, and electric/electronic faucets and flush vlaves.
   2. The service engineering representative shall notify the Contractor in writing that the equipment was installed according to manufacturer's recommendations and is operating as intended by the manufacturer.
      a. The written notification shall include a complete start-up report on manufacturer's letterhead with all information including date and signature.
      b. The report shall be made available to the Engineer and Commisioning Agent for review before acceptance is granted.

1.38 GUARANTEES

A. The Contractor shall guarantee all equipment, material and workmanship under these Specifications and the Contract for a period of one (1) year from the date of final acceptance by Owner, unless otherwise noted.

B. All refrigeration compressors shall have five (5) year guarantee from the date of final acceptance by the Owner unless otherwise noted.

C. All water heaters shall have an optional minimum five (5) year guarantee from the date of final acceptance by the Owner unless otherwise noted.

D. During this guarantee period, all defects developing through faulty equipment, materials or workmanship shall be corrected or replaced immediately by the Contractor without expense to the Owner. Such repairs or replacements shall be made to the Engineer's satisfaction.

1.39 RESTRICTIONS

A. Water heaters provided under this Division may not be used for temporary hot water requirements due to premature wear and dirt/dust infiltration. Written approval may be obtained from the Owner only after submission of a written cleaning plan and guarantee/warranty extension.

B. Piping shall not be run in any concrete floor slab. Written approval from the Structural Engineer may be obtained only after submission and approval of a layout shop drawing.

PART 2 PRODUCTS - NOT USED.

PART 3 EXECUTION - NOT USED.

**END OF SECTION 22 05 10**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Plumbing demolition.
   1. Existing plumbing fixtures, water piping, sanitary/waste piping, storm piping as indicated on the plans, decribed in notes or implied by nature of the work.
      a. All plumbing water piping removed from active lines to remain shall be capped watertight.
      b. All sanitary branch piping removed from active systems to remain shall either have a new cleanout provided at termination or the branch line shall be removed to within 24" of the active main and capped.
      c. Removal shall be complete to behind finished surfaces.

B. Demolition shall include the removal of all hangers and supports, anchors and other items not required for the new work.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions in the field. Note which items are to remain and which items are to be removed as indicated on drawings.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition drawings are based on casual field observation and existing record documents.

D. Report discrepancies to Engineer before disturbing existing installation, i.e. asbestos. Where asbestos materials are deemed to be part of the equipment, the abatement contractor shall be responsible for demolition and proper removal and disposal of equipment.

E. Beginning of demolition means installer accepts existing conditions.

3.02 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings to be removed.

B. Provide temporary piping, ductwork, control wiring, and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or piping, coordinate shut-down time with owner.

C. Existing Domestic Cold Water System: Maintain existing systems in service. Disable systems only to make switchovers and/or connections. Minimize outage duration.
   1. Obtain permission from Owner at least 24 hours before partially or completely disabling system.

D. Existing Sanitary System: Maintain existing system in service. Disable system only to make switchovers and/or connections. Minimize outage duration.

3.03 DEMOLITION AND EXTENSION OF EXISTING PLUMBING WORK

A. All demolition work shall be scheduled and coordinated in order to accommodate construction phasing schedule.

B. Remove, relocate, and extend existing installations to accommodate new construction.

C. Remove abandoned piping to source of supply, provide isolation valve and cap at mains.

D. Contractor shall make safe all work associated with this division.

E. Disconnect and remove plumbing piping and fittings serving equipment that has been removed .

F. Disconnect and remove existing equipment, piping and fittings as indicated on the drawings.

3.04 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment which remain or are to be reused in accordance with manufacturer's reccommended maintenance procedures.

**END OF SECTION**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Pressure gages and pressure gage taps.

B. Thermometers and thermometer wells.

1.03 RELATED REQUIREMENTS

A. Section 22 30 00 - Plumbing Equipment.

1.04 REFERENCE STANDARDS

A. ASME B40.100 - Pressure Gauges and Gauge Attachments 2013.

B. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers 2014.

C. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers 2014, with Editorial Revision (2017).

D. AWWA M6 - Water Meters -- Selection, Installation, Testing, and Maintenance 2012, with Addendum (2018).

E. UL 393 - Indicating Pressure Gauges for Fire-Protection Service Current Edition, Including All Revisions.

1.05 SUBMITTALS

A. See Section 01 33 00 - Submittial Procedures, for submittal procedures.

B. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.

1.06 FIELD CONDITIONS

A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.01 PRESSURE GAGES

A. Pressure Gauges shall be as equal to "WIKA" Type 213.53.

B. Pressure Gages: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
   1. Case: Steel with brass bourdon tube.
   2. Size: 4-1/2 inch diameter.
   3. Mid-Scale Accuracy: One percent.
   4. Scale: Psi - {Selected for complete range of system operation}.

2.02 PRESSURE GAGE TAPPINGS

A. Gage Cock: Tee or lever handle, brass for maximum 150 psi.

2.03 STEM TYPE THERMOMETERS

A. Manufacturers:
   1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
   2. Omega Engineering, Inc: www.omega.com/#sle.
   3. Weksler Glass Thermometer Corp: www.wekslerglass.com/#sle.

B. Thermometers shall be as equal to "WIKA" Type T19010302008XWI.

C. Thermometer: ASTM E 1, 360 degree adjustable angle with locking nut, blue liquid filled (non-mercury), V-Shaped polyester Case with glass window.

2.04 TEST PLUGS

A. Test Plug: 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with Nordel core for temperatures up to 350 degrees F.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install pressure gages with pulsation dampers. Provide gage cock to isolate each gage. Provide siphon on gages in steam systems. Extend nipples and siphons to allow clearance from insulation.

C. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

D. Provide instruments with scale ranges selected according to service with largest appropriate scale.

E. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

F. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

3.02 SCHEDULES

A. Pressure Gages, Location and Scale Range:
   1. Expansion tanks.
   2. Pressure tanks, 0 to 100 psi.

B. Stem Type Thermometers, Location and Scale Range:
   1. Headers to central equipment, 0 to 180 degrees F.
   2. Domestic hot water supply and recirculation, 0 to 180 degrees F.

**END OF SECTION 22 05 19**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Pipe Markers.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

A. See Section 01 33 00 - Submittial Procedures, for submittal procedures.

B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Chart and Schedule: Submit (2) valve charts and schedules, including valve tag number, location, function, and valve manufacturer's name and model number. Charts and schedules shall be mounted within mechanical areas served, and shall also be permanently bound and submitted with O&M manuals and 'As-Built' documents.

D. Product Data: Provide manufacturers catalog literature for each product required.

E. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Brady Corporation: www.bradycorp.com.

B. Champion America, Inc: www.Champion-America.com.

C. Seton Identification Products: www.seton.com/aec.

2.02 NAMEPLATES

A. Description: Laminated three-layer plastic with engraved letters.
   1. Letter Color: White.
   2. Letter Height: 1/4 inch.
   3. Background Color: Black.

2.03 TAGS

A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.

B. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

2.04 PIPE MARKERS

A. Comply with ASME A13.1.

B. Plastic Pipe Markers: Factory fabricated, flexible, self-adhesive plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Install plastic pipe markers in accordance with manufacturer's instructions.

D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

E. Identify control panels and major control components outside panels with plastic nameplates.

F. Identify valves in main and branch piping with tags.

G. Identify piping, concealed or exposed, with plastic tape pipe markers. Use tags on piping 3/4 inch outside diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

**END OF SECTION 22 05 53**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.03 RELATED REQUIREMENTS

A. Section 221005 - Plumbing Piping: Placement of hangers and hanger inserts.

1.04 REFERENCE STANDARDS

A. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus 2019.

B. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement 2007 (Reapproved 2013).

C. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement 2007 (Reapproved 2013).

D. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation 2019.

E. ASTM C585 - Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing 2010 (Reapproved 2016).

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.

G. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials 2016.

H. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.05 SUBMITTALS

A. See Section 01 33 00 - Submittial Procedures, for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum three years of experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.08 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, NFPA 255, UL 723, ASTM E84, UL 723, NFPA 255, ASTM E84, UL 723, or NFPA 255.

B. MANUFACTURERS:
   1. Johns Manville Corporation
   2. Knauf Fiber Glass
   3. CertainTeed Corporation

2.02 GLASS FIBER

A. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
   1. 'K' value: ASTM C177, 0.24 at 75 degrees F.
   2. Maximum service temperature: 850 degrees F.
   3. Maximum moisture absorption: 0.2 percent by volume.
   4. Equal to Johns Manville Microlock AP

B. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.

C. Vapor Barrier Lap Adhesive/Mastic:

2.03 FLEXIBLE ELASTOMERIC CELLULAR INSULATION - FOR USE WITHIN CAVITIES OF MASONRY CONCRETE BLOCK WALLS.

A. Manufacturer:
   1. Armacell LLC: www.armacell.us/#sle.
   2. Substitutions: See Section 016000 - Product Requirements.

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C 534 Grade 3; use molded tubular material wherever possible.
   1. Minimum Service Temperature: -40 degrees F.
   2. Maximum Service Temperature: 220 degrees F.
   3. Connection: Waterproof vapor barrier adhesive.

2.04 JACKETS

A. PVC Plastic.
   1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
      a. Minimum Service Temperature: 0 degrees F.
      b. Maximum Service Temperature: 150 degrees F.
      c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
      d. Thickness: 10 mil.
      e. Connections: Brush on welding adhesive.
      f. Equal to Johns Manville Zeston 2000
   2. Covering Adhesive Mastic:

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, roof drain bodies, and expansion joints.

E. Glass fiber insulated pipes conveying fluids below ambient temperature:
   1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
   2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

F. For hot piping conveying fluids over 90 degrees F, insulate flanges and unions at equipment.

G. Glass fiber insulated pipes conveying fluids above ambient temperature:
   1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
   2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

H. Inserts and Shields:
   1. Application: Piping 1-1/2 inches diameter or larger.
   2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
   3. Insert location: Between support shield and piping and under the finish jacket.
   4. Insert configuration: Minimum 12 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
   5. Insert material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

I. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 078400.

J. All piping exposed in finished spaces: Finish with PVC jacket and fitting covers.

3.03 SCHEDULES

A. Plumbing Systems:
   1. Domestic Cold Water, Hot Water, and Hot Water Recirculation:
      a. All Sizes - Glass Fiber Insulation; 1" Thickness
   2. Piping Within Cavities of Concrete Block Walls, Condensate Drain Piping
      a. Cellular Foam Insulation:
         1) Thickness: 1/2 inch.

**END OF SECTION 22 07 19**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Pipe, pipe fittings, valves, and connections for piping systems.
   1. Sanitary sewer pipe
   2. Waste Drain pipe
   3. Domestic water piping

1.03 RELATED REQUIREMENTS

A. Section 09 91 00 - Painting.

B. Section 220548 - Vibration Isolation and Seismic Controls.

C. Section 220553 - Identification for Plumbing Piping and Equipment.

D. Section 220719 - Plumbing Piping Insulation.

1.04 REFERENCE STANDARDS

A. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings 2018.

B. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings 2018.

C. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV 2016.

D. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV 2017.

E. ASME B31.9 - Building Services Piping 2020.

F. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers 2019.

G. ASTM B32 - Standard Specification for Solder Metal 2020.

H. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes 2020.

I. ASTM B88 - Standard Specification for Seamless Copper Water Tube 2020.

J. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric) 2020.

K. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV) 2020.

L. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40 2017.

M. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems 2020.

N. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings 2020.

O. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings 2017.

P. ASTM D2855 - Standard Practice for the Two-Step (Primer & Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets 2020.

Q. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings 2016.

R. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 1992 (Reapproved 2008).

S. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2018.

T. MSS SP-69 - Pipe Hangers and Supports - Selection and Application; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2003.

U. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves 2013.

V. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends 2010.

1.05 SUBMITTALS

A. See Section 01 33-00 - Submittial Procedures, for submittal procedures.

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

C. Project Record Documents: Record actual locations of valves.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with State of Connecticut, standards.
   1. Maintain one copy on project site.

B. Valves: Manufacturer's name and pressure rating marked on valve body.

C. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.07 REGULATORY REQUIREMENTS

A. Perform Work in accordance with State of Connecticut plumbing code.

B. Conform to applicable code for installation of backflow prevention devices.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.09 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 SANITARY SEWER, WASTE DRAIN AND VENT PIPING, BURIED, WITHIN OR TO 5 FEET OF BUILDING

A. PVC Pipe: ASTM D2665 or ASTM D3034.
   1. Fittings: PVC.
   2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.02 SANITARY SEWER, WASTE DRAIN AND VENT PIPING, ABOVE GRADE

A. PVC Pipe: ASTM D2665.
   1. Fittings: PVC.
   2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.03 WATER PIPING, ABOVE GRADE

A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).
   1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
   2. Joints: ASTM B32, alloy Sn95 solder.

3. Mechanical Joints: Copper press fittings as manufactured by Viega or Rigid Tool Co.
   a. Press fittings: Copper press fittings shall conform to the material and sizing requirementsof ASME B16.18 or ASME B16.22. O-rings for copper press fittings shall be EPDM.

2.04 STORM WATER PIPING, BURIED, WITHIN OR TO 5 FEET OF BUILDING

A. PVC Pipe: ASTM D2665 or ASTM D3034.
   1. Fittings: PVC.
   2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.05 STORM WATER PIPING, ABOVE GRADE

A. PVC Pipe: ASTM D2665 or ASTM D3034.
   1. Fittings: PVC.
   2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.06 FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe Sizes 3 Inches and Under:
   1. Copper tube and pipe: Class 150 bronze unions with soldered joints.

B. Flanges for Pipe Size Over 1 Inch:
   1. 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.

2.07 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.
   1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
   2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
   3. Trapeze Hangers: Welded steel channel frames attached to structure.
   4. Vertical Pipe Support: Steel riser clamp.

B. Manufacturers
   1. Anvil International Inc.
   2. Tolco Inc.
   3. Beeline Products

C. Plumbing Piping - Waste, Sanitary, Vent, and Storm:
   1. Conform to ASME B31.9.
   2. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Anvil, fig. 104, Malleable iron, adjustable swivel, split ring.
   3. Hangers for Pipe Sizes 2 Inches and Over: Anvi,l fig. 260, Carbon steel, adjustable, clevis.
   4. Multiple or Trapeze Hangers: Anvil, fig. 46, Steel channels with welded spacers and hanger rods.
   5. Wall Support for Pipe Sizes to 3 Inches: Anvil, fig. 194, Cast iron hook.
   6. Wall Support for Pipe Sizes 4 Inches and Over: Anvil, fig. 195, Welded steel bracket and wrought steel clamp.
   7. Vertical Support: Anvil, fig. 261, Steel riser clamp.
   8. Floor Support: Anvil, fig. 191, Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
   9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
   10. Beam Clamps: Anvil, fig. 95, Carbon steel clamp, hardened steel cup, set screw and locknut, fig. 96 retaining clip.
   11. Threaded rod: Carbon steel, threaded complete lenght, size to load.

D. Plumbing Piping - Water:
   1. Conform to ASME B31.9.
   2. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Anvil, fig. 65, Malleable iron, adjustable swivel, split ring.
   3. Hangers for Cold Pipe Sizes 2 Inches and Over: Anvil, fig. 260, Carbon steel, adjustable, clevis. Size for insulation with fig. 167 shield.
   4. Hangers for Hot Pipe Sizes 2 Inches to 4 Inches: Anvil, fig. 260,Carbon steel, adjustable, clevis. Size for insulation with fig. 167 shield.
   5. Hangers for Hot Pipe Sizes 6 Inches and Over: Anvil, fig. 181, Adjustable steel yoke, cast iron pipe roll, double hanger. Size for insulation with fig. 167 shield.
   6. Multiple or Trapeze Hangers: Anvil, fig. 46, Steel channels with welded supports or spacers and hanger rods.
   7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Over: Anvil, fig. 46, Steel channels with welded supports or spacers and hanger rods, cast iron roll. Size for insulation with fig. 162 shield.
   8. Wall Support for Pipe Sizes to 3 Inches: Anvil, fig. 194, Welded steel bracket.
   9. Wall Support for Pipe Sizes 4 Inches and Over: Anvil, fig. 195, Welded steel bracket and wrought steel clamp.
   10. Wall Support for Hot Pipe Sizes 6 Inches and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron pipe roll.
   11. Vertical Support: Anvil fig. 261, Steel riser clamp.
   12. Floor Support for Cold Pipe: Anvil, fig. 191, Cast iron adjustable pipe saddle and U-bolt, lock nut, nipple, floor flange, and concrete pier or steel support.
   13. Floor Support for Hot Pipe Sizes to 4 Inches: Anvil, fig. 259, Cast iron adjustable pipe saddle and U-bolt, locknut, nipple, floor flange, and concrete pier or steel support.
   14. Floor Support for Hot Pipe Sizes 6 Inches and Over: Anvil, fig. 274, Adjustable cast iron pipe roll standwith base plate, steel screws, and concrete pier or steel support.
   15. Copper Pipe Support: Carbon steel ring, adjustable, copper plated or plastic coated.

2.08 BALL VALVES

A. Manufacturers:
   1. Watts Regulator Co.
   2. Apollo Valve

B. Construction, 4 Inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze, two piece body, chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder ends with union.

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. Bevel plain end ferrous pipe.

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 in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

H. Provide access where valves and fittings are not exposed.

I. Install vent piping penetrating roofed areas to maintain integrity of roof assembly.

J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

K. Provide support for utility meters in accordance with requirements of utility companies.

L. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.

M. Install valves with stems upright or horizontal, not inverted.

N. Ball valve handles shall allow for full range of operation.

O. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

P. Sleeve pipes passing through partitions, walls and floors. Maintain assembley rating.

Q. 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.

R. Pipe Hangers and Supports:
   1. Support horizontal piping as scheduled.
   2. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
   3. Place hangers within 12 inches of each horizontal elbow.
   4. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
   5. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
   6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
   7. Provide copper plated hangers and supports for copper piping.
   8. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

S. Press Connections:
   1. Copper press fittings shall be made in accordance with the manufacturers installation instructions.
   2. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting.
   3. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting.
   4. The joints shall be pressed using the tool approved by the manufacturer.

3.04 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.

B. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

C. Provide spring loaded check valves on discharge of water pumps.

3.05 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.

C. Vent Piping: Slope vent piping to drain back to drainage system

3.06 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Prior to starting work, verify system is complete, flushed and clean.

B. 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).

C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.

D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

E. Maintain disinfectant in system for 24 hours.

F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

H. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.
   1. Samples are to be tested by an independent laboratory with written results.
   2. If the tested samples do not meet the State minimums/maximums, the system is to be disinfected again and the prcess repeated at no additional expense to the Owner.

I. All procedures are to be in strict accordance with the State of Connecticut Department of Health guidelines and regulations.

3.07 TESTING

A. Before any water, waste, sanitary, or vent piping is covered up, it shall be approved by the authority having jurisdiction and shall pass all testing described herin.

B. Sanitary, Waste and Vent Piping
   1. Piping shall be hydrostatically tested to 10 ft of head for a minimum of 4 hours with no discernible loss of water.
   2. Testing shall be done either in sections or as a whole.
   3. If there is reasonable doubt of watertightness, a smoke test shall be performed.

C. Water Piping
   1. Piping shall be hydrostatically tested with potable water to 125 psi or 1-1/2 times the operating pressure of the system, whichever is greater.
   2. Piping may be tested in sections or as a system in whole
   3. A pressure gauge shall be provided in the piping. The gauge shall be a minimum 4" dial face in 2 Psi increments.
   4. Minimum test time shall be 4 hours with a maximum loss of 2 psi.
   5. Do not test piping using valves or through valves that have been installed. Cap branch piping for testing.

D. Test Results
   1. Results of the testing shall be submitted in writing and signed by the contractor doing the work, the Owner's representative on site and/or the Architect - Engineer of record.
   2. If any section or joint of the piping fails the test, the contractor shall repair the leak and any associated damaged areas caused directly by the leak at no cost to the Owner.

3.08 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: 4 inches to 6 inches:
         1) Maximum hanger spacing: 10 ft.
         2) Hanger rod diameter: 5/8 inch.
   2. Plastic Piping:
      a. All Sizes:
         1) Maximum hanger spacing: 6 ft.
         2) Hanger rod diameter: 3/8 inch.

**END OF SECTION 22 10 05**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Pipe, pipe fittings, valves, and connections for gas piping systems.
   1. Natural Gas.
   2. Regulators and safety devices for Natural and L.P. gas systems

1.03 RELATED SECTIONS

A. Section 22 05 53 - Identification for Plumbing Piping and Equipment

B. Section 22 30 00 - Plumbing Equipment

1.04 REFERENCES

A. ANSI Z223.1

B. CSA / AGA Standards

C. FM P7825 - Approval Guide; Factory Mutual Research Corporation; current edition.

D. ANSI/ASME B36.10 Welded and Seamless Wrought-Steel pipe

E. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

F. ANSI/ASME B1.20.1 - Pipe Threads, General Purpose, Inch

1.05 SYSTEM DESCRIPTION

A. Provide piping from the gas meter as shown on the plans.

B. Provide gas piping, including fittings and valves to form a complete system.
   1. Piping includes connections to equipment shown on the plans or provided by others.
   2. Provide any required gas regulators at equipment connections for reductions in pressure. Coordinate with all other trades for requirements of equipment.

1.06 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures.

B. Piping and fittings
   1. Product Data: Provide Manufacturers literature.
   2. Shop Drawings: Indicate all catlog data.

C. Equipment and Valving
   1. Product Data: Provide Manufacturers literature.
   2. Shop Drawings: Indicate all catlog data.

D. Test Reports: Indicate final testing, inspection and approval reports by the AHJ and/or the service utility.

E. Certificates: Certify that products of this section meet or exceed specified requirements.

1.07 QUALITY ASSURANCE

A. Requirements of the service Utility

B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

C. Installer Qualifications: Company specializing in performing the work of this section with minimum 3 years of experience.

D. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.

E. All valves, regulators, etc. shall be tested and rated for respective natural gas applications by UL and CSA.

1.08 PROJECT CONDITIONS

A. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

PART 2 PRODUCTS

2.01 MATERIALS

A. Metallic pipe: Steel and wrought-iron pipe, minimum schedule 40, ANSI/ASME B36.10, ASTM A53

B. Metallic pipe fittings: Steel or malleable iron.

C. Piping shall be threaded up to 2 1/2" in diameter, over 2 1/2" piping shall be welded.

2.02 ACCESSORIES

A. Shutoff Valves
   1. Plug type - Heavy duty, iron body construction, flat head type with brass plug and washer, CSA / UL tested and approved
   2. Ball type - Bronze body, chrome plated ball, brass stem, PTFE seat, stem packing and bearing CSA/UL tested and approved.

PART 3 EXECUTION

3.01 PIPING - GENERAL

A. The service entrance of the gas pipe to the building shall be provided with a line size, CSA/UL tested and approved shut-off plug valve. The valve shall be lockable open or shut with a standard padlock.

B. Ream ends of pipe free from burrs. Keep free of scale, dirt and oil. Piping shall be blown out with compressed air.

C. Pipe threads shall be tapered in compliance with ANSI/ASME B1.20.1. Apply pipe joint compound to male threads only.
   1. Threaded pipe shall be used for piping of 2" or less. All piping 2.5" and larger shall have welded fittings and joints.

D. Provide couplings for pipe size transitions and for joining lengths of pipe. Bushings shall not be used.

3.02 PIPING INSIDE BUILDINGS

A. Do not cut, notch or drill through beams or joists to install piping.

B. Slope piping upwards towards risers or equipment at not less than 1/4" in 15 feet.

C. Piping shall not be installed in concealed locations except with the use of elbows, tees and couplings.
   1. Where fittings are inserted in the piping, the pipe shall be reconnected by welding, flanges or a ground joint union.
   2. Valves shall not be installed in concealed locations.

D. Where piping is installed in partition walls, a steel striker plate is to be provided the full length of the concealed pipe run

E. Changes in direction shall be made by the use of fittings, factory or field bends.
   1. Bends shall be made only with bending equipment and shall be free from buckling, cracks or other damage.
   2. Pipe shall not be bent more than 90° with the inside radius not less than 6 times the outside diameter of the pipe.

F. Provide drips at all risers or low points in the system. Drips are to be readily accessible for cleaning or emptying and are not to be used for supporting the piping.

G. Provide plug type gas cocks in pipe branch lines and connections to equipment and cap until ready for connection to equipment.
   1. Ball type shutoffs will be acceptable in branch lines off mains

H. All gas piping inside and outside the building shall be painted yellow and pipe markers provided.

I. Branch piping is to be connected from top or side of horizontal piping.

J. Maximum hanger spacing:
   1. 1/2" pipe -6 feet
   2. 3/4" to 1" pipe -8 feet
   3. 1¼" and larger pipe -10 feet

3.03 PIPING OUTSIDE THE BUILDINGS (EXPOSED, NOT BURIED)

A. Slope piping upwards towards risers or equipment at not less than 1/4" in 15 feet.

B. Piping shall not be installed in concealed locations except with the use of elbows, tees and couplings.
   1. Where fittings are inserted in the piping, the pipe shall be reconnected by welding, flanges or a ground joint union.
   2. Valves shall not be installed in concealed locations.

C. Changes in direction shall be made by the use of fittings, factory or field bends.
   1. Bends shall be made only with bending equipment and shall be free from buckling, cracks or other damage.
   2. Pipe shall not be bent more than 90° with the inside radius not less than 6 times the outside diameter of the pipe.

D. Provide drips at all risers or low points in the system. Drips are to be readily accessible for cleaning or emptying and are not to be used for supporting the piping.
   1. Where drips could be subject to freezing, the AHJ may authorize the drips to be deleted.

E. Provide plug type gas cocks in pipe branch lines and connections to equipment and cap until ready for connection to equipment.
   1. Ball type shutoffs will be acceptable in branch lines off mains

F. All gas piping outside the building shall be painted yellow with primer, two coats of paint and pipe markers provided.

G. Branch piping is to be connected from top or side of horizontal piping.

H. Maximum roof support spacing:
   1. 1/2" pipe -4 feet
   2. 3/4" to 1" pipe -6 feet
   3. 1¼" and larger pipe -8 feet
   4. Within 12" either side of bends, valves and regulators.

3.04 TESTING

A. All piping, new and existing, shall be tested and shall be in compliance with NFPA-54 with records of inspection and tests performed.

B. Test medium shall be compressed air or other inert gas.

C. Test pressure shall be 1-1/2 times the maximum working pressure but not less than 3 PSIG. Duration shall be ½ hour for each 500 cubic feet of pipe or fraction thereof.
   1. Piping shall be tested without valves installed.
   2. Valves are not to be used as a bulkhead between gas in one section of pipe and test medium in another.

D. Provide gauges or a manometer of increments not greater than 1/10 pound. Soap solution shall be used at joints or fittings.

1. Pressure gauges shall be permanently installed downstream from each line pressure regulator.

E. After turning on the gas the piping shall be purged of all test medium and the system shall again be checked for leakage.

F. The gas utility shall be the governing authority and shall be presented with copies of tests results and records. All rules and regulations must be complied with and coordinated to insure a safe installation.

G. If any part of the gas system is defective or not in compliance with this specification the contractor shall repair or replace the items at no cost to the Owner.

3.05 REGULATORS

A. Set primary regulator at no more than 14" W.C., specific equipment requirements and/ or as required by local Gas Co.

B. Set secondary regulators as necessary for appliances and equipment.

C. Vent regulators and other equipment to exterior of building and terminate with suppressor.
1. Vents shall be run independently of each other and shall be field located.

D. Provide strainers on the inlet of each line pressure regulator or electrically operated valve.

E. Provide a shut-off valve upstream of each gas pressure regulator

3.06 EQUIPMENT CONNECTORS

A. Connectors shall have a plug type shut-off gas cock installed in rigid tubing in an accessible location upstream of the connector.
1. Flexible connectors of semi-rigid stainless steel with polyethylene jacket may be used for connecting appliances to the shut-off valve.
2. All connectors shall be provided with a drip leg, full line size.

B. Connectors shall be made from the top or side of horizontal lines.

C. Provide unions for connectors at gas-cocks and equipment.

D. Connectors to kitchen equipment are to be the "quick disconnect" type.

**END OF SECTION 22 12 50**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Water closets.

B. Lavatories.

C. Sinks.

D. Service sinks.

E. Showers.

1.03 RELATED REQUIREMENTS

A. Section 07 92 00 - Sealants: Seal fixtures to walls and floors.

B. Section 221005 - Plumbing Piping.

1.04 REFERENCE STANDARDS

A. ASME A112.18.1 - Plumbing Supply Fittings 2018, with Errata.

B. ASME A112.19.2 - Ceramic Plumbing Fixtures 2018.

C. ASME A112.19.4M - Porcelain Enameled Formed Steel Plumbing Fixtures 1994 (R2009).

1.05 SUBMITTALS

A. See Section 01 33 00 - Submittial Procedures, for submittal procedures.

B. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

C. Maintenance Data: Include fixture trim exploded view and replacement parts lists.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.07 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Accept fixtures on site in factory packaging. Inspect for damage.

B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.09 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 FLUSH VALVE WATER CLOSETS

A. Water Closets: Vitreous china, ASME A112.19.2, floor mounted, siphon jet flush action.
   1. Manufacturers:
      a. American Standard Inc: www.americanstandard.com.
      b. Kohler
      c. Sloan

B. Flush Valves: ASME A112.18.1, diaphragm type, complete with vacuum breaker stops and accessories.

C. Seats:
   1. Manufacturers:
      a. Bemis Manufacturing Company: www.bemismfg.com/#sle.
      b. Church Seat Company: www.churchseats.com/#sle.
      c. Olsonite: www.olsonite.com/#sle.
   2. Solid white plastic, open front, extended back, self-sustaining hinge, brass bolts, without cover.

2.02 LAVATORIES

A. Lavatory Manufacturers:
   1. American Standard Inc: www.americanstandard.com.
   2. Kohler Company: www.kohler.com/#sle.
   3. Sloan

B. Vitreous China Wall Hung Basin: ASME A112.19.2; vitreous china wall hung lavatory, 20"x18" with 4 inch high back, rectangular basin with splash lip, overflow, and soap depression.

C. Supply Faucet Manufacturers:
   1. Chicago: www.eljer.com.
   2. Delta
   3. Symmons

D. Supply Faucet: ASME A112.18.1; chrome plated combination supply fitting with open grid strainer, water economy aerator with maximum flow of 2.2 gallons per minute, single lever handle.

E. For all accessible lavatories , per Ansi A117.1, ADA,UFAS - insulate all exposed water and waste piping with premolded insulation.

2.03 SINKS

A. Sink Manufacturers:
   1. Elkay
   2. Advance Tabco
   3. Just Manufacturing

2.04 SHOWERS

A. Shower Units
   1. Shower Manufacturers:
      a. Acorn
      b. Creative Terrazzo
      c. Fiat

B. Receptor:
   1. Precast terrazzo of marble chips cast in white portland cement, compressive strength of 5,000 psi at seven days.36"x36" and 39"x39" inches with standard color or selected by Architect if choice.
   2. Drain shall be stainless steel, cast integral, with a "quick" drain connection, removeable stainless steel strainer plate.

2.05 MOP BASIN

A. Service Sink Manufacturers:
   1. Acorn
   2. Creative Terrazzo
   3. Fiat Products

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

3.02 PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.
   1. Refer to Architectural drawings for special rough-in requirements and dimensions.

3.03 INSTALLATION

A. Install each fixture with trap, easily removable for servicing and cleaning.

B. Provide chrome plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.

C. Install components level and plumb.

D. Install and secure fixtures in place with wall supports and bolts.

E. Caulk and seal fixtures to wall and floor surfaces with sealant as specified in Section 079200, color to match fixture.

3.04 ADJUSTING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.05 CLEANING

A. Clean plumbing fixtures and equipment prior to final inspection.

3.06 TESTING AND ADJUSTING

A. All plumbing fixtures shall be tested and adjusted prior to final inspection.
   1. Refer to fixture installtion manuals for adjustments.

**END OF SECTION 22 40 00**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.02 DESCRIPTION

A. The General Conditions and Supplementary General Conditions are a part of this Division and are to be considered a part of this Contract.

B. Where items of the General Conditions and Supplementary General Conditions are repeated in other Sections of the Specifications, it is merely intended to qualify or to call particular attention to them. It is not intended that any other parts of the General Conditions and Supplementary General Conditions shall be assumed to be omitted if not repeated therein.

C. This Section applies equally and specifically to all Contractors supplying labor and/or equipment and/or materials as required under each Section of this Division.

D. The following information contains specifications of Work in connection with, and in addition to, this Division:
   1. All drawings associated with the project.
   2. All specifications associated with the project.

E. Division of work responsibilities shall be as defined and directed by the Bidding Agent and/or the Bidding General Contractor.

1.03 INTENT

A. It is the intent of the Specifications and Drawings to call for finished work, tested and ready for operation.

B. Furnish, deliver and install any apparatus, appliance, material or Work not shown on Drawings but mentioned in the Specifications, or vice versa, or any incidental accessories necessary to make the Work complete and perfect in all respects and ready for operation, even if not particularly specified, under their respective Section without additional expense to the Owner.

C. Include in the work minor details not usually shown or specified but necessary for proper installation and operation, as though they were hereinafter shown or specified.

D. Provide Engineer written notice of any materials or apparatus believed inadequate or unsuitable; in violation of laws, ordinances, rules or regulations of authorities having jurisdiction; and any necessary items of Work omitted. In the absence of such written notice, it is mutually agreed that Work under each Section has included the cost of all required items for the accepted, satisfactory functioning of the entire system without extra compensation.

E. The Work indicated is diagrammatic. The Architect and/or Engineer may require as part of this Contract, the relocation of devices to reasonable distances from the general locations shown.

F. Verbal clarifications of the Drawings or Specifications during the bid period are not to be relied upon. Refer any questions or clarifications to the Engineer at least five Working days prior to bidding to allow for issuance of an addendum. After the five-day deadline, Bidder must make a decision and qualify the Bid, if the Bidder feels it necessary.

1.04 DRAWINGS

A. Drawings are diagrammatic and indicate the general arrangement of systems and work included in the Contract. (Do not scale the Drawings.) Consult the Architectural Drawings and Details for exact location of fixtures and equipment; where same are not definitely located, obtain this information from the Architect.

B. Closely follow Drawings in layout of Work; check Drawings of other Divisions to verify spaces in which work will be installed. Maintain maximum headroom. Where space conditions appear inadequate, Engineer shall be notified before proceeding with installations.

C. Engineer may, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades and/or for proper execution of the work.

D. Where variances occur between the Drawings and Specifications or within either of the Documents, include the item or arrangement of better quality, greater quantity or higher cost in the Contract price. The Engineer shall decide on the item and the manner in which the work shall be installed.

1.05 SURVEYS AND MEASUREMENTS

A. Before submitting a Bid, the Contractor shall visit the site and shall become thoroughly familiar with all conditions under which the work will be installed. Contractor will be held responsible for any assumptions, omissions or errors made as a result of failure to become familiar with the site and the Contract Documents.

B. Base all measurements, both horizontal and vertical, from established bench marks. All Work shall agree with these established lines and levels. Verify all measurements at the site and check the correctness of same as related to the Work.

C. Should the Contractor discover any discrepancies between actual measurements and those indicated which prevent following good practice or the intent of the Drawings and Specifications, notify the Engineer do not proceed with that Work until instructions have been received from the Engineer.

1.06 CODES AND STANDARDS

A. The Codes and Standards listed below apply to all Work. Where Codes or Standards are mentioned in these Specifications, follow the latest edition or revision.

B. The current adopted editions of the following State or local Codes apply:
   1. 2020 New York State Building Code
   2. 2018 International Building Code
   3. 2018 International Mechanical Code
   4. 2018 International Energy Conservation Code

C. All materials furnished and all work installed shall comply with the rules and recommendations of the NFPA, the requirements of the local utility companies, the recommendations of the fire insurance rating organization having jurisdiction and the requirements of all Governmental departments having jurisdiction.

D. Include in the Work, without extra cost to the Owner, any labor, materials, testing, services, apparatus and Drawings in order to comply with all applicable laws, ordinances, rules and regulations, whether or not shown on Drawings and/or specified.

1.07 PERMITS AND FEES

A. Give all necessary notices, obtain all permits; pay all Government and State sales taxes and fees where applicable, and other costs, including utility connections or extensions in connection with the Work. File all necessary Drawings, prepare all Documents and obtain all necessary approvals of all Governmental and State departments having jurisdiction, obtain all required certificates of inspections for Work and deliver a copy to the Engineer before request for acceptance and final payment for the Work.

1.08 COORDINATION

A. Carry out all work in conjunction with other trades and give full cooperation in order that all work may proceed with a minimum of delay and interference. Particular emphasis is placed on timely installation of major apparatus and furnishing other Contractors, especially the General Contractor or Construction Manager, with information as to openings, chases, sleeves, bases, inserts, equipment locations, panels, access doors, etc. required by other trades, and to allow for serviceable access to equipment.

B. Mechanical contractors' shall initiate coordination drawings and sections clearly showing how the work is to be installed in relation to the work of other trades, at no extra charge to the Owner. The Contractors' shall prepare coordination drawings at a scale no less than 1/4"=1'-0",

showing the work of all trades, including but not limited to, the following: proposed ductwork installation in detail, including ceiling heights, approved structural steel shop drawings, duct heights, access doors, light fixtures, registers and diffusers, sprinkler piping, electrical distribution conduits, wires, panels and any other electrical work which may conflict with the sheet metal ducts or piping, waste and vent piping, water piping, storm piping, and rain leaders. Provide elevation details showing connections and equipment layout and configuration based on approved submittals. Each shall use a different color code. A coordination meeting of all Contractors involved is then to be held and all possible conflicts are to be resolved. All trades shall sign acceptance of the drawings and then shall submit two (2) prints of each drawing to the Engineer for record.

C. Contractors are required to examine all of the Project Drawings and mutually arrange Work so as to avoid interference. In general, ductwork, heating piping, sprinkler piping and drainage lines take precedence over water, gas and electrical conduits. The Engineer regarding the arrangement of Work, which cannot be agreed upon by the Contractors, will make final decisions. Service of equipment will take precedence.

D. Where the Work of the Contractor will be installed in close proximity to or will interfere with Work of other trades, assist in working out space conditions to make a satisfactory adjustment.

E. If Work is installed before coordinating with other Divisions or so as to cause interference with Work of other Sections, the Contractor causing the interference will make necessary changes to correct the condition without extra charge to the Owner.

F. Initial contact and coordination has been conducted with utility entities for the purpose of the preparation of Bid Documents. The Contractor shall coordinate all final specific utility requirements.

1.09 ACCEPTANCES

A. The equipment, materials, Workmanship, design and arrangement of all Work installed are subject to the review of the Engineer.

B. Within 30 days after the awarding of a Contract, submit to the Engineer for review a list of manufacturers of equipment proposed for the Work. The intent to use the exact makes specified does not relieve the Contractor of the responsibility of submitting such a list.

C. If extensive or unacceptable delivery time is expected on a particular item of equipment specified, notify the Engineer, in writing, within 30 days of the awarding of the Contract. In such instances, deviations may be made pending acceptance by the Engineer or the Owner's representative.

D. Where any specific material, process or method of construction or manufactured article is specified by reference to the catalog or model number of a manufacturer, the Specifications are to be used as a guide and are not intended to take precedence over the basic duty and performance specified or noted on the Drawings. In all cases, verify the duty specified with the specific characteristics of the equipment offered for review. Equipment characteristics are to be used as mandatory requirements where the Contractor proposes to use an acceptable equivalent.

E. If material or equipment is installed before shop drawing review, liability for its removal and replacement is assumed by the Contractor, at no extra charge to the Owner, if, in the opinion of the Engineer, the material or equipment does not meet the intent of the Drawings and Specifications.

F. Failure on the part of the Engineer to reject shop drawings or to reject Work in progress shall not be interpreted as acceptance of Work not in conformance with the Drawings and/or Specifications. Correct Work not in conformance with the Drawings and/or Specifications whenever non-conformance is discovered.

1.10 EQUIPMENT DEVIATIONS

A. Where the Contractor proposes to deviate (substitute or provide an equivalent) from the equipment or materials as hereinafter specified, he shall do so by making a request in writing.

The Contractor shall state in his request whether it is a substitution or an equivalent to that specified, and the amount of credit involved. A copy of said request shall be included in the Base Bid with manufacturer's equipment cuts.

1. The Base Bid shall be based on using the materials and equipment as specified and scheduled with no exceptions. Equipment Manufacturers Scheduled on Drawings are considered Base Bid and any other acceptable manufacturers listed in the specifications is considered a substitution and equipment deviation and subject to the requirements for equipment substitution and deviation. When any alternate manufacturer does not qualify acceptable, as determined by the Engineer, provide the Base Bid manufacturer at no additional cost to Owner.

B. In these Specifications and on the accompanying Drawings, one or more makes of materials, apparatus or appliances may have been specified for use in this installation. This has been done for convenience in fixing the standard of workmanship, finish and design required for installation. In the event that only one (1) manufacturer of a product is specified and it is found that the manufacturer has discontinued the product, the Contractor shall use an acceptable equivalent product that meets the requirements of an equivalent product, as noted below, and has all the features of the originally specified product. The details of workmanship, finish and design, and the guaranteed performance of any material, apparatus or appliance which the Contractor desires to deviate for those mentioned herein shall also conform to these standards.

C. Where no specific make of material, apparatus or appliance is mentioned, any first-class product made by a reputable manufacturer may be submitted for the Engineer's review.

D. Where two or more names are given as equivalents or where one name only is used and is followed by the words "or acceptable equivalent", the Contractor must use the item named or he may apply for an equipment deviation through the prescribed manner in accordance with this Specification.

E. Equipment, material or devices submitted for review as an "accepted equivalent" shall meet the following requirements:
   1. The equivalent shall have the same construction features such as, but not limited to:
   2. Material thickness, gauge, weight, density, etc.
   3. Welded, riveted, bolted, etc., construction
   4. Finish, undercoatings, corrosion protection
   5. The equivalent shall perform with the same or better operating efficiency.
   6. The equivalent shall have equal or greater reserve capacity.
   7. The equivalent shall be locally represented by the manufacturer for service, parts and technical information.
   8. The equivalent shall bear the same labels of performance certification as is applicable to the specified item, such as AMCA or ARI labels.

F. Where the Contractor proposes to use an item of equipment other than specified or detailed on the Drawings which requires any redesign of the structure, partitions, foundations, piping, wiring or any other part of the mechanical, electrical or architectural layout, all such redesign and all new drawings and detailing required therefore shall be prepared by the Designers of Record at the expense of the Contractor and at no additional cost to the Owner.

G. Where such accepted deviation or substitution requires a different quantity and arrangement of piping, ductwork, valves, pumps, insulation, wiring, conduit and equipment from that specified or indicated on the Drawings, the Contractor shall, with the acceptance by the Engineer, furnish and install any such additional equipment required by the system at no additional cost to the Owner, including any costs added to other trades due to the substitution.

H. The Engineer shall determine if an "accepted equivalent" to a manufacturer listed in the Specifications is considered acceptable.

1.11 SHOP DRAWINGS

A. Refer to individual specification sections for additional submittal information.

B. The Contractor shall submit for review detailed shop drawings of all equipment and material specified in each section and coordinated ductwork layouts. No material or equipment may be delivered to the job site or installed until the Contractor has received shop drawings for the particular material or equipment which have been properly reviewed.

C. Shop drawings shall be submitted within 60 days after award of Contract before any material or equipment is purchased. The Contractor shall submit for review copies of all shop drawings to be incorporated in the Contract. Refer to the General Conditions and Supplementary General Conditions for the quantity of copies required for submission. Where quantities are not specified, provide seven (9) copies for review.

D. Provide shop drawings for all devices specified under equipment specifications for all systems, materials, equipment and/or devices. Shop drawings shall include manufacturers' names, catalog numbers, cuts, diagrams and other such descriptive data as may be required to identify and accept the equipment. A complete list in each category (example: all fixtures) of all shop drawings, catalog cuts, material lists, etc., shall be submitted to the Engineer at one time. No consideration will be given to a partial shop drawing submittal. Partial submissions shall be rejected.

E. Equipment shop drawings shall contain full range performance curves, graphs, tables or other pertinent data which clearly indicates operational range of a given unit size. Computer generated/plotted curves, based solely on design performance, will not be accepted.

F. All specific options and/or alternatives shall be clearly indicated. Failure to do so shall be grounds for rejection.

G. Submittals shall be marked with the trade involved, i.e., HVAC, plumbing, fire protection, etc. and the specific associated specification section.

H. Where multiple quantities or types of equipment are being submitted, provide a cover sheet (with a list of contents) on the submittal identifying the equipment or material being submitted.

I. Failure to submit shop drawings in ample time for review shall not entitle the Contractor to an extension of Contract time. Contractor must allow for a one week review at the Engineer's office plus normal delivery time to the G.C., Architect, Engineer, and return to the Architect, and G.C. No claim for extension by reason of such default will be allowed, nor shall the Contractor be entitled to purchase, furnish and/or install equipment which has not been reviewed by the Engineer. The Contractor shall incur all costs associated with delay of construction due to equipment and/or materials arriving late due to late or improper shop drawing submittal.

J. The Contractor shall furnish all necessary templates, patterns, etc., for installation work and for the purpose of making adjoining work conform; furnish setting plans and shop details to other trades as required.

K. Acceptance rendered on shop drawings shall not be considered as a guarantee of measurements or building conditions. Where drawings are reviewed, review does not indicate that drawings have been checked in detail; said approval does not in any way relieve the Contractor from his responsibility or necessity of furnishing material or performing work as required by the Contract Drawings and Specifications. Verify available space prior to submitting shop drawings.

L. Acceptance of shop drawings shall not apply to quantity nor relieve Contractor of his responsibility to comply with intent of Drawings and Specifications.

M. Acceptance of shop drawings is final and no further changes will be allowed without the written consent of the Engineer.

N. Shop drawing submittal sheets which may show items that are not being furnished shall have those items crossed off to clearly indicate which items will be furnished.

O. Bidders shall not rely on any verbal clarification of the Drawings and/or Specifications. Any questions shall be referred to the Engineer at least five (5) working days prior to Bidding to allow for issuance of an Addendum. After the five (5) day deadline, Bidder shall make a decision and qualify the Bid, if the Bidder deems if necessary.

P. Contractor shall make any corrections required by Engineer and shall resubmit required number of corrected copies of shop drawings or new samples until accepted. Contractor shall direct specific attention in writing or on resubmitted shop drawings to revisions other than corrections requested by Engineer on previous submissions. Engineer shall review no more than one resubmittal of any shop drawing or sample at Owner's expense. The fees for review of additional resubmittals shall be paid by the Contractor at the Engineer's standard rates.

1.12 CHANGES IN WORK

A. A Change Order is a written order to the Contractor signed by the Owner and the Architect, issued after Contracts have been awarded, authorizing a change in the work or an adjustment in the Contract sum or the Contract time. A Change Order signed by the Contractor indicates his agreement therewith, including the adjustment in the Contract sum or the Contract time.

B. All changes in the work shall follow the recommendations of the AIA "General Conditions of the Contract for Construction", Article 12.

1.13 MANUFACTURER'S IDENTIFICATION

A. All component parts of each item of equipment or device shall bear the manufacturer's nameplate giving name of manufacturer, description, size, type, serial and model number, electrical characteristics, etc., in order to facilitate maintenance or replacement. Nameplate data shall not be obstructed. The nameplate of a Contractor or distributor will not be acceptable.

B. All material and equipment for the electrical portion of the mechanical systems shall bear the label of or be listed by UL, or other accredited authoritative agencies or testing organizations approved by the authority having jurisdiction.

1.14 RECORD DRAWINGS

A. Maintain at the job site a record set of Mechanical Drawings on which any changes in location or routing of all equipment, materials and access panels shall be recorded.

B. At the end of construction, the Contractor shall provide the Owner with a complete set of As-Built Drawings, including all updated coordination drawings, ductwork and piping plans. As-Builts shall be drawn on the latest version of Autocad or compatible software, approved in writing, prior to submittal.

1.15 MATERIALS AND WORKMANSHIP

A. All materials and apparatus required for the work, except as otherwise specifically indicated, shall be new, of first-class quality, and shall be furnished, delivered, erected, connected and finished in every detail and be so selected and arranged as to fit properly into the building spaces. Where no specific type or quality of material is given, a first-class standard article as accepted by industry standards shall be furnished.

B. The Contractor shall furnish the services of an experienced superintendent who shall be constantly in charge of the installation of the work together with all skilled workmen, fitters, metal workers, welders, helpers and laborers required to unload, transfer, erect, connect, adjust, start, operate and test each system.

C. Unless otherwise specifically indicated on the Drawings or Specifications, all equipment and materials shall be installed with the acceptance of the Engineer and in accordance with the recommendations of the manufacturer. This includes the performance of such tests as the manufacturer recommends.

D. All labor for installation of mechanical systems shall be performed by experienced, skilled tradesmen under the supervision of a licensed journeyman foreman. All work shall be of a quality consistent with good trade practice and shall be installed in a neat, workmanlike manner. The Engineer reserves the right to reject any work which, in his opinion, has been installed in a substandard, dangerous or unserviceable manner. The Contractor shall replace said work in a satisfactory manner at no extra cost to the Owner.

E. Year-2000 Compliant: All digitally controlled/monitored equipment and systems shall be certified "Year 2000 Compliant". Computer hardware and software shall be capable of accurately processing, providing, and receiving date data from, into, and between the twentieth and twenty-first centuries, including leap-year calculations. All program codes shall be "non-date sensitive" codes that will not cause an automatic program malfunction, stop command, miscalculation or similar function stopping continued and proper operation upon a sequence of numbers that occur by date.

1.16 PROTECTION OF MATERIALS AND EQUIPMENT

A. Work under each Section shall include protecting the work and material of all other Sections from damage by work or workmen and shall include making good all damage thus caused.

B. The Contractor shall be responsible for work and equipment until the facility has been accepted by the Owner. Protect work against theft, injury or damage and carefully store material and equipment received on site which is not immediately installed. Close open ends of work with temporary covers or plugs during construction to prevent entry of foreign material.

C. Work under each Section includes receiving, unloading, uncrating, storing, protecting, setting in place and completely connecting equipment supplied under each Section. Work under each Section shall also include exercising special care in handling and protecting equipment and fixtures, and shall include the cost of replacing any of the equipment and fixtures which are missing or damaged.

D. Equipment and material stored on the job site shall be protected from the weather, vehicles, dirt and/or damage by workmen or machinery. Insure that all electrical or absorbent equipment or material is protected from moisture during storage.

1.17 BASES AND SUPPORTS

A. Unless otherwise specifically noted, the Contractor shall furnish all necessary supports, rails, framing, bases and piers required for all equipment furnished under this Division.

B. Unless otherwise indicated in individual trade Sections, all floor mounted equipment shall be mounted on a minimum of four (4") inch high concrete pads which shall be furnished and installed per Division 3. All pads shall be extended six (6") inches beyond machine base in all directions with top edge chamfered. Shop drawings of all foundations and pads shall be submitted to the Engineer for review before they are constructed. The Mechanical Contractor shall field coordinate all required dimensional and necessary loading information.

C. Unless otherwise shown, all equipment shall be securely attached to the building structure in an acceptable manner. Attachments shall be of a strong and durable nature; any attachments that are insufficient, in the opinion of the Engineer, shall be replaced as directed without extra cost to the Owner.

D. All equipment supports shall be designed and constructed such that the equipment will be capable of resisting both vertical and horizontal movement. The equipment shall be positively anchored to the bases or supports to resist vertical movement. The equipment and its supports shall be provided with suitable restraints to resist horizontal movement from any direction as dictated by applicable seismic Codes.

1.18 SLEEVES, INSERTS AND ANCHOR BOLTS

A. The Contractor shall provide, set in place and be held responsible for the location of all sleeves, inserts and anchor bolts required for the work. In the event that failure to do so requires cutting and patching of finished work, it shall be done at the Contractor's expense.

B. It is the responsibility of the Contractor to furnish cast-in-place steel sleeves, inserts and anchors in sufficient time to be installed during initial concrete pours. Where job schedules make this impossible, coordinate and obtain acceptance from the Structural Engineer for alternate installation methods.

C. Penetrations through fire-rated walls, ceilings and all floors (except slab on grade) in which piping or ducts pass shall be filled solidly with acceptable fire-stopping material. Sleeves shall

be steel or a UL / FM listed and approved assembly.

D. When ducts, piping or conduit penetrate the floor of a mechanical room located above an occupied space, such penetrations shall be made completely watertight, such that a liquid leak shall not pass through the penetration.

1.19 FIRE-STOPS AND SEALS

A. Refer to Division 7 Specification for additional and more specific information.

B. Fire-stopping systems shall be submitted as shop drawing.

C. Penetrations through fire-rated walls, ceiling or floors shall be sealed with a UL approved fire-stop fitting classified for an hourly rating equivalent to the fire rating of the wall, ceiling or floor.

D. Thruwall and floor seals shall be used to provide a positive means of sealing pipes or ducts which pass through the concrete foundation of a structure below grade or below ground water level. Seals shall also be used at entry points through concrete walls or floors which must be sealed.

1.20 CUTTING AND PATCHING

A. All cutting and patching shall be done per Division 1 requirements. The Contractor shall furnish sketches showing the location and sizes of all openings, chases, etc., required for the installation of work.

B. Work under this Division shall include furnishing, locating and setting inserts and/or sleeves required before the floors and walls are built or be responsible for cutting, drilling or chopping where sleeves and inserts were not installed or correctly located. The Contractor shall do all drilling required for the installation of hangers.

C. Exercise extreme caution when core drilling or punching openings in concrete floor slabs in order to avoid cutting or damaging structural members. No structural members or structural slabs/floors shall be cut without the written acceptance of the Structural Engineer and all such cutting shall be done in a manner directed by him.

1.21 SCAFFOLDING, RIGGING, HOISTING

A. The Contractor shall furnish all scaffolding, rigging, hoisting and services necessary for erection and delivery into the premises any equipment and apparatus furnished under this Division. Remove same from premises when no longer required.

1.22 WATERPROOFING

A. Where any work pierces waterproofing, including waterproof concrete and floors in wet areas, the method of installation shall be reviewed by the Engineer before work is done. The Contractor shall furnish all necessary sleeves, caulking and flashing required to make openings absolutely watertight.

1.23 ACCESSIBILITY AND ACCESS PANELS

A. The Contractor shall be responsible for the sufficiency of the size of shafts and chases, the adequate thickness of partitions, and the adequate clearance in double partitions and hung ceilings for the proper installation of the work.

B. Locate all equipment which must be serviced, operated or maintained in fully accessible positions. Equipment shall include, but not be limited to: motors, controllers, coil, valves, switchgear, drain points, etc. Access doors shall be furnished if required for better accessibility. Minor deviations from the Drawings may be made to allow better accessibility, but changes of magnitude or which involve extra cost shall not be made without the acceptance of the Engineer.

C. Access doors in walls, ceilings, floors, etc., shall be field coordinated. It is the responsibility of the Contractor to coordinate and provide information regarding the sizes and quantities of access doors required for his work. The Contractor shall arrange his work in such a manner as to minimize the quantity of access doors required, such as grouping shutoff valves in the same area. Where possible, locate valves in already accessible areas, such as lay-in ceilings, etc.

D. On a clean set of prints, the Contractor shall mark in red pencil the location of each required access door, including its size and fire rating (if any), and shall submit the print to the Architect for review before access doors are purchased or installed.

E. Upon completion of the Project, the Contractor shall physically demonstrate that all equipment and devices installed have been located and/or provided with adequate access panels for repair, maintenance and/or operation. Any equipment not so furnished shall be relocated or provided with additional access panels by the installing Contractor at no additional cost to the Owner. All access panel or door locations shall be indicated on Owner's final as-built record drawings.

F. Permanent ladders for access to equipment when shown on Plans shall be furnished and installed. Coordinate exact requirements in field.

1.24 TEMPORARY OPENINGS

A. The Contractor shall ascertain from an examination of the Drawings whether any special temporary openings in the building will be required for the admission of apparatus provided under this Division and shall coordinate the requirements accordingly. In the event of failure of the Contractor to give sufficient notice in time to arrange for these openings during construction, the Contractor shall assume all costs of providing such openings thereafter.

1.25 TAGS AND CHARTS

A. Each valve and piece of apparatus under this Division shall be provided with suitable brass or laminated plastic tags securely fastened with brass chains, screws or rivets. Equipment shall be numbered with laminated plastic tags or neatly stenciled letters two (2") inches high using designations in equipment schedules and/or shall conform to a directory indicating number, location and use of each item. Directories shall be prepared under each Section and shall be glass framed.

B. Directory shall indicate valve tag number and the unit number, floor/area branch line, main line, service or other pertinent data to quickly and easily identify the valve's purpose.

1.26 ESCUTCHEONS

A. The Contractor shall provide escutcheons on pipes wherever they pass through floors, ceilings, walls or partitions in finished visible locations.

1.27 PAINTING

A. All finish painting in completed areas shall be performed per Division 9 of the Specifications.

B. All materials shipped to the job site under this Division, such as grilles, registers and/or radiation covers, shall have standard manufacturer's finish, unless otherwise specified by Architect.

C. The Contractor shall paint the interior of all ducts wherever the interior of the duct can be seen through a register or louver. Paint shall be flat black, rust preventative type.

D. All outdoor piping, fittings and hangers shall be properly primed with zinc-rich primer and finished with a minimum of two (2) coats of high grade exterior enamel.

1.28 ELECTRICAL CONNECTIONS

A. Unless otherwise specified, all wiring shall be furnished and installed per Division 26 Specifications.

B. All motor controllers not factory mounted on mechanical equipment shall be furnished, mounted, and installed by the Division 26 contractor, and shall be coordinated with this contractor. Provide properly sized overload heaters and all required accessories with all motor controllers. See Division 26 Motor Controllers for motor controller requirements.

C. All power wiring shall be furnished and installed per Division 26 complete from power source to motor or equipment junction box including power wiring through the motor controller and proper means of disconnect per NEC and Division 26. The Division 26 Contractor shall provide all disconnects, unless noted otherwise.

1.29 QUIET OPERATION

A. If noise level is deemed objectionable by the Owner/Engineer, the Contractor shall test and record sound levels in the presence of the Owner/Engineer. The sound level shall be observed on the "A" weighting network of a sound level or sound survey meter. The ASHRAE "Guide and Data Book" provides a means to determine sound level of mechanical equipment when the total of background plus equipment sound levels exceeds the minimum acceptable equipment sound level.

B. If objectionable noises or vibrations of any magnitude are produced and transmitted to occupied portions of the building by apparatus, piping, ducts or other parts of the mechanical work, the Contractor shall make such changes or additions as necessary without extra cost to the Owner.

1.30 MAINTENANCE

A. The Contractor shall provide the necessary skilled labor to assure the proper operation and to provide all required current and preventative maintenance for all equipment and controls provided under this Division until final acceptance of the building by the Owner. The Contractor shall not assume acceptance of the building by the Owner until he receives written notification.

B. The Contractor shall receive calls for any and all problems experienced in the operation of the equipment provided under this Division and he shall take steps to immediately correct any deficiencies that may exist.

C. The Contractor shall provide a check list and shall put a copy of it in the boiler or main mechanical room. The check list shall itemize each piece of equipment furnished under his Section.

D. The Contractor shall certify on this check list that he has examined each piece of equipment and that, in his opinion, it is operating as intended by the manufacturer, it has been properly lubricated, and that all necessary current and preventative maintenance has been performed as recommended by the manufacturer and by good and accepted practice.

E. The Contractor shall check all controls in the building to ascertain that they are functioning as designed. This shall apply to all thermostats, aquastats, humidistats, freezestats and firestats, etc. This portion of the work shall be performed by the Contractor who installed the controls.

F. During construction, the Contractor shall ensure that all filters are in place on all equipment. If the equipment is operated during construction (see restrictions section of this specification), strict attention shall be paid to maintaining clean and effective filters and cleaning ductwork and equipment. Filters shall be new and/or clean when the system testing and balancing takes place. The Contractor shall bear the cost of all filters and media during construction until final acceptance by the Owner. This requirement shall apply equally to fluid filters and strainers.

G. Where normal preventative maintenance for any piece of equipment requires special tools, the Contractor shall furnish the appropriate tools for that piece of equipment (i.e., special filter removal hooks, valve wrenches, etc.).

1.31 DEMOLITION

A. All required demolition work shall be performed by the Contractor. All demolition work shall be performed in a neat and orderly fashion.

B. Demolition work, if indicated on the drawings, is intended for general information only and is not intended to describe the full extent of demolition work required under this Contract. All existing mechanical work and systems, including but not limited to piping, equipment, ductwork, wiring, controls, hangers, and supports, made obsolete by this project, shall be removed in their entirety under this Contract, unless noted otherwise.

C. After piping, ductwork, equipment, etc., has been removed, neatly cap remaining ductwork and piping, and insulate caps to match the existing adjacent ductwork and piping. In finished areas, all ductwork and piping shall be cut back to a concealed location, i.e., within walls, above ceilings, etc., before capping.

D. Before submitting his Bid, the Contractor shall visit the site with the Contract Documents in hand, and shall inspect all existing systems to determine the extent of demolition work involved. Particular attention is drawn to the removal of existing walls or portions of existing walls. In those areas, all exposed and concealed piping, ductwork, equipment, etc., running across or through affected areas shall be removed as required. Piping and ductwork shall then be either capped, or, if required for the proper continuing operation of an existing system to remain, piping and ductwork shall be rerouted around the affected areas and reconnected as required.

E. In general, it shall be the responsibility of the Contractor to remove demolished equipment, piping, ductwork, etc., from the site and properly dispose of it. If the Owner shall so request, however, the Contractor shall turn over demolished equipment, etc., to the Owner for the Owner's use. Unless otherwise noted, demolished work shall not be abandoned in place. Contractor shall make safe all utilities pertaining to this section.

1.32 AIR ELIMINATION

A. The Contractor shall be responsible for bleeding all air from closed hydronic piping systems after the system has been filled, and thereafter rebleeding as often as required to completely eliminate all air from the system.

B. Where work on an existing piping system has allowed air to enter that system, the Contractor shall also bleed that system even if no piping work was done in the area where air has developed.

C. Where air cannot be bled from any piping due to the absence of an air vent, the Contractor shall install a manual air vent in locations required to successfully bleed such air.

D. Where the piping layout would require an air vent in an inaccessible location, the Contractor shall install an extended 1/4-inch copper bleed line and petcock to an accessible location such as a closet, mechanical room, above lay-in ceiling, etc.

1.33 LUBRICATION

A. All equipment installed under this Contract having moving parts and requiring lubrication shall be properly lubricated according to manufacturer's recommendations prior to testing and operation. Any such equipment discovered to have been operated before lubrication by the Contractor is subject to rejection and replacement at no additional cost to the Owner. Units furnished with sealed bearings are exempted.

B. The Contractor shall furnish and install, as appropriate on all equipment requiring lubrication, Zerk pressure gun grease fittings or sight gravity-feed oilers equipped with shutoff and needle valve adjustment. Units furnished with sealed bearings and lifetime lubrication are exempted. All fittings and oilers are to be fully accessible for lubrication with equipment which does not require special adapters. Where fittings would be otherwise inaccessible, furnish and install extended grease lines.

1.34 CLEANING

A. The Contractor shall be responsible for keeping the jobsite clean, safe and neat throughout the duration of construction. The Contractor shall clean up his own debris daily and shall coordinate removal of rubbish and debris with the General Contractor/Construction Manager.

B. No debris, construction materials, cigarette butts, coffee cups, etc., shall be left above suspended ceilings.

C. Terminal equipment and plumbing fixtures shall cleaned at substantial completion.

D. If any part of a system should be stopped or damaged by any foreign matter after being placed in operation, the system shall be disconnected, cleaned and reconnected wherever necessary to locate and/or remove obstructions. Any work damaged in the course of removing obstructions shall be repaired or replaced when the system is reconnected at no additional cost to the Owner.

E. During the course of construction, all ducts and pipes shall be capped in an acceptable manner to insure adequate protection against the entrance of foreign matter.

F. Upon completion of all work under the Contract, the Contractor shall remove from the premises all rubbish, debris and excess materials left over from his work. Any oil or grease stains on floor areas caused by the Contractor shall be removed and floor areas left clean.

1.35 OPERATING INSTRUCTIONS

A. Upon completion of all work and tests, the Contractor shall furnish the necessary skilled labor and helpers for operating his system and equipment for a period specified under each applicable Section of this Division. During this period, he shall fully instruct the Owner or the Owner's representative in the operation, adjustment and maintenance of all equipment furnished. The Contractor shall give at least 72 hours notice to the Owner and the Engineer in advance of this period.

B. The Contractor shall formally submit for delivery to the Engineer three (3) complete bound sets of typewritten or blueprinted instructions for operating and maintaining all systems and equipment included in this Division. All instructions shall be submitted in draft for review prior to final issue. Manufacturer's advertising literature or catalogs will not be acceptable for operating and maintenance instruction.

C. The Contractor, in the above-mentioned instructions, shall include the maintenance schedule for the principal items of equipment furnished under this Division.

D. The appropriate Contractor shall physically demonstrate procedures for all routine maintenance of all equipment furnished under each respective Section to assure accessibility to all devices.

E. An authorized manufacturer's representative shall attest in writing that the equipment has been properly installed prior to startup of any major equipment. The following equipment will require this inspection: pumps; air conditioning equipment, controls, air handling equipment, boilers. These letters will be bound into the operating and maintenance books.

F. Refer to individual trade Sections for any other particular requirements related to operating instructions.

1.36 ADJUSTING AND TESTING

A. After all the equipment and accessories to be furnished are in place, they shall be put in final adjustment and subjected to such operating tests so as to assure the Engineer that they are in proper adjustment, the control operate as described in the sequence of operation and all systems are in satisfactory, permanent operating condition.

B. Where requested by the Engineer, a factory-trained service engineering representative shall inspect the installation and assist in the initial startup and adjustment to the equipment. The period of these services shall be for such time as necessary to secure proper installation and adjustments. After the equipment is placed in permanent operation, the service engineering representative shall supervise the initial operation of the equipment and instruct the personnel responsible for operation and maintenance of the equipment. The service engineering representative shall notify the Contractor in writing that the equipment was installed according to manufacturer's recommendations and is operating as intended by the manufacturer.

1.37 GUARANTEES

A. The Contractor shall guarantee all equipment, material and workmanship under these Specifications and the Contract for a period of one (1) year from the date of final acceptance by Owner, unless otherwise noted.

B. All refrigeration compressors shall have five (5) year guarantee from the date of final acceptance by the Owner unless otherwise noted.

C. During this guarantee period, all defects developing through faulty equipment, materials or workmanship shall be corrected or replaced immediately by the Contractor without expense to the Owner. Such repairs or replacements shall be made to the Engineer's satisfaction.

1.38 RESTRICTIONS

A. Mechanical equipment provided under this Division may not be used for temporary heating/cooling requirements due to premature wear and dirt/dust infiltration. Equipment shall

be protected from dust and debris during construction. Duct opening shall be protected during construction to prevent dust and debris from being transported through ductwork to equipment or other spaces and to ensure ductwork is clean and ready for use at the time of equipment start-up.Written approval may be obtained from the Owner only after submission of a written cleaning plan and guarantee/warranty extension.

PART 2 PRODUCTS - NOT USED.

PART 3 EXECUTION - NOT USED.

**END OF SECTION 23 05 00**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Thermometers and thermometer wells.

1.03 RELATED REQUIREMENTS

A. Section 232113 - Hydronic Piping.

1.04 REFERENCE STANDARDS

A. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers 2014.

B. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers 2014, with Editorial Revision (2017).

1.05 SUBMITTALS

A. See Section 01 33 00 - Submittial Procedures, for submittal procedures.

B. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.

C. Project Record Documents: Record actual locations of components and instrumentation.

1.06 FIELD CONDITIONS

A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.01 STEM TYPE THERMOMETERS

A. Manufacturers:
   1. Winters Instruments: www.winters.com
   2. Trerice: www.trerice.com
   3. Weiss Instruments: www.weissinstruments.com
   4. Substitutions: See Section 016000 - Product Requirements.

B. Thermometer: ASTM E 1, adjustable angle, red appearing non-toxic liquid fill, lens front tube, cast aluminum case with enamel finish or impact resistance valox polyester case, cast aluminum adjustable joint with positive locking device.
   1. Size: 9 inch scale.
   2. Window: Clear glass.
   3. Stem: 3/4 inch NPT brass.
   4. Accuracy: +/- 1 percent, per ASTM E77.
   5. Units of measure: Degree F.

2.02 THERMOMETER SUPPORTS

A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

**END OF SECTION 23 05 19**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Pipe Markers.

1.03 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems 2020.

1.04 SUBMITTALS

A. See Section 01 33 00 - Submittial Procedures, for submittal procedures.

B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Product Data: Provide manufacturers catalog literature for each product required.

E. Samples: Submit two labels 1" x _3" inch in size.

F. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Brady Corporation: www.bradycorp.com.

B. Champion America, Inc: www.Champion-America.com.

C. Seton Identification Products: www.seton.com/aec.

D. Substitutions: See Section 01 6000 - Product Requirements.

2.02 NAMEPLATES

A. Description: Laminated three-layer plastic with engraved letters.
   1. Letter Color: White.
   2. Letter Height: 1/4 inch.
   3. Background Color: Black.

2.03 TAGS

A. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

B. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.04 PIPE MARKERS

A. Color: Conform to ASME A13.1.

B. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Section 099100 for stencil painting.

3.02 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Install plastic pipe markers in accordance with manufacturer's instructions.

D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

E. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.

F. Identify control panels and major control components outside panels with plastic nameplates.

G. Identify thermostats relating to terminal boxes or valves with nameplates.

H. Identify valves in main and branch piping with tags.

I. Identify air terminal units and radiator valves with numbered tags.

J. Tag automatic controls, instruments, and relays. Key to control schematic.

K. Identify piping, concealed or exposed, with plastic pipe markers. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

**END OF SECTION 23 05 53**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Testing, adjustment, and balancing of air systems.

B. Testing, adjustment, and balancing of hydronic systems.

C. Measurement of final operating condition of HVAC systems.

1.03 RELATED REQUIREMENTS

A. Section 23 05 48 - Vibration and Seismic Controls for HVAC Systems.

1.04 REFERENCE STANDARDS

A. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems 2008 (Reaffirmed 2017).

B. NEBB (TAB) - Procedural Standards for Testing Adjusting and Balancing of Environmental Systems 2015, with Errata (2017).

C. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing 2002.

1.05 SUBMITTALS

A. See Section 01 33 00 - Submittial Procedures, for submittal procedures.

B. Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.

C. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.

1. Include at least the following in the plan:
    a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
    b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
    c. Identification and types of measurement instruments to be used and their most recent calibration date.
    d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
    e. Final test report forms to be used.
    f. Detailed step-by-step procedures for TAB work for each system and issue, including:
        1) Terminal flow calibration (for each terminal type).
        2) Diffuser proportioning.
        3) Branch/submain proportioning.
        4) Total flow calculations.
        5) Rechecking.
        6) Diversity issues.
    g. Details of how TOTAL flow will be determined; for example:
        1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
        2) Water: Pump curves, circuit setter, flow station, ultrasonic, etc.
    h. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and methods to verify this.

i. Confirmation of understanding of the outside air ventilation criteria under all conditions.
j. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).
k. Method of checking building static and exhaust fan and/or relief damper capacity.
l. Proposed selection points for sound measurements and sound measurement methods.
m. Methods for making coil or other system plant capacity measurements, if specified.
n. Time schedule for TAB work to be done in phases (by floor, etc.).
o. Description of TAB work for areas to be built out later, if any.
p. Time schedule for deferred or seasonal TAB work, if specified.
q. False loading of systems to complete TAB work, if specified.
r. Exhaust fan balancing and capacity verifications, including any required room pressure differentials.
s. Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
t. Procedures for formal deficiency reports, including scope, frequency and distribution.

D. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
1. Revise TAB plan to reflect actual procedures and submit as part of final report.
2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
3. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
4. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
5. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
6. Units of Measure: Report data in I-P (inch-pound) units only.
7. Include the following on the title page of each report:
a. Name of Testing, Adjusting, and Balancing Agency.
b. Address of Testing, Adjusting, and Balancing Agency.
c. Telephone number of Testing, Adjusting, and Balancing Agency.
d. Project name.
e. Project location.
f. Project Engineer.
g. Project Contractor.
h. Project altitude.
i. Report date.

E. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:
1. AABC MN-1, AABC National Standards for Total System Balance.
2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
3. SMACNA HVAC Systems Testing, Adjusting, and Balancing.

4. Maintain at least one copy of the standard to be used at project site at all times.

B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.

D. TAB Agency Qualifications:
   1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
   2. Having minimum of ten years documented experience.
   3. Certified by one of the following:
      a. AABC, Associated Air Balance Council: www.aabchq.com; upon completion submit AABC National Performance Guaranty.
      b. NEBB, National Environmental Balancing Bureau: www.nebb.org/#sle.
      c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org/#sle.

E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.02 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
   1. Systems are started and operating in a safe and normal condition.
   2. Temperature control systems are installed complete and operable.
   3. Proper thermal overload protection is in place for electrical equipment.
   4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
   5. Duct systems are clean of debris.
   6. Fans are rotating correctly.
   7. Fire and volume dampers are in place and open.
   8. Air coil fins are cleaned and combed.
   9. Access doors are closed and duct end caps are in place.
   10. Air outlets are installed and connected.
   11. Duct system leakage is minimized.
   12. Hydronic systems are flushed, filled, and vented.
   13. Pumps are rotating correctly.
   14. Proper strainer baskets are clean and in place.
   15. Service and balance valves are open.

B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

C. Beginning of work means acceptance of existing conditions.

3.03 PREPARATION

A. Hold a pre-balancing meeting at least one week prior to starting TAB work.
   1. Require attendance by all installers whose work will be tested, adjusted, or balanced.

B. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect to facilitate spot checks during testing.

C. Provide additional balancing devices as required.

3.04 ADJUSTMENT TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.05 RECORDING AND ADJUSTING

A. Field Logs: Maintain written logs including:
   1. Running log of events and issues.
   2. Discrepancies, deficient or uncompleted work by others.
   3. Contract interpretation requests.
   4. Lists of completed tests.

B. Ensure recorded data represents actual measured or observed conditions.

C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.

E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

H. Check and adjust systems approximately six months after final acceptance and submit report.

3.06 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.

L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static

pressure near the building entries.

3.07 WATER SYSTEM PROCEDURE

A. Adjust water systems to provide required or design quantities.

B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

D. Effect system balance with automatic control valves fully open to heat transfer elements.

E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.08 SCOPE

A. Test, adjust, and balance the following:
   1. HVAC Pumps
   2. Packaged Roof Top Heating/Cooling Units
   3. Terminal Heat Transfer Units
   4. Exhaust Fans
   5. Air Inlets and Outlets

3.09 MINIMUM DATA TO BE REPORTED

A. Report:
   1. Summary Comments:
      a. Design versus final performance
      b. Notable characteristics of system
      c. Description of systems operation sequence
      d. summary of outdoor and exhaust flows to indicate amount of building pressurization
      e. Nomenclature used throughout report
      f. Test Conditions
   2. Instrument List:
      a. Manufacturer
      b. Model number
      c. Serial number
      d. Range
      e. Calibration date

B. Electric Motors:
   1. Manufacturer
   2. Model/Frame
   3. HP/BHP
   4. Phase, voltage, amperage; nameplate, actual, no load
   5. RPM
   6. Service factor
   7. Starter size, rating, heater elements
   8. Sheave Make/Size/Bore

C. V-Belt Drives:
   1. Identification/location
   2. Required driven RPM
   3. Driven sheave, diameter and RPM

4. Belt, size and quantity
5. Motor sheave diameter and RPM
6. Center to center distance, maximum, minimum, and actual

D. Pumps:
1. Identification/number
2. Manufacturer
3. Size/model
4. Impeller
5. Service
6. Design flow rate, pressure drop, BHP
7. Actual flow rate, pressure drop, BHP
8. Discharge pressure
9. Suction pressure
10. Total operating head pressure
11. Shut off, discharge and suction pressures
12. Shut off, total head pressure

E. Air Moving Equipment:
1. Location
2. Manufacturer
3. Model number
4. Serial number
5. Arrangement/Class/Discharge
6. Air flow, specified and actual
7. Return air flow, specified and actual
8. Outside air flow, specified and actual
9. Total static pressure (total external), specified and actual
10. Inlet pressure
11. Discharge pressure
12. Sheave Make/Size/Bore
13. Number of Belts/Make/Size
14. Fan RPM

F. Return Air/Outside Air:
1. Identification/location
2. Design air flow
3. Actual air flow
4. Design return air flow
5. Actual return air flow
6. Design outside air flow
7. Actual outside air flow
8. Return air temperature
9. Outside air temperature
10. Required mixed air temperature
11. Actual mixed air temperature
12. Design outside/return air ratio
13. Actual outside/return air ratio

G. Exhaust Fans:
1. Location
2. Manufacturer
3. Model number
4. Serial number
5. Air flow, specified and actual

6. Total static pressure (total external), specified and actual
7. Inlet pressure
8. Discharge pressure
9. Sheave Make/Size/Bore
10. Number of Belts/Make/Size
11. Fan RPM

H. Duct Traverses:
1. System zone/branch
2. Duct size
3. Area
4. Design velocity
5. Design air flow
6. Test velocity
7. Test air flow
8. Duct static pressure
9. Air temperature
10. Air correction factor

I. Terminal Unit Data:
1. Manufacturer
2. Type, constant, variable, single, dual duct
3. Identification/number
4. Location
5. Model number
6. Size
7. Minimum static pressure
8. Minimum design air flow
9. Maximum design air flow
10. Maximum actual air flow
11. Inlet static pressure

J. Air Distribution Tests:
1. Air terminal number
2. Room number/location
3. Terminal type
4. Terminal size
5. Area factor
6. Design velocity
7. Design air flow
8. Test (final) velocity
9. Test (final) air flow
10. Percent of design air flow

**END OF SECTION 23 05 93**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Duct insulation.

1.03 RELATED REQUIREMENTS

A. Section 233100 - HVAC Ducts and Casings: Metal and non-metal ducts.

1.04 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2017.

B. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications 2013 (Reapproved 2019).

C. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation 2014 (Reapproved 2019).

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.

E. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials 2016.

F. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2005 (Revised 2009).

G. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.05 SUBMITTALS

A. See Section 01 33 00 - Submittial Procedures, for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this sectionwith minimum 3 years of experience and approved by manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.08 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, UL 723, NFPA 255, ASTM E84, UL 723, NFPA 255, ASTM E84, NFPA 255, or UL 723.

2.02 GLASS FIBER, FLEXIBLE

A. Manufacturer:
   1. Johns Manville Corporation: www.jm.com/#sle.
   2. Owens Corning Corp: www.owenscorning.com/#sle.
   3. CertainTeed Corporation;: www.certainteed.com.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Insulation: ASTM C 553; flexible, formaldehyde-free, noncombustible blanket, Greenguard Certified.
   1. 'K' value: 0.27 at 75 degrees F, when tested in accordance with ASTM C518.
   2. Maximum Water Vapor Sorption: 5.0 percent by weight.
   3. Density: 0.75 lb/cuft.
   4. Equal to Johns Manville Microlite XG.

C. Vapor Barrier Jacket:
   1. Kraft paper with glass fiber yarn and bonded to aluminized film.
   2. Moisture Vapor Permeability: 0.029 ng/Pa s m (0.02 perm inch), when tested in accordance with ASTM E96/E96M.
   3. Secure with pressure sensitive tape.

D. Vapor Barrier Tape:
   1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

E. Tie Wire: Annealed steel, 16 gage.

2.03 OUTDOOR DUCT INSULATION

A. Closed cell expanded polystyrene foam insulation (minimum R-value of 5 per inch thickness) covered with self-adhering modified bitumen weather barrier.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that ducts have been tested before applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Insulated ducts conveying air below ambient temperature:
   1. Provide insulation with vapor barrier jackets.
   2. Finish with tape and vapor barrier jacket.
   3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
   4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

D. Insulated ducts conveying air above ambient temperature:
   1. Provide with or without standard vapor barrier jacket.
   2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

3.03 DUCT INSULATION SCHEDULE

A. Unlined Supply and Return Ducts: 2" (minimum installed R-5)

B. Exhaust Ducts: 0"

**END OF SECTION 23 07 13**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.03 RELATED REQUIREMENTS

A. Section 232113 - Hydronic Piping.

B. Section 232300 - Refrigerant Piping.

1.04 REFERENCE STANDARDS

A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.

B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric) 2014.

C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus 2019.

D. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement 2007 (Reapproved 2013).

E. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement 2007 (Reapproved 2013).

F. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2017.

G. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation 2017.

H. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form 2020a.

I. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation 2019.

J. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel 2008 (Reapproved 2018).

K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.

L. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials 2016.

M. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.05 SUBMITTALS

A. See Section 01 33 00 - Submittial Procedures, for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.08 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with NFPA 255, ASTM E84, UL 723, NFPA 255, ASTM E84, UL 723, ASTM E84, NFPA 255, or UL 723.

2.02 GLASS FIBER

A. Manufacturers:

B. Insulation: ASTM C 547 and ASTM C795; rigid molded, noncombustible, GREENGUARD certified.
   1. 'K' value: ASTM C177, 0.27 at 75 degrees F.
   2. Maximum service temperature: 850 degrees F.
   3. Maximum moisture absorption: 0.2 percent by volume.
   4. Equal to Johns Manville Micro-Lok HP.

C. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.

D. Vapor Barrier Lap Adhesive/Mastic:

2.03 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturer:
   1. Armacell International: www.armacell.com/#sle.
   2. Substitutions: See Section 016000 - Product Requirements.

B. Insulation: Closed cell flexible elastomeric pipe (tube) insulation complying with ASTM C 534 Type I, tubular Grade 1, GREENGUARD certified
   1. Minimum Service Temperature: -297 degrees F.
   2. Maximum Service Temperature: +220 degrees F.
   3. Connection: Waterproof vapor barrier adhesive.
   4. Equal to AP Armaflex.

C. Elastomeric Foam Adhesive: Air dried, Low V.O.C. contact adhesive, compatible with insulation equal to Armaflex 520 BLV.

D. For insulation exposed to weather, apply Armaflex WB finish.

E. For insulation thickness greater than 1", provide two layers of insulation in accordance with manufacturer's recommendations for multi-layering.

2.04 JACKETS

A. PVC Plastic.
   1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
      a. Minimum Service Temperature: 0 degrees F.
      b. Maximum Service Temperature: 150 degrees F.
      c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
      d. Thickness: 10 mil.
      e. Connections: Brush on welding adhesive.

f. Equal to Johns Manville Zeston 2000.

2. Covering Adhesive Mastic:

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

E. Pipes conveying fluids over 105 degrees F: Insulate flanges and unions at equipment.

F. Glass fiber insulated pipes conveying fluids above ambient temperature:
   1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
   2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

G. Inserts and Shields:
   1. Application: Piping 1-1/2 inches diameter or larger.
   2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
   3. Insert location: Between support shield and piping and under the finish jacket.
   4. Insert configuration: Minimum 12 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
   5. Insert material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

H. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 078400.

3.03 SCHEDULE

A. Heating Systems:
   1. Heating Water Supply and Return (Glass Fiber Insulation):
      a. 1-1/2" pipe size or less, 1-1/2" thickness.
      b. 2" pipe size or larger, 2" thickness.

B. Cooling Systems (Flexible Elastomeric Cellular Insulation):
   1. Refrigerant Gas and Liquid: 1"

**END OF SECTION 23 07 19**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL

A. The building is normally unoccupied. All terminal heating equipment in the building (i.e. unit heaters, cabinet unit heaters, finned-tube radiation and in-floor radiant) shall have thermostats set to maintain the unoccupied setpoint (60F adjustable).

B. Rooftop HVAC units (RTU-1,2,3) shall have their thermostats setpoints set so unit shall not operate when the building is unoccupied. Thermostat shall allow timed override of the unoccupied setpoint to allow the unit to provide heating or cooling and ventilation at the occupied setpoint.

3.02 HYDRONIC HOT WATER SYSTEM CONTROL

A. The boilers shall have an integrated control system furnished by the boiler manufacturer. The HVAC contractor shall mount and wire the controllers and sensors furnished by the boiler manufacturer, including peer to peer communications wiring between the boiler controllers.

B. The hot water heating system shall be enabled when the outside air temperature drops below 60 degrees F and there is a call for heat from at least one zone.

C. When the boiler system is enabled, the lead boiler pump shall run and the lead boiler shall start on minimum fire. Hot water supply sensor shall modulate the lead boiler to maintain a supply temperature to satisfy the following reset schedule:
   1. OUTSIDE AIR 20 DEG.F./HWS 180 DEG.F.
   2. OUTSIDE AIR 60 DEG.F./HWS 140 DEG.F.

D. The boiler control system shall regulate the lag boiler such that the boilers function as one system. When a lag boiler is enabled, its boiler pump shall run.

E. Boiler control system shall alternate lead boiler to ensure equal run time

3.03 TERMINAL HEATING EQUIPMENT WATER LOOP CONTROL

A. Pump P-1 shall run when the outside air temperature drops below 60 degrees F and there is a call for heat by a zone thermostat.

B. When a zone calls for heat, the 2-way zone valve shall open to full coil flow. When the zone temperature setpoint is satisfied, the zone valve shall close.

C. Pump shall be controlled through an integral variable frequency drive supplied with the pump. The variable frequency drive shall be programmed to provide dynamic auto flow without an external signal.

3.04 RADIANT LOOP TEMPERATURE CONTROL:

A. Pumps RZP-1,2,3 shall run when the outside air temperature drops below 60 degrees F and only if their associated zone thermostat is calling for heat.

B. Hot water supply zone sensor shall, through outdoor air reset program in the mixing control system, shall modulate the 3-way mixing valve to maintain the following schedule:
   1. OUTSIDE AIR 20 DEG.F./HWS 110 DEG.F.
   2. OUTSIDE AIR 60 DEG.F./HWS 90 DEG.F.

C. The pump shall be controlled through an integral variable frequency drive supplied with the pump. The variable frequency drive shall be programmed to provide constant flow without an external signal.

3.05 EXHAUST FAN CONTROL

A. EF-1 - Fan shall be enabled by occupancy sensor provided by Electrical Contractor.

B. EF-2,3 - Fan shall be enabled/disabled by manual switch provided by Electrical Contractor.

C. EF-4 - Fan shall be enabled by either manual switch provided by Electrical Contractor or by line voltage cooling thermostat provided by mechanical Contractor if space temperature exceeds 95F.

D. EF-5,6 - Fans shall be enabled by existing lighting occupancy sensor.

3.06 TERMINAL HEATING EQUIPMENT CONTROL

A. Cabinet unit heater: Space thermostat shall open 2-way zone valve. Integral aquastat in heater shall enable fan when there is flow of hot water through the coil.

B. Finned-tube Radiation: Space thermostat shall open 2-way zone valve.

**END OF SECTION 23 09 93**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Radiant floor heating systems using cross-linked polyethylene (PEX) tubing and appropriate fittings.

1.03 RELATED SECTIONS

A. Section 03 30 00 - Cast-in-Place Concrete.

1.04 REFERENCES

A. General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to the extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.

B. Certified to ASTM International by NSF:
   1. ASTM F876 Standard Specification for Cross-linked Polyethylene (PEX) Tubing.
   2. ASTM F877 Standard Specification for Cross-linked Polyethylene (PEX) Plastic Hot-and Cold-Water Distribution Systems.

C. Certified to ASTM International, UL, NFPA and ULC by Intertek:
   1. ASTM E84, Standard Test Method for Surface Burning Characteristics of Test Materials.
   2. ASTM E119, UL 263 and NFPA 251 Fire Tests of Building Construction and Materials.

D. Certified to International Code Council (ICC) by NSF:
   1. International Mechanical Code (IMC)
   2. International Building Code (IBC)

E. German Institute for Standards (Deutsches Institut fur Normung e.V., DIN):
   1. DIN 4726 Pipelines of Plastic Materials Used in Warm Water Floor Heating Systems; General Requirements

F. International Association of Plumbing and Mechanical Officials (IAPMO):
   1. Certificate of Listing

G. National Sanitary Foundation (NSF) International:
   1. NSF - RFH (Radiant Floor Heating)

H. Plastics Pipe Institute (PPI)
   1. Technical Report TR - 3 Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials
   2. Technical Report TR - 4 Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Piping and Fitting Compounds

1.05 SYSTEM DESCRIPTION

A. Design Requirements:
   1. Cross-linked Polyethylene Tubing (PEX): Standard Grade hydrostatic pressure ratings from Plastics Pipe Institute in accordance with TR-3 as listed in TR-4. The following three standard-grade hydrostatic ratings are required:
      a. 200 degrees F (93 degrees C) at 80 psi (551 kPa).
      b. 180 degrees F (82 degrees C) at 100 psi (689 kPa).
      c. 73.4 degrees F (23 degrees C) at 160 psi (1102 kPa).

B. Performance requirements: Provide Hydronic system that is manufactured, fabricated and installed to comply with regulatory agencies and authorities with jurisdiction, and maintain performance criteria stated by the tubing manufacturer without defects, damage, or failure.

1. Cross-linked Polyethylene Tubing (PEX):
    a. Show compliance with ASTM F877
    b. Show compliance with DIN 4726 regarding oxygen diffusion concerns where applicable.
    c. Show compliance with NFPA 90A requirements of flame spread/smoke development rating of 25/50 in accordance with ASTM E84 through certification listings with Intertek.
        1) Show compliance with ASTM E119, UL 263 and NFPA 251.

1.06 SUBMITTALS

A. See Section 01 33 00 - Submittial Procedures, for submittal procedures.

B. Product Data: Submit manufacturer's product submittal data and installation instructions for each product.

C. Shop Drawings - Hydronic System
    1. Provide engineering analysis using manufacturer's proprietary software.
    2. Provide installation drawings indicating tubing layout, manifold locations, zoning requirements, and manifold schedules with details required for installation of the system.

D. Samples: Submit selection and verification samples of primary materials.

E. Documentation:
    1. Provide manufacturer's detailed instructions for site preparation and product installation.
    2. Provide documentation indicating the installer is trained to install the manufacturer's products, as needed.

F. Quality Assurance and Control Submittals:
    1. Upon request, submit test reports from recognized testing laboratories.

G. Closeout Submittals - Submit the following:
    1. Warranty documents specified
    2. Operation and maintenance data
    3. Manufacturer's field reports as specified in this document
    4. Final as-built tubing layout drawing

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications:
    1. Manufacturer shall have a minimum of ten years experience in similar systems.
    2. Manufacturer shall provide products of consistent quality in appearance and physical properties.
    3. Manufacturer shall use the highest quality products in the production of systems and components referenced in this document.
    4. Materials shall be from a single manufacturer to ensure consistent quality and compatibility.

B. Installer Qualifications:
    1. Use and installer with demonstrated experience on projects of similar size and complexity and/or documentation proving successful completion of familiarization training hosted/approved in writing by the system manufacturer.

C. Certifications: Provide letters of certification as follows:
    1. Installer employs skilled workers holding a trade qualification license or equivalent, or apprentices under the supervision of a licensed trades person.

D. Regulatory Requirements and Approvals - Hydronic Systems: Provide a radiant system that complies with the following requirements:
    1. International Code Council (ICC):
        a. International Mechanical Code (IMC)
        b. International Building Code (IBC)
        c. ICC Evaluation Service (ES) Evaluation Report No. ESR 1155

E. Pre-installation meetings
   1. Verify project requirements, substrate conditions, excavation conditions, system performance requirements, coverings, manufacturer's installation instructions, and warranty requirements.
   2. Review project construction timeline to ensure compliance or discuss modifications as required.
   3. Coordinate with other trade representatives to verify areas of responsibility.
   4. Establish the frequency (during construction phase of the project) the engineer intends for site visits and inspections by the manufacturer's representative.

F. Mock-up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
   1. Finish areas designated by Architect.
   2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
   3. Refinish mock-up area as required to produce acceptable work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Division 1 Product Requirements Section.

B. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.

C. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

D. Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer:
   1. Store tubing in cartons or under cover to avoid dirt or foreign material from entering the tubing.
   2. Do not expose tubing to direct sunlight for more than 30 days. If construction delays are encountered, cover the tubing that is exposed to direct sunlight.

1.09 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

B. Morter-set Systems: Mortar shall cure for 25 days (or time specified by mortar manufacturer) prior to starting heating systems.

1.10 WARRANTY

A. See Section 017700 - Closeout Procedures, for additional warranty requirements.

B. Manufacturer's Warranty - Hydronic Systems
   1. Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official.
   2. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under contract documents.
      a. Warranty covers the repair or replacement of any tubing or fittings proven defective.
      b. Warranty may transfer to subsequent owners.
      c. Warranty Period for Tubing shall be minimum 25-year, non-prorated warranty against failure due to defect in material or workmanship, beginning with date of substantial completion.
      d. Warranty Period for Manifolds and Fittings shall be minimum 2-year, non-prorated warranty against failure due to defect in material or workmanship, beginning with date of substantial completion.

1.11 SYSTEM START-UP

A. Do not start the system for a minimum of 25 days or as specified by mortar, concrete and/or covering manufacturer as applicable.

B. Verify all electrical components are installed per local and National Electrical Code (NEC) prior to start-up.

1.12 OWNER'S INSTRUCTIONS

A. Instruct Owner about operation and maintenance of installed system.

B. Provide Owner with manufacturer's installation instructions for installed components within the system.

C. Provide Owner with all operating instructions/documents for sensors and controls.

D. Provide Owner with copies of any detailed layout drawings and photos of installed product before coverings are installed.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Watts Radiant (Radiant PEX+): www.wattsradiant.com

2.02 PRODUCT CHARACTERISTICS

A. Material:
   1. Cross-linked polyethylene (PEX)
   2. Manufactured by PEX-a or PEX-b (Engle or Silane) method to ensure the highest level of oxidation protection.

B. Material Standard:
   1. Manufactured in accordance with ASTM F876 and ASTM F877
   2. Tested for compliance by an independent third-party agency.

C. Pressure Ratings:
   1. Standard Grade hydrostatic design
   2. Pressure ratings as issued by the Plastics Pipe Institute (PPI), a division of the Society of the Plastics Industry (SPI).

D. Temperature/Pressure Ratings: shall be capable of withstanding temperatures of:
   1. 73.4°F (23°C) at 160 psi (1.10 MPa)
   2. 180°F (82.2°C) at 100 psi (0.69 MPa)
   3. 200°F (93.3°C) at 80 psi (0.55 MPa).

E. Minimum Bend Radius (Cold Bending):
   1. No less than six times the outside diameter.
   2. Use the tubing manufacturer's bend supports if radius is less than stated.

F. Barrier Tubing Type:
   1. Oxygen Diffusion Barrier
      a. Tubing has an oxygen diffusion barrier that shall not exceed an oxygen diffusion rate of 0.10 g/cubic meter (.000062 lb/cu. ft.) per day at 104 degrees F (40 degrees C) water temperature in accordance with German DIN 4726.
      b. Tubing also adds a protective polypropylene layer to the outside of the EVOH barrier.
   2. Nominal Inside Diameter: Provide tubing with nominal inside diameter in accordance with ASTM F876, as indicated:
      a. 5/8 inch (15.88 mm)

2.03 MANIFOLDS AND FITTINGS

A. Manifolds (Stainless Steel)
   1. For system compatibility, use Stainless Steel manifolds offered by the respective tubing manufacturer.

2. Manifolds shall provide individual flow control for each loop of the manifold through valve actuators available from the manifold supplier.
3. Manifolds shall feature manual flow balancing capability within the manifold body for balancing unequal loop lengths across the manifold. Balance valves shall not be ball valves.
4. Manifolds accommodate PEX tubing.
5. Each manifold location shall have the ability to vent air manually from the system.
6. Stainless Steel Manifolds
   a. Heavy-duty, DIN Standard, 304 stainless steel
   b. Matching fittings and accessories are made of solid brass and are heavily plated with nickel to match the appearance of the manifold trunk.
   c. Internal balancing valves
   d. 0 - 2½ gpm (0 - 0.16 L/sec)flow meters
   e. Manifold brackets
   f. All connections are BSP (British Standard Pipe) or straight thread and require the use of the included gasket.
   g. 2” (54 mm) OC circuit spacing
   h. 12 gpm (.75 L/sec) maximum flow rate
   i. 194°F (90°C) maximum operating temperature
   j. 87 psi (600 kPa) maximum operating pressure
   k. 2½ gpm (0.16 L/sec) per circuit maximum flow rate

B. Fittings
   1. For system compatibility, use fittings offered by the tubing manufacturer.
      a. The fitting assembly shall comply with ASTM F877 and CAN/CSA B137.5 requirements.
      b. Fittings shall be designed to work with either ASTM F1807 CrimpRings or ASTM F2098 CinchClamps or a Compression ferrule, and are designed to be used with ASTM F876 (SDR-9) rated PEX tubing.
      c. Available connections:
         1) Sweat
         2) NPT
         3) BSP
      d. Material:
         1) UNS 31400 Copper Alloy
         2) UNS 36000 Copper Alloy
         3) UNS 37700 Copper Alloy

PART 3EXECUTION

3.01 EXAMINATION

A. Site Verification of Conditions:
   1. Verify that site conditions are acceptable for installation of the system. Refer to manufacturer's installation manual for information.
   2. Do not proceed with installation of the system until unacceptable conditions are corrected.

3.02 INSTALLATION OF FLOOR HEATING SYSTEMS

A. Comply with manufacturer's product data, including product technical bulletins, installation instructions and design drawings, including the following:
   1. Installation manuals
   2. Design software engineering and analysis

B. Slab-On-Grade Installation:
   1. Fasten the tubing to the flat mesh or reinforcing bar in accordance with the tubing manufacturer's installation recommendations.

2. Use closer tubing on-center distances along exterior walls. Increase tubing on-center distances as the installation moves away from the exterior wall as determined by manufacturer analysis.
3. Install tubing at a consistent depth below the surface elevation. Ensure sufficient clearance to avoid control joint saw cutting.
4. Where tubing crosses metal expansion joints in the concrete, ensure the tubing passes below the joints or is sleeved through the joint.

3.03 FIELD QUALITY CONTROL AND TESTING

A. Site tests:
   1. To ensure system integrity, pressure test the system before covering tubing in concrete or when other trades are working in the vicinity of the tubing.
   2. Test all electrical controls in accordance with respective installation manuals.

3.04 SYSTEM ADJUSTING

A. Balancing Across Manifold: Balance all loops across each manifold for equal flow resistance based on actual loop lengths and total manifold flow.

B. Balancing between manifolds is accomplished with a flow control device installed on the return piping leg from each manifold when direct return piping is used for the supply and return mains or the circuits deviate by more than 10%.

3.05 CLEANING

A. Remove temporary coverings and protection of adjacent work areas.

B. Repair or replace damaged installed products.

C. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance.

D. Remove construction debris from project site and legally dispose of debris.

3.06 DEMONSTRATION

A. Demonstrate operation of system to Owner or Owner's personnel.

B. Provide Owner or Owner's personnel with manufacturer's installation, operation, and maintenance instructions for installed components within the system.

3.07 PROTECTION

A. Protect installed work from damage caused by subsequent construction activity on the site. Provide Owner with copy of photos and drawings of product locations to assist.

**END OF SECTION 23 21 12**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Hydronic system requirements.

B. Heating water piping, above grade.

C. Pipe and pipe fittings for:
   1. Heating water piping system.
   2. Equipment drains and overflows.

D. Pipe hangers and supports.

E. Unions, flanges, mechanical couplings, and dielectric connections.

F. Valves:
   1. Ball valves.

1.03 RELATED REQUIREMENTS

A. Section 232114 - Hydronic Specialties.

1.04 REFERENCE STANDARDS

A. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings 2018.

B. ASME B31.9 - Building Services Piping 2020.

C. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2001 (R2005).

D. ASME B31.9 - Building Services Piping; The American Society of Mechanical Engineers; 2008 (ANSI/ASME B31.9).

E. ASTM B32 - Standard Specification for Solder Metal 2020.

F. ASTM B88 - Standard Specification for Seamless Copper Water Tube 2020.

G. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 2015, with Editorial Revision (2018).

H. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series) 2020.

I. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40 2017.

J. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80 2020.

K. ASTM D2855 - Standard Practice for the Two-Step (Primer & Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets 2020.

L. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2018.

1.05 SUBMITTALS

A. See Section 01 33 00 - Submittial Procedures, for submittal procedures.

B. Product Data: Include data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.

C. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

D. Project Record Documents: Record actual locations of valves.

E. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

F. Grooved joint couplings, fittings, valves, amd specialties shall be shown on product submittals and shall be specifically identified with the applicable Victaulic style or series designation.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum five years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified in this sectionwith minimum five years of experience.

1.07 REGULATORY REQUIREMENTS

A. Conform to ASME B31.9 code for installation of piping system.

B. Provide certificate of compliance from authority having jurisdiction, indicating approval of welders.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.09 WARRANTY

A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

PART 2 PRODUCTS

2.01 HYDRONIC SYSTEM REQUIREMENTS

A. Comply with ASME B31.9 and applicable federal, state, and local regulations.

B. Piping: Provide piping, fittings, hangers and supports as required, as indicated, and as follows:
   1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
   2. Use non-conducting dielectric connections whenever jointing dissimilar metals.
   3. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.
   4. Provide pipe hangers and supports in accordance with ASME B31.9 unless indicated otherwise.

C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.

D. Valves: Provide valves where indicated:
   1. Provide drain valves where indicated, and if not indicated provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use 3/4 inch gate valves with cap.

2.02 HEATING WATER PIPING, ABOVE GRADE

A. Steel Pipe (2.5" and larger): ASTM A53/A53M, Schedule 40, black, using one of the following joint types:
   1. Joints:
      a. 3/4" to 2" - threaded cast iron.

b. 2-1/2" and larger - welded or grooved mechanical joint.

2. Mechanical Joints: Groove pipe per ANSI/AWWA C606.
   a. Rigid Type Couplings: Housing cast with offsetting, angle pattern bolt pads to provide rigidity and system support when hanging in accordance with ANSI B31.1 and B31.9. Victaulic Style 07.
   b. Flexible Type Couplings: Used in locations where vibration attenuation and stress relief are required. Victaulic Style 77
   c. Flanged Adapters: Flat face, for direct connection to ANSI Class 125 or 150 flanged compontents. Victaulic Style 741.

B. Copper Tube (2" and smaller) : ASTM B 88 (ASTM B 88M), Type L (B), drawn.
   1. Solder Joints: ASME B16.22 solder wrought copper fittings.
      a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
   2. Mechanical Joints: Copper press fittings as manufactured by Viega or Rigid Tool Co.
      a. Press fittings: Copper press fittings shall conform to the material and sizing requirements of ASME B16.18 or ASME B16.22. O-rings for copper press fittings shall be EPDM.

2.03 EQUIPMENT/CONDENSATE DRAINS AND OVERFLOWS

A. PVC Pipe: ASTM D1785, Schedule 40, or ASTM D2241, SDR 21 or 26.
   1. Fittings: ASTM D2466 or D2467, PVC.
   2. Joints: Solvent welded in accordance with ASTM D2855.

2.04 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.
   1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.

B. Conform to ASME B31.9.

C. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Carbon steel, adjustable swivel, split ring.

D. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.

E. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

F. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

G. Vertical Support: Steel riser clamp.

H. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and steel support.

I. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

J. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

K. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

L. In grooved installations, use rigid couplings with offsetting angle-pattern bolt pads or with wedge shaped grooves in header piping to permit support and hanging in accordance with ASME B31.9.

2.05 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

A. Unions for Pipe 2 Inches and Under:
   1. Copper Pipe: Bronze, soldered joints.

2.06 BALL VALVES

A. Manufacturers:
   1. Milwaukee Valve Company: www.milwaukeevalve.com.
   2. Substitutions: See Section 016000 - Product Requirements.

B. Up To and Including 2 Inches:
   1. Bronze one piece body, full port, chrome plated brass ball, teflon seats and stuffing box ring, lever handle with balancing stops, solder ends with union.

C. Over 2 Inches:
   1. Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, flanged.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment using jointing system specified.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

E. After completion, fill, clean, and treat systems.

3.02 ABOVE GROUND PIPING

A. Install in accordance with manufacturer's instructions.

B. Install heating water piping to ASME B31.9 requirements.

C. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

D. Route piping in orderly manner, parallel to building structure, and maintain gradient.

E. Install piping to conserve building space and to avoid interfere with use of space.

F. Group piping whenever practical at common elevations.

G. Sleeve pipe passing through partitions, walls and floors.

H. Slope piping and arrange to drain at low points.

I. 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. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
   4. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

J. Provide access where valves and fittings are not exposed.

K. Use eccentric reducers to maintain top of pipe level.

L. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

M. All piping supports shall be secured to the building structure.

N. Install valves with stems upright or horizontal, not inverted. Ball valve operators shall allow for full range of operation.

O. Press Connections:
   1. Copper press fittings shall be made in accordance with the manufacturers installation instructions.
   2. The tubing shall b fully inserted into the fitting and the tube marked at the shoulder of the fitting.
   3. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting.
   4. The joints shall be pressed using the tool approved by the manufacturer.

3.03 SCHEDULES

A. Hanger Spacing for Copper Tubing.
   1. 1/2 inch and 3/4 inch: Maximum span, 5 feet; minimum rod size, 1/4 inch.
   2. 1 inch: Maximum span, 6 feet; minimum rod size, 1/4 inch.
   3. 1-1/2 inch and 2 inch: Maximum span, 8 feet; minimum rod size, 3/8 inch.

B. Hanger Spacing for Steel Piping.
   1. 2-1/2 inches: Maximum span, 11 feet; minimum rod size, 3/8 inch.
   2. 3 inches: Maximum span, 12 feet; minimum rod size, 3/8 inch.

C. Hanger Spacing for Plastic Piping.
   1. 1/2 inch: Maximum span, 42 inches; minimum rod size, 1/4 inch.
   2. 3/4 inch: Maximum span, 45 inches; minimum rod size, 1/4 inch.
   3. 1 inch: Maximum span, 51 inches; minimum rod size, 1/4 inch.
   4. 1-1/4 inches: Maximum span, 57 inches; minimum rod size, 3/8 inch.

**END OF SECTION 23 21 13**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Piping.

B. Refrigerant.

1.03 RELATED REQUIREMENTS

A. Section 23 81 27 - Small Split-System Heating and Cooling.

1.04 REFERENCE STANDARDS

A. ASHRAE Std 15 - Safety Standard for Refrigeration Systems and Designation and Classification of Refrigerants 2019, with Errata (2020).

B. ASHRAE Std 34 - Designation and Safety Classification of Refrigerants 2019.

C. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings 2018.

D. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes 2018.

E. ASME B31.5 - Refrigeration Piping and Heat Transfer Components 2020.

F. ASME B31.9 - Building Services Piping 2020.

G. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service 2020.

H. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding 2011 (Amended 2012).

I. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2018.

1.05 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

B. Provide pipe hangers and supports in accordance with ASME B31.5 unless indicated otherwise.

1.06 SUBMITTALS

A. See Section 01 33 00 - Submittial Procedures, for submittal procedures.

B. Product Data: Provide general assembly of specialties, including manufacturers catalogue information. Provide manufacturers catalog data including load capacity.

C. Shop Drawings: Indicate schematic layout of system, including equipment, critical dimensions, and sizes.

D. Design Data: Submit design data indicating pipe sizing. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

E. Test Reports: Indicate results of leak test, acid test.

F. Manufacturer's Installation Instructions: Indicate support, connection requirements, and isolation for servicing.

G. Project Record Documents: Record exact locations of equipment and refrigeration accessories on record drawings.

H. Maintenance Data: Include instructions for changing cartridges, assembly views, spare parts lists.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum ten years of documented experience.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store piping and specialties in shipping containers with labeling in place.

B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.

C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

PART 2 PRODUCTS

2.01 PIPING

A. Copper Tube to 7/8 inch OD: ASTM B88 (ASTM B88M), Type K (A), annealed.
   1. Fittings: ASME B16.26 cast copper.
   2. Joints: Flared.

B. Pipe Supports and Anchors:
   1. Conform to ASME B31.5.
   2. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
   3. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
   4. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.02 REFRIGERANT

A. Refrigerant: R410a, as defined in ASHRAE Std 34.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt on inside and outside before assembly.

3.02 INSTALLATION

A. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.

B. Install piping to conserve building space and avoid interference with use of space.

C. Group piping whenever practical at common elevations and locations.

D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

E. 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.

F. Pipe Hangers and Supports:
   1. Install in accordance with ASME B31.5.
   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. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
7. Provide copper plated hangers and supports for copper piping.

G. Provide clearance for installation of insulation and access to valves and fittings.

H. Flood piping system with nitrogen when brazing.

I. Where pipe support members are welded to structural building frame, brush clean, and apply one coat of zinc rich primer to welding.

J. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.

K. Fully charge completed system with refrigerant after testing.

3.03 FIELD QUALITY CONTROL

A. Test refrigeration system in accordance with ASME B31.5.

B. Pressure test system with dry nitrogen. Test to no leakage.

3.04 SCHEDULES

A. Hanger Spacing for Copper Tubing.
1. 1/2 inch, 5/8 inch, and 7/8 inch OD: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. 1-1/8 inch OD: Maximum span, 6 feet; minimum rod size, 1/4 inch.

**END OF SECTION 23 23 00**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Metal ductwork.

B. Nonmetal ductwork.

C. Duct cleaning.

1.03 RELATED REQUIREMENTS

A. Section 230713 - Duct Insulation: External insulation and duct liner.

B. Section 233300 - Air Duct Accessories.

C. Section 233700 - Air Outlets and Inlets.

1.04 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.

B. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2018.

C. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems 2018.

D. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2005 (Revised 2009).

E. SMACNA (KVS) - Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines 2001.

F. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors current edition, including all revisions.

1.05 PERFORMANCE REQUIREMENTS

A. No variation of duct configuration or sizes permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.06 SUBMITTALS

A. See Section 01 33 00 - Submittial Procedures, for submittal procedures.

B. Product Data: Provide data for duct materials, duct sealants, duct connections, duct sealants, and duct sealants.

C. Shop Drawings: Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work for all systems. Layout drawings shall be a minimum of 1/4" = 1'-0".

D. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum ten years of documented experience.

1.08 FIELD CONDITIONS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

PART 2 PRODUCTS

2.01 DUCT ASSEMBLIES

A. Materials:
   1. Galvanized Steel Ducts: Hot-dipped galvanized steel sheet, ASTM A 653/A 653M FS Type B, with G90/Z275 coating. Minimum 26ga. (0.019") thickness.

B. Insulated Flexible Ducts:
   1. Manufacturers:
      a. Quietflex, Hart and Cooley, Therma Flex
      b. Substitutions: See Section 01 6000 - Product Requirements.
   2. UL 181, Class 1, polyethylene core supported by helically wound spring steel wire; R-6 fiberglass insulation; polyethylene vapor barrier film, GREENGUARD certified.
      a. Pressure Rating: 10 inches WG positive and 1.0 inches WG negative.
      b. Maximum Velocity: 4000 fpm.
      c. Temperature Range: -20 degrees F to 210 degrees F.

2.02 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards and as indicated.

B. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

C. Provide air foil turning vanes when rectangular elbows must be used.

D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

E. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA HVAC Duct Construction Standards.

F. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Joints shall be minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.

G. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.

H. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA HVAC Duct Construction Standards.

B. Install in accordance with manufacturer's instructions.

C. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.

D. Install and seal metal and flexible ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

E. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

F. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

G. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow.

H. Use double nuts and lock washers on threaded rod supports.

3.02 CLEANING

A. Clean duct systems with high power vacuum machines. Protect equipment that could be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes.

3.03 SCHEDULES

A. Ductwork Material:
   1. Low Pressure Supply (System with Cooling Coils): Galvanized Steel.
   2. Return and Relief: Galvanized Steel.
   3. General Exhaust: Galvanized Steel.
   4. Outside Air Intake: Galvanized Steel.

B. Ductwork Pressure Class:
   1. Supply : 1 inch.
   2. Return: 1 inch.
   3. General Exhaust: 1 inch.

**END OF SECTION 23 31 00**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Air turning devices/extractors.

B. Duct access doors.

C. Duct test holes.

D. Flexible duct connections.

E. Volume control dampers.

1.03 RELATED REQUIREMENTS

A. Section 233100 - HVAC Ducts and Casings.

1.04 REFERENCE STANDARDS

A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2018.

B. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2005 (Revised 2009).

C. UL 33 - Safety Heat Responsive Links for Fire-Protection Service Current Edition, Including All Revisions.

D. UL 555 - Standard for Fire Dampers Current Edition, Including All Revisions.

1.05 SUBMITTALS

A. See Section 01 33 00 - Submittial Procedures, for submittal procedures.

B. Product Data: Provide for shop fabricated assemblies including volume control dampers, duct access doors, duct test holes, and hardware used.

C. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers, duct access doors, and duct test holes.

D. Manufacturer's Installation Instructions: Provide instructions for fire dampers.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum ten years of documented experience.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 AIR TURNING DEVICES/EXTRACTORS

A. Manufacturers:
   1. Krueger: www.krueger-hvac.com/#sle.
   2. Ruskin Company: www.ruskin.com/#sle.
   3. Titus: www.titus-hvac.com/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Multi-blade device with radius blades attached to pivoting frame and bracket, steel construction, with push-pull operator strap.

2.02 FLEXIBLE DUCT CONNECTIONS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards and as indicated.

B. Flexible Duct Connections: Fabric crimped into metal edging strip.
   1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.

a. Net Fabric Width: Approximately 2 inches wide.
2. Metal: 3 inches wide, 24 gage thick galvanized steel.

2.03 VOLUME CONTROL DAMPERS

A. Manufacturers:
1. Greenheck, Inc: www.greenheck.com
2. Nailor Industries Inc: www.nailor.com/#sle.
3. Ruskin Company: www.ruskin.com/#sle.
4. Substitutions: See Section 016000 - Product Requirements.

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards and as indicated.

C. Splitter Dampers:
1. Material: Same gage as duct to 24 inches size in either direction, and two gages heavier for sizes over 24 inches.
2. Blade: Fabricate of single thickness sheet metal to streamline shape, secured with continuous hinge or rod.
3. Operator: Minimum 1/4 inch diameter rod in self aligning, universal joint action, flanged bushing with set screw .

D. End Bearings: Except in round ducts 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.

E. Quadrants:
1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards. Refer to Section 233100 for duct construction and pressure class.

B. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.

C. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment; see Section 220548.

D. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.

E. Use splitter dampers only where indicated.

F. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

**END OF SECTION 23 23 00**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Diffusers.

B. Registers/grilles.

1.03 RELATED REQUIREMENTS

A. Section 09 91 00 - Painting - Painting of ducts visible behind outlets and inlets.

B. Section 23 05 48 - Vibration and Seismic Controls for HVAC Systems..

C. Section 23 31 00 - HVAC Ducts and Casings.

D. Section 23 33 00 - Air Duct Accessories.

1.04 REFERENCE STANDARDS

A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating 2015.

B. ARI 890 - Standard for Air Diffusers and Air Diffuser Assemblies; Air-Conditioning and Refrigeration Institute; 2001.

C. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Inlets 2006 (Reaffirmed 2011).

D. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2005 (Revised 2009).

1.05 SUBMITTALS

A. See Section 01 33 00 - Submittial Procedures, for submittal procedures.

B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

1.06 QUALITY ASSURANCE

A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.

PART 2 PRODUCTS

2.01 DIFFUSERS, GRILLES AND REGISTERS

A. MANUFACTURERS:
   1. Krueger: www.krueger-hvac.com/#sle.
   2. Anemostat Air Products; www.anemostat.com
   3. Price Industries: www.price-hvac.com/#sle.
   4. Titus: www.titus-hvac.com/#sle.
   5. Metalaire: www.metalaire.com

B. Refer to drawings for type, fabrication, frame and color.

2.02 DIFFUSERS, GRILLES AND REGISTERS

A. Refer to drawings for type, fabrication, frame and color.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.

C. Install diffusers to ductwork with air tight connection.

D. Paint ductwork visible behind air outlets and inlets matte black. Refer to Section 099100.

**END OF SECTION 23 37 00**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Boilers.

B. Controls and boiler trim.

C. Boiler flue venting.

D. Condensation neutralizing system.

1.03 RELATED SECTIONS

A. Section 23 21 13 - Hydronic Piping.

1.04 REFERENCES

A. ANSI Z21.13 - American National Standard for Gas-Fired Low-Pressure Steam and Hot Water Boilers; 2004 (addendum 2005).

B. ASME (BPV IV) - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; The American Society of Mechanical Engineers; 2004.

C. HI BTS - Testing and Rating Standard for Commercial Boilers; The Hydronics Institute; 2007.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association; 2003.

E. Connecticut General Statute 29-329-3

F. NFPA 70 - National Electrical Code; National Fire Protection Association; 2005.

1.05 PERFORMANCE REQUIREMENTS

A. Performance rating shall be in accordance with Hydronics Institute Testing and Rating Standard for Commercial Boilers.

B. Refer to the schedule on the plans for project specific performance requirements.

1.06 SUBMITTALS

A. See Section 01 33 00 - Submittial Procedures, for submittals procedures.

B. Product Data: Provide data indicating general assembly, components, controls, safety controls, and wiring diagrams with electrical characteristics and connection requirements, and service connections.

C. Manufacturer's Instructions: Indicate assembly, support details, connection requirements, and include start up instructions.

D. Manufacturer's Inspection Report: Submit authorized boiler inspection prior to shipment.

E. Manufacturer's Field Reports: Indicate specified performance and efficiency has been met or exceeded. Provide combustion test which shall include boiler firing rate, over fire draft, gas flow rate, heat input, burner manifold gas pressure, percent carbon monoxide (CO), percent oxygen (O), percent excess air, flue gas temperature at outlet, ambient temperature, net stack temperature, percent stack loss, percent combustion efficiency, and heat output.

F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Carmel Fire Department's name and registered with manufacturer.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum twenty years of documented experience.

1.08 REGULATORY REQUIREMENTS

A. Conform to ASME (BPV IV) for construction of boilers.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.09 DELIVERY, STORAGE, AND PROTECTION

A. Protect boilers from damage by leaving factory inspection openings and shipping packaging in place until final installation.

1.10 WARRANTY

A. Provide a twelve (12) year limited warranty on the heat exchanger and three (3) year limited warranty on the blower motor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Heat Transfer Products

2.02 GENERAL

A. Substitutions shall be considered on their ability to fit the design documents without substantial modification or redesign of system schematic and the ability to meet the design temperature schedule. All requests for alternate consideration shall require a full set of plans indicating details, locations, sizing, integration into existing mechanical room and control sequence for engineers review. All boiler manufacturers shall have a minimum of 5 years field experience and operation in similar low temperature systems for consideration.

2.03 CONSTRUCTION

A. Construction: Boilers shall be natural gas fired, condensing firetube design with a modulating forced draft power burner and positive pressure vent discharge.

2.04 BOILER SIZE AND RATINGS

A. Boiler size and rating shall be as indicated in the schedule on the plans.

B. Boiler rating shall be based on firing natural gas with a rating of 1000 Btu's per cubic foot.

C. Output shall vary depending on return water temperature.

2.05 BOILER FLUE VENTING

A. The boiler shall be A.G.A./C.G.A. Approved as a Direct Vent Boiler, with conventional chimney or stack not required. The boiler shall have the combustion air intake supply ducted in from the outside. Intake piping to be PVC piping or equal. Exhaust venting shall be constructed of Polypropylene piping. Intake and exhaust piping is to be furnished by the contractor.

2.06 GAS FIRED CONDENSING BOILER

A. The boiler shall bear the ASME "H" Stamp with a working pressure of 160 psi and shall be National Board listed.

B. The boiler shall be a sealed combustion system, taking outside air for combustion and exhausting flue gas with stainless steel adpater for PVC. The boiler's total combined equivanent length, including fittings allowances for both intake and exhaust, shall not exceed 200 feet. The vent connectors shall be located on the top of the boiler.

C. The combustion chamber shall be designed to drain condensate to the back of the unit, where a condensate collection container will contain a flow switch to monitor condensate flow and have a cleanout for periodic maintenance.

D. The boiler's heat exchanger shall be constructed of 316L stainless steel, built and tested in accordance with ANSI Z21.13b-2002. The boiler shall be UL listed and shall exceed minimum efficiency requirements of ASHRAE 103 with an AFUE rating of up to 98%.

2.07 BOILER CONTROLS

A. The boiler shall have an integrated digital control system utilizing an algorithm to fully adjust the firing rate while maintaining the desired output temperature of the boiler. Combustion gas and air are premixed prior to introduction to the stianless steel sintered burner using a low voltage gas valve and variable speed fan. The control uses pulse width moduation to send a command signal to the fan which adjusts the volume of combustion air and gas supplied to the burner.

B. The control is cooected to a digital 2 line 20 character per line LCD display that provides information on the operation of the boiler. The display will show a fault code and narrative to aid in troubleshooting and also provide a means for adjustment of the operating temperature ranging from 50 - 190 degrees and differential temperature ranging from 5 - 30 degrees. The control shall be set up to monitor outdoor temperature through an outdoor sensor and provide outdoor reset shutdown capability. The control shall feature a dry contact output to connect to an optional alarm monitoring device. The control shall also regulate up to eight (8) boilers through a cascade system functioning as one boiler system. This allows for greater turn down ratios and systematic control to maximize efficiency. The control shall have a 0-10 volt input available to connectto building management system.

C. The boiler shall also have the ability to accept optional controls such as a U.L. 353 Compliant Low Water Cut Off and Manual Reset High Limit Temperatue Switch.

2.08 CONDENSATION NEUTRALIZING SYSTEM

A. PRODUCT
   1. Furnish and install fireside condensate neutralizing tubes for each boiler condensate drain and all flue pipe condensate drains.

B. PIPING
   1. All piping shall be PVC and supplied /installed by the contractor. All PVC joints shall be glued in place and secured with tie wraps.

C. OPERATION AND MAINTENANCE
   1. The contractor shall inform the owner of any maintenance or scheduled rechagge of the tube's limestone aggregate as described in the manufacturer's I and O manual.

2.09 BOILER TRIM

A. Low Water Cut-off: With drain valve and manual reset to automatically prevent burner operation whenever boiler water falls below safe level.

B. Temperature Controls:
   1. Manual reset type shall control burner to prevent boiler water temperature from exceeding safe system water temperature.

C. ASME rated pressure relief valves.

D. Combination pressure and thermometer gage.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install boiler and provide connection of natural gas service in accordance with requirements of the gas code and applicable codes.

C. Provide piping connections and accessories as indicated.

D. Pipe relief valves to nearest floor drain.

3.02 STARTING EQUIPMENT

A. An authorized service technician shall start, test, and adjust the boilers and furnish a start-up report attesting to a successful light-off for review by the engineer. Start-up report shall include a print out from an ECOM combustion analyzer for low, medium, and high fire. Gas analysis must include the following:

1. Air Temperature
2. Gas temperature
3. Oxygen as a %
4. CO as a %
5. NO as ppm
6. NO2 as ppm
7. NOx as ppm
8. CO2 as a %
9. Efficiency as a %
10. Losses as a %
11. Excess air as a %

B. This print out shall be submitted with the start-up report for review, and approval by the mechanical engineer.

3.03 TRAINING

A. Provide one day training for the operating personnel to be performed at the jobsite. Contractor shall coordinate with the manufacturer's representative for start-up and training services.

**END OF SECTION 23 52 40**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including GeneralConditions and Division 01 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Air cooled outdoor units.

B. Indoor ductless units.

C. Controls.

1.03 RELATED REQUIREMENTS

A. Section 23 23 00 - Refrigerant Piping.

1.04 REFERENCE STANDARDS

A. AHRI 210/240 - Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment 2008, Including All Addenda.

B. AHRI 270 - Sound Performance Rating of Outdoor Unitary Equipment 2015.

C. AHRI 520 - Performance Rating of Positive Displacement Condensing Units 2004.

D. ASHRAE Std 15 - Safety Standard for Refrigeration Systems and Designation and Classification of Refrigerants 2019, with Errata (2020).

E. ASHRAE Std 23.1 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Condensing Units that Operate at Subcritical Pressures of the Refrigerant 2019.

F. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. ASHRAE Std 90.2 - Energy-Efficient Design of Low-Rise Residential Buildings 2018.

H. NEMA MG 1 - Motors and Generators 2018.

I. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2018.

J. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems 2018.

K. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical Current Edition, Including All Revisions.

1.05 SUBMITTALS

A. See Section 01 33 00 - Submittial Procedures, for submittal procedures.

B. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.

C. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.

D. Design Data: Indicate refrigerant pipe sizing.

E. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.

F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

G. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Carmel Fire Department s name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum twenty years of documented experience.

B. Units shall be tested by a nationally recognized testing laboratory and bear the ETL Label.

C. Units shall be rated in accordance with ARI 210 and bear the ARI Certification Label.

D. Units shall be manufactured in a factory that is ISO 9001 and ISO 14001 registered.

1.07 WARRANTY

A. See Section 017700 - Closeout Procedures, for additional warranty requirements.

B. The units shall be covered by the manufacturer's limited warranty for a period of one (1) year from the date of installation. In addition the compressor shall have a limited warranty for a period of six (6) years from the date of installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fujitsu

B. Substitute equipment may be considered for approval that includes at a minimum:
   1. R-410a refrigerant
   2. Inverter compressor technology.
   3. Ability to meet all other provisions of the specifications herein and as specified on the drawings.

2.02 INDOOR UNITS FOR DUCTLESS SYSTEMS

A. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of wall or ceiling mounted cabinet, supply fan, evaporator coil, washable filter, and controls; wired for single power connection with control transformer.

B. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.
   1. Construction and Ratings: In accordance with AHRI 210/240 and UL listed.

2.03 OUTDOOR UNITS

A. Outdoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting cabinet, with compressor and condenser.
   1. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Std 23 and UL listed.

B. Compressor: DC rotary compressor with variable compressor speed inverter, resiliently mounted integral with condenser, with positive lubrication, crankcase heater, high pressure control, motor overload protection, service valves and drier. Provide time delay control to prevent short cycling.

C. Air Cooled Condenser: ARI 520; Aluminum fin and copper tube coil, with direct drive axial propeller fan resiliently mounted, ABS plastic fan guard.

D. Accessories: Filter drier, high pressure switch (manual reset), low pressure switch (automatic reset), service valves and gage ports, thermometer well (in liquid line).
   1. Provide thermostatic expansion valves.
   2. Provide heat pump reversing valves (where specified)

E. Operating Controls:
   1. Control by room thermostat to maintain room temperature setting.
   2. The control system shall consist of two(2) microprocessors, one on each indoor unit and outdoor unit. The microprocessor located in the indoor unit shall have the capability of monitoring return air temperature and indoor coil temperature, receiving and processing

commands from the remote controller and providing emergency operation and controlling the outdoor unit.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrates are ready for installation of units and openings are as indicated on shop drawings.

B. Verify that proper power supply is available and in correct location.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions and requirements of local authorities having jurisdiction.

B. Install in accordance with NFPA 90A and NFPA 90B.

C. Install refrigeration systems in accordance with ASHRAE Std 15.

D. Pipe drain from cooling coils to nearest receptor or to grade.

E. Contractor shall provide additional refrigerant if system volume exceeds pre-charge capacity of outdoor unit.

**END OF SECTION 23 81 27**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

1.02 DESCRIPTION

A. Related Work Specified Elsewhere:
   1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section..
   2. This section applies to certain sections of Division 1, Division 21 "Fire Suppression", Division 22 "Plumbing", Division 23, "Mechanical". This section applies to all sections of Division 26, "Electrical," Division 27 "Communications", Division 28 "Electronic Safety and Security" of this project specification unless specified otherwise in the individual sections.
   3. Temporary Facilities and controls are specified in Section 01 50 00. Cooperate in ensuring adequate protection.
   4. General material, equipment and workmanship standards are specified in Section 01 60 00.
   5. Finished painting is specified in section 09 91 00.
   6. Access doors and panels to be installed in finished surfaces are specified in Section 08 31 13.
   7. Cutting and patching, chases, furred spaces, trenches, covers, pits, foundations and other construction required in conjunction with the work under this Division is specified in Section 01 73 29.

1.03 DRAWINGS AND COORDINATION

A. It is not the intention of the drawings to show every item, piece of equipment and detail. Provide complete, operating systems.

B. Install work as closely as possible to layouts shown on drawings. Modify work as necessary to meet job conditions and to clear other equipment. Consult Architect before making changes which affect the function or appearance of systems.

C. Dimensions, elevations and locations are shown approximately. Verify actual conditions in the field.

D. Owner, Architect, and Engineer reserve the right to order changes in layout of such items as switches, receptacles, and fixtures if such changes do not substantially affect costs and if affected items have not been fabricated or installed.

E. In some cases, drawings are based upon products of one or several manufactures as listed on the Contract Documents. This contractor shall be responsible for modifications made necessary by substitution of products of different manufacturers.

F. Do not install part of a system until all critical components of the system and related systems have been approved. Coordinate parts of systems to ensure proper operation of the entire system.

G. Install products in accordance with manufacturer's written instructions. Notify Engineer if Contract Documents conflict with manufacturer's instructions. Comply with Engineers interpretations.

H. Provide brackets, supports, anchors and frames required for installation of work specified herein.

1.04 CODES AND STANDARDS

A. The Codes and Standards listed below apply to all Work. Where Codes or Standards are mentioned in these Specifications, follow the latest edition or revision.

B. The current adopted editions of the following State or local Codes apply:
   1. All 2020 New York State Building Codes

2. 2018 International Building Code with Amendments
3. 2018 International Fuel Gas Code with Amendments
4. 2018 International Existing Building Code with Amendments
5. 2018 International Mechanical Code with Amendments
6. 2018 International Plumbing Code with Amendments
7. 2017 National Electrical Code (NFPA 70)
8. 2018 International Energy Conservation Code with Amendments
9. 2018 International Residential Code with Amendments
10. 2009 ICC A117.1 Accessible and Usable Buildings and Facilities
11. NECA-1 Good Workmanship In Electrical Construction - latest edition

C. All materials furnished and all work installed shall comply with the rules and recommendations of the NFPA, the requirements of the local utility companies, the recommendations of the fire insurance rating organization having jurisdiction and the requirements of all Governmental departments having jurisdiction.

D. Include in the Work, without extra cost to the Owner, any labor, materials, testing, services, apparatus and Drawings in order to comply with all applicable laws, ordinances, rules and regulations, whether or not shown on Drawings and/or specified.

1.05 PERMITS AND FEES

A. Give all necessary notices, obtain all permits; pay all Government and State sales taxes and fees where applicable, and other costs, including utility connections or extensions in connection with the Work. File all necessary Drawings, prepare all Documents and obtain all necessary approvals of all Governmental and State departments having jurisdiction, obtain all required certificates of inspections for Work and deliver a copy to the Engineer before request for acceptance and final payment for the Work.

1.06 REFERENCES

A. FM P7825 - Approval Guide; Factory Mutual Research Corporation; Current Edition.

B. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association; (and Revision 1,2,3); Current Edition.

C. NEMA ICS 6 - National Electrical Manufacturers Association; Enclosures for Industrial Control and Systems

D. NEMA MG 10 - National Electrical Manufacturers Association; (R 1988) Energy Management Guide for Selection and Use of Polyphase Motors; Current Edition.

E. NEMA MG 11 - National Electrical Manufacturers Association; 1977; (R 1992) Energy Management Guide of Selection and Use of Single-Phase Motors; Current Edition.

F. NFPA 70 - National Electrical Code; National Fire Protection Association; 2017 Edition

G. SSPC-Paint 15 - Steel Joist Shop Paint; Society for Protective Coatings; (Part of Steel Structures Painting Manual, Vol. Two); Current Edition.

H. IEEE 100 - Dictionary of Electrical and Electronics Terms; Current Edition.

I. IBC 2018, Structural Loads, Seismic bracing and restraints.

1.07 DEFINITIONS

A. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

B. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

C. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

D. The word “PROVIDE” as used in these documents and on the plans shall mean furnish (or supply) and install as required for proper operation or use.

E. When in reference to non-electrical work, the term "MECHANICAL" shall be inclusive of Division 21, Division 22, and Division 23.

1.08 EQUIPMENT DEVIATIONS

A. Where the Contractor proposes to deviate (substitute or provide an equivalent) from the equipment or materials as hereinafter specified, he shall do so by making a request in writing within 60 days from the Award of Contract. The Contractor shall state in his request whether it is a substitution or an equivalent to that specified, and the amount of credit involved. A copy of said request shall be included in the Base Bid with manufacturer's equipment cuts.
   1. The Base Product Specification shall be based on using the materials and equipment as specified and scheduled with no exceptions. Equipment Manufacturers Scheduled on Drawings are considered Base Product Specification and any other acceptable manufacturers listed in the specifications is considered an equivalent manufacturer to the Base Product Specification. Unlisted manufacturers are considered a substitution and equipment deviation and subject to the requirements for equipment substitution and deviation. When any alternate manufacturer does not qualify acceptable, as determined by the Engineer, provide the Base Bid manufacturer at no additional cost to Owner.
   2. Where an equivalent manufacturer is listed in the specifications, it may or may not indicate that there is an equal product available. Any products must meet all criteria of the Base Product Specification as determined by the Engineer.

B. Substitutions and Equipment Deviations will not be considered if they have a direct bearing on the changing or revising of Contract Documents or if it involves other Contractor's scope of work or thier equipment or where specifically prohibited. Coordination with all trades is required and must be acceptable to all other involved Contractors.

C. Substitutions may be considered for one of the following:
   1. Substitution for Cause: Changes proposed by the Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of warranty terms.
   2. Substitutions for Convenience: Changes proposed by the Contractor or Owner that are not required in order to meet other Project requirements, but may offer advantage to either the Owner or Contractor.

D. In these Specifications and on the accompanying Drawings, one or more makes of materials, apparatus or appliances may have been specified for use in this installation. This has been done for convenience in fixing the standard of workmanship, finish and design required for installation. In the event that only one (1) manufacturer of a product is specified and it is found that the manufacturer has discontinued the product, the Contractor shall use an acceptable equivalent product that meets the requirements of an equivalent product, as noted below, and has all the features of the originally specified product. The details of workmanship, finish and design, and the guaranteed performance of any material, apparatus or appliance which the Contractor desires to deviate for those mentioned herein shall also conform to these standards.

E. Where no specific make of material, apparatus or appliance is mentioned, any first-class product made by a reputable manufacturer may be submitted for the Engineer's review.

F. Where two or more names are given as equivalents, the Contractor must use the specified item or one of the named equivalents. Where one name only is used and is followed by the words "or acceptable equivalent", the Contractor must use the item named or he may apply for an equipment deviation through the prescribed manner in accordance with this Specification.

G. Equipment, material or devices submitted for review as an "accepted equivalent" shall meet the following requirements:
   1. The equivalent shall have the same construction features such as, but not limited to:
      a. Material thickness, gauge, weight, density, etc.
      b. Welded, riveted, bolted, etc., construction

2. Finish, undercoatings, corrosion protection
3. The equivalent shall perform with the same or better operating efficiency.
4. The equivalent shall have equal or greater reserve capacity.
5. The equivalent shall be locally represented by the manufacturer for service, parts and technical information.
6. The equivalent shall bear the same labels of performance certification as is applicable to the specified item, such as AMCA or ARI labels.

H. Where the Contractor proposes to use an item of equipment other than specified or detailed on the Drawings which requires any redesign of the structure, partitions, foundations, piping, wiring or any other part of the mechanical, electrical, or architectural layout, all such redesign and all new drawings and detailing required therefore shall be prepared by the Designers of Record at the expense of the Contractor and at no additional cost to the Owner.

I. Where such accepted deviation or substitution requires a different quantity and arrangement of piping, ductwork, valves, pumps, insulation, wiring, conduit and equipment from that specified or indicated on the Drawings, the Contractor shall, with the acceptance by the Engineer, furnish and install any such additional equipment required by the system at no additional cost to the Owner, including any costs added to other trades due to the substitution.

J. The Engineer shall determine if an "accepted equivalent" to a manufacturer listed in the Specifications is considered acceptable.

1.09 SUBMITTALS

A. See Section 01 33 00 - Administrative Requirements, for submittal procedures.

B. Provide manufacturer's ORIGINAL printed product data, catalog cuts and description of any special installation procedures. Photocopied and/or illegible product data sheets shall not be acceptable. All product datasheets shall be highlighted or stamped with arrows to indicate the specific components being submitted for approval.

C. Submittals shall include the manufacturer's name, trade name, place of manufacture, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and technical paragraph reference. Submittals shall also include applicable federal, military, industry, and technical society publication references, and years of satisfactory service, and other information necessary to establish contract compliance of each item to be provided. Photographs of existing installations are unacceptable and will be returned without approval.

D. Submittals for each manufactured item shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts. Handwritten and typed modifications and other notations not part of the manufacturer's preprinted data will result in the rejection of the submittal. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified for certificates of compliance.

E. Submit drawings a minimum of 14 inches by 20 inches in size using a minimum scale of 1/8 inch per foot except as specified otherwise. Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

F. Where installation procedures or part of the installation procedures are required to be in accordance with manufacturer's instructions, submit printed copies of those instructions prior to installation. Installation of the item shall not proceed until manufacturer's instructions are received. Failure to submit manufacturer's instructions shall be cause for rejection of the equipment or material.

G. Submit manufacturer's certifications as required for products, materials, finishes, and equipment as specified in the technical sections. Certificates from material suppliers are not

acceptable. Preprinted certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced publications"; or "equal or exceed the service and performance of the specified material." Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance.

H. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), Underwriters Laboratories Inc. (UL), and Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance.

I. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

J. Submittals shall be project specific with all associated options indicated. Generic manufacturer specification sheets or brochurs will be rejected without review.

1.10 QUALITY ASSURANCE

A. Material and Equipment Qualifications
   1. Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

B. Regulatory Requirements
   1. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70.

C. Alternative Qualifications
   1. Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

D. Service Support
   1. The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

E. Manufacturer's Nameplate
   1. Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

F. Modification of References
   1. In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or

words of similar meaning, to mean the Building Official or Inspector and/or Fire Marshal.

G. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

H. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience.

I. Design Seismic bracing and restraints under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in New York State.

J. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.

1.11 COORDINATION WITH OTHER DIVISIONS

A. Carry out all work in conjunction with other trades and give full cooperation in order that all work may proceed with a minimum of delay and interference. Particular emphasis is placed on timely installation of major apparatus and furnishing other Contractors, especially the General Contractor or Construction Manager, with information as to openings, chases, sleeves, bases, inserts, equipment locations, panels, access doors, etc. required by other trades, and to allow for serviceable access to equipment.

B. Mechanical contractors' shall initiate coordination drawings and sections clearly showing how the work is to be installed in relation to the work of other trades, at no extra charge to the Owner. The Contractors' shall prepare coordination drawings at a scale no less than 1/4"=1'-0", showing the work of all trades, including but not limited to, the following: proposed ductwork installation in detail, including ceiling heights, approved structural steel shop drawings, duct heights, access doors, light fixtures, registers and diffusers, sprinkler piping and heads, electrical distribution conduits, wires, panels and any other electrical work which may conflict with the sheet metal ducts or piping, waste and vent piping, water piping, storm piping, and rain leaders. Provide elevation details showing connections and equipment layout and configuration based on approved submittals. Each shall use a different color code. A coordination meeting of all Contractors involved is then to be held and all possible conflicts are to be resolved. All trades shall sign acceptance of the drawings and then shall submit two (2) prints of each drawing to the Engineer for record.

C. Contractors are required to examine all of the Project Drawings and mutually arrange work so as to avoid interference. In general, ductwork, heating piping, sprinkler piping and drainage lines take precedence over water, gas and electrical conduits. The Engineer regarding the arrangement of work, which cannot be agreed upon by the Contractors, will make final decisions. Service of equipment will take precedence.

D. Where the work of the Contractor will be installed in close proximity to or will interfere with work of other trades, assist in working out space conditions to make a satisfactory adjustment.

E. If work is installed before coordinating with other Divisions or so as to cause interference with work of other Sections, the Contractor causing the interference will make necessary changes to correct the condition without extra charge to the Owner.

F. Initial contact and coordination has been conducted with utility entities for the purpose of the preparation of Bid Documents. The Contractor shall coordinate all final specific utility requirements.

1.12 PRE-INSTALLATION MEETING

A. Convene one week before starting work of this section.

1.13 PROJECT CONDITIONS

A. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

B. Sequence installation to conform with the project phasing indicated on the Architectural drawings.

1.14 WARRANTY

A. See Section 017700 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a one year period after Date of Substantial Completion.

1.15 OPERATING INSTRUCTIONS

A. Submit text of posted operating instructions for each system and principal item of equipment as specified in the technical sections. The operating instructions shall include the following:
   1. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
   2. Start up, proper adjustment, operating, lubrication, and shutdown procedures.
   3. Safety precautions.
   4. The procedure in the event of equipment failure.
   5. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

B. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.16 ELECTRICAL REQUIREMENTS

A. Electrical installations shall conform to ANSI C2, NECA-1, NFPA 70, and requirements specified herein.

B. Wiring and Conduit
   1. Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide power wiring and conduit for field-installed equipment, and motor control equipment, the conduit and wiring connecting such assemblies, or other power sources to equipment. Power and Control wiring and conduit shall be provided under Division 26 and shall conform to the requirements of the section specifying the associated equipment.

C. New Work
   1. Provide electrical components of mechanical equipment, such as motors, motor starters, control or push-button stations, float or pressure switches, solenoid valves, integral disconnects, and other devices functioning to control mechanical equipment, as well as control wiring and conduit to conform with the requirements of the section covering the mechanical equipment. Extended voltage range motors shall not be permitted. The interconnecting power wiring and conduit, control wiring and conduit, the motor control equipment and the electrical power circuits shall be provided under Division 26, except internal wiring for components of packaged equipment shall be provided as an integral part of the equipment.
      a. When motors and equipment furnished are larger than sizes indicated, provide any required changes to the electrical service as may be necessary and related work as a part of the work for the section specifying that motor or equipment.

D. Instruction To Owners Personnel
   1. Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated Owner personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Owner for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for

instruction with equipment or system. When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instructions to acquaint the operating personnel with the changes or modifications. Instructions and/or training shall be video taped. Provide the owner with two copies of the video tape prior to project close out.

E. Lockout Requirements
   1. Provide disconnecting means capable of being locked out for machines and other equipment to prevent unexpected startup or release of stored energy in accordance with 29 CFR 1910.147. Mechanical isolation of machines and other equipment shall be in accordance with requirements of Division 23, "Mechanical."

1.17 THROUGH-PENETRATION FIRESTOP SYSTEMS

A. Refer to Division 7 Specification for additional and more specific information.

B. Fire-stopping systems shall be submitted as shop drawing.

C. Penetrations through fire-rated walls, ceiling or floors and penetrations through smoke barriers, smoke resistive construction, and construction enclosing compartmentalized areas involving both empty openings, openings containing penetration items, and openings due to flue decks shall be sealed with a U.L. approved fire-stop fitting classified for an hourly rating equivalent to the fire rating of the wall, ceiling or floor.

D. Thruwall and floor seals shall be used to provide a positive means of sealing pipes or ducts which pass through the concrete foundation of a structure below grade or below ground water level. Seals shall also be used at entry points through concrete walls or floors which must be sealed.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.02 STARTING EQUIPMENT AND SYSTEMS

A. Provide manufacturer's field representative to prepare and start equipment.

B. Adjust for proper operation within manufacturer's published tolerances.

C. Demonstrate proper operation of equipment to Owner's designated representative.

3.03 CLEANING

A. Clean the entire installation at substantial completion .

B. Protect installed equipment from subsequent construction operations.

**END OF SECTION 26 05 02**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Electrical demolition.

1.03 RELATED REQUIREMENTS

A. Section 017700 - Execution and Closeout Requirements: Additional requirements for alterations work.

PART 3 EXECUTION

2.01 EXAMINATION

A. Verify field measurements and circuiting arrangements are as shown on Drawings.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition drawings are based on casual field observation and existing record documents.

D. Report discrepancies H2M Architects + Engineers before disturbing existing installation.

E. Beginning of demolition means installer accepts existing conditions.

2.02 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings to be removed.

B. Coordinate utility service outages with utility company and all other affected parties including TD Bank and the American Tower Corporation Cell Tower Compound.

C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
   1. Obtain permission from owner, and other affected entities at least 2 weeks before partially or completely disabling system.
   2. Make temporary connections to maintain service in areas adjacent to work area.
   3. Make available provisions for temporary power during any extended outages.
   4. Replace fuel costs incurred by temporary power systems used/owned by affected parties.

E. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Minimize outage duration.
   1. Notify owner before partially or completely disabling system.
   2. Notify local fire service.
   3. Make notifications at least 24 hours in advance.

F. Existing Telephone System: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
   1. Notify owner at least 24 hours before partially or completely disabling system.
   2. Notify telephone utility company at least 24 hours before partially or completely disabling system.

2.03 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment that remain or that are to be reused.

B. Panelboards: Clean exposed surfaces and check tightness of existing electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide

typed circuit directory showing revised circuiting arrangement.

C. Luminaires being removed and reused: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps , ballasts and broken electrical parts.

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Single conductor building wire.

B. Metal-clad cable.

C. Wire and cable for 600 volts and less.

D. Wiring connectors.

E. Electrical tape.

F. Heat shrink tubing.

G. Wire pulling lubricant.

1.03 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.

B. Section 260505 - Selective Demolition For Electrical: Disconnection, removal, and/or extension of existing electrical conductors and cables.

C. Section 260526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.

D. Section 312316 - Excavation.

E. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

F. Section 283100 - Fire Detection and Alarm: Fire alarm system conductors and cables.

G.

H. Section 312316.13 - Trenching: Excavating, bedding, and backfilling.

I. Section 312323 - Fill: Bedding and backfilling.

1.04 REFERENCE STANDARDS

A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire 2013 (Reapproved 2018).

B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft 2011 (Reapproved 2017).

C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes 2010, with Editorial Revision (2020).

D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation 2004 (Reapproved 2020).

E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape 2017.

F. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes 2013.

G. FS A-A-59544 - Cable and Wire, Electrical (Power, Fixed Installation); Federal Specification 2008a (Validated 2019).

H. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

I. NECA 120 - Standard for Installing Armored Cable (AC) and Metal-Clad Cable (MC) 2012.

J. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy 2009.

K. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems 2017.

L. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

M. UL 44 - Thermoset-Insulated Wires and Cables Current Edition, Including All Revisions.

N. UL 83 - Thermoplastic-Insulated Wires and Cables Current Edition, Including All Revisions.

O. UL 486A-486B - Wire Connectors Current Edition, Including All Revisions.

P. UL 486C - Splicing Wire Connectors Current Edition, Including All Revisions.

Q. UL 486D - Sealed Wire Connector Systems Current Edition, Including All Revisions.

R. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape Current Edition, Including All Revisions.

S. UL 1569 - Metal-Clad Cables Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
   3. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.06 SUBMITTALS

A. See Section 01 33 00 - Submittial Procedures, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.

C. Product Data: Provide for each cable assembly type.

D. Test Reports: Indicate procedures and values obtained.

E. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors. Include proposed modifications to raceways, boxes, wiring gutters, enclosures, etc. to accommodate substituted conductors.

F. Field Quality Control Test Reports.

G. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

H. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.

I. Project Record Documents: Record actual locations of components and circuits.

1.07 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having

jurisdiction.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.09 FIELD CONDITIONS

A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.

B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.

C. Nonmetallic-sheathed cable is not permitted.

D. Underground feeder and branch-circuit cable is not permitted.

E. Service entrance cable is not permitted.

F. Armored cable is not permitted.

G. Metal-clad cable is permitted only as follows:
   1. Where not otherwise restricted, may be used:
      a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.
         1) Maximum Length: 6 feet.
      b. Where concealed in hollow stud walls, above accessible ceilings, and under raised floors for branch circuits up to 20 A.
         1) Exception: Provide single conductor building wire in raceway for circuit homerun from first outlet to panelboard.
   2. In addition to other applicable restrictions, may not be used:
      a. Where not approved for use by the authority having jurisdiction.
      b. Where exposed to view, except in dedicated electrical, communications, and mechanical rooms where not subject to damage.
      c. Where exposed to damage.
      d. For damp, wet, or corrosive locations.

H. Conductor sizes are based on copper. Aluminum conductors will not be accepted.

2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A. Provide products that comply with requirements of NFPA 70.

B. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose indicated.

C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

D. Comply with NEMA WC 70.

E. Comply with FS A-A-59544 where applicable.

F. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

G. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.

H. Conductors for Grounding and Bonding: Also comply with Section 260526.

I. Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum rated, listed and labeled as suitable for use in return air plenums.

J. Conductor Material:
   1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
   2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B 787M unless otherwise indicated.
   3. Tinned Copper Conductors: Comply with ASTM B33.

K. Minimum Conductor Size:
   1. Branch Circuits: 12 AWG.
      a. Exceptions:
         1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
         2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.
         3) 20 A, 277 V circuits longer than 150 feet: 10 AWG, for voltage drop.
   2. Control Circuits: 14 AWG.

L. Conductor Color Coding:
   1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
   2. Color Coding Method: Integrally colored insulation.
      a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
   3. Color Code:
      a. 208Y/120 V, 3 Phase, 4 Wire System:
         1) Phase A: Black.
         2) Phase B: Red.
         3) Phase C: Blue.
         4) Neutral/Grounded: White.
      b. Equipment Ground, All Systems: Green.
      c. For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with NFPA 70 and is approved by the authority having jurisdiction.

2.03 SINGLE CONDUCTOR BUILDING WIRE

A. Manufacturers:
   1. Copper Building Wire:
      a. Cerro Wire LLC: www.cerrowire.com/#sle.
      b. Encore Wire Corporation: www.encorewire.com/#sle.
      c. Southwire Company: www.southwire.com/#sle.

B. Description: Single conductor insulated wire.

C. Conductor Stranding:
   1. Feeders and Branch Circuits:
      a. Size 10 AWG and Smaller: Solid.
      b. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation:
   1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
      a. Size 4 AWG and Larger: Type XHHW-2.
      b. Installed Underground: Type XHHW-2.

c. Fixture Wiring Within Luminaires: Type TFFN/TFN for luminaires with labeled maximum temperature of 90 degrees C; Approved suitable type for luminaires with labeled maximum temperature greater than 90 degrees C.

F. Conductor: Copper.

G. Insulation Voltage Rating: 600 volts.

H. Insulation: NFPA 70 , Type THHN/THWN.

2.04 METAL-CLAD CABLE

A. Manufacturers:
1. AFC Cable Systems Inc: www.afcweb.com/#sle.
2. Encore Wire Corporation: www.encorewire.com/#sle.
3. Southwire Company: www.southwire.com/#sle.
4. Substitutions: See Section 016000 - Product Requirements.

B. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.

C. Conductor Stranding:
1. Size 10 AWG and Smaller: Solid.
2. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.

F. Provide dedicated neutral conductor for each phase conductor where indicated or required.

G. Grounding: Full-size integral equipment grounding conductor.

H. Armor: Aluminum or steel, interlocked tape.

I. Description: NFPA 70, Type MC.

J. Conductor: Copper.

K. Insulation Voltage Rating: 600 volts.

L. Insulation Temperature Rating: 60 degrees C.

M. Insulation Material: Thermoplastic.

N. Armor Material: Aluminum.

O. Armor Design: Interlocked metal tape.

2.05 WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B. Connectors for Grounding and Bonding: Comply with Section 260526.

C. Wiring Connectors for Splices and Taps:
1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.

D. Wiring Connectors for Terminations:
1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
3. Where over-sized conductors are larger than the manufacturer's maximum available size equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective

device. (Reducers are not allowed when lugs are available from the manufacturer to accommodate the over-sized conductors.)

4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
5. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
6. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
7. Conductors for Control Circuits: Use crimped terminals for all connections.

E. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.

F. Mechanical Connectors: Provide bolted type or set-screw type.
1. Manufacturers:
a. Ilsco: www.ilsco.com/#sle.
b. Thomas & Betts Corporation: www.tnb.com/#sle.

G. Compression Connectors: Provide circumferential type or hex type crimp configuration.
1. Manufacturers:
a. Ilsco: www.ilsco.com/#sle.
b. Thomas & Betts Corporation: www.tnb.com/#sle.

H. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.
1. Manufacturers:
a. Ilsco: www.ilsco.com/#sle.
b. Thomas & Betts Corporation: www.tnb.com/#sle.

2.06 WIRING ACCESSORIES

A. Electrical Tape:
1. Manufacturers:
a. 3M: www.3m.com/#sle.
b. Plymouth Rubber Europa: www.plymouthrubber.com/#sle.
2. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
4. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.
5. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.
6. Varnished Cambric Electrical Tape: Cotton cambric fabric tape, with or without adhesive, oil-primed and coated with high-grade insulating varnish; minimum thickness of 7 mil; suitable for continuous temperature environment up to 221 degrees F.
7. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.

B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.

C. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that work likely to damage wire and cable has been completed.

C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.

D. Verify that raceway installation is complete and supported.

E. Verify that field measurements are as shown on the drawings.

F. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.03 INSTALLATION

A. Circuiting Requirements:
   1. Unless dimensioned, circuit routing indicated is diagrammatic.
   2. When circuit destination is indicated and routing is not shown, determine exact routing required.
   3. Arrange circuiting to minimize splices.
   4. Include circuit lengths required to install connected devices within 10 ft of location shown.
   5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
   6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
   7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are shown as separate, combining them together in a single raceway is not permitted.
   8. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.

B. Install products in accordance with manufacturer's instructions.

C. Install conductors and cable in a neat and workmanlike manner in accordance with NECA 1.

D. Install metal-clad cable (Type MC) in accordance with NECA 120.

E. Installation in Raceway:
   1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
   2. Pull all conductors and cables together into raceway at same time.
   3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
   4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

F. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

G. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.

H. Terminate cables using suitable fittings.
   1. Metal-Clad Cable (Type MC):
      a. Use listed fittings.

b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
c. Do not use direct-bearing set-screw type fittings for cables with aluminum armor.

I. Install conductors with a minimum of 12 inches of slack at each outlet.

J. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.

K. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

L. Make wiring connections using specified wiring connectors.
1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
3. Do not remove conductor strands to facilitate insertion into connector.
4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

M. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.
b. For taped connections likely to require re-entering, including motor leads, first apply varnished cambric electrical tape, followed by adequate amount of rubber splicing electrical tape, followed by outer covering of vinyl insulating electrical tape.
2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
3. Wet Locations: Use heat shrink tubing.

N. Insulate ends of spare conductors using vinyl insulating electrical tape.

O. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.

P. Identify conductors and cables in accordance with Section 260553.

Q. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.

R. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

S. Install wire and cable securely, in a neat and workmanlike manner, as specified in NECA 1.

T. Route wire and cable as required to meet project conditions.
1. Wire and cable routing indicated is approximate unless dimensioned.

2. Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.
3. Include wire and cable of lengths required to install connected devices within 10 ft of location shown.

U. Use wiring methods indicated.

V. Pull all conductors into raceway at same time.

W. Use suitable wire pulling lubricant for building wire 4 AWG and larger.

X. Support cables above accessible ceiling, using spring metal clips or metal cable ties to support cables from structure or ceiling suspension system. Do not rest cable on ceiling panels.

Y. Neatly train and lace wiring inside boxes, equipment, and panelboards.

Z. Clean conductor surfaces before installing lugs and connectors.

AA. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

BB. Identify and color code wire and cable under provisions of Section 260553. Identify each conductor with its circuit number or other designation indicated.

3.04 FIELD QUALITY CONTROL

A. Perform field inspection and testing in accordance with Section 014000.

B. Perform inspections and tests listed in NETA STD ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.
1. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.

C. Correct deficiencies and replace damaged or defective conductors and cables.

**END OF SECTION 26 05 19**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Grounding and bonding requirements.

B. Conductors for grounding and bonding.

C. Connectors for grounding and bonding.

D. Ground bars.

E. Ground rod electrodes.

1.03 RELATED REQUIREMENTS

A. Section 260519 - Low-Voltage Power Conductors & Cables (600 V & Less): Additional requirements for conductors for grounding and bonding, including conductor color coding.

B. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

C. Section 033000 - Cast-in-Place Concrete.

D. Section 265600 - Exterior Lighting: Additional grounding and bonding requirements for pole-mounted luminaires.

1.04 REFERENCE STANDARDS

A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System 2012.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings 2017.

D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems 2017.

E. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 467 - Grounding and Bonding Equipment Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Verify exact locations of underground metal water service pipe entrances to building.
   2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
   3. Notify H2M Architects + Engineers of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.06 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: 5 ohms.

1.07 SUBMITTALS

A. See Section 01 33 00 - Submittial Procedures, for submittals procedures.

B. Product Data: Provide for grounding electrodes and connections.

C. Test Reports: Indicate overall resistance to ground and resistance of each electrode.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination,

preparation, and installation of product.

E. Field quality control test reports.

F. Project Record Documents: Record actual locations of components and grounding electrodes.

G. Certificate of Compliance: Indicate approval of installation by authority having jurisdiction.

1.08 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

A. Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.

B. Do not use products for applications other than as permitted by NFPA 70 and product listing.

C. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

D. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

E. Grounding System Resistance:
   1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by H2M Architects + Engineers. Precipitation within the previous 48 hours does not constitute normally dry conditions.
   2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.

F. Grounding Electrode System:
   1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
      a. Provide continuous grounding electrode conductors without splice or joint.
      b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
   2. Metal Underground Water Pipe(s):
      a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.
      b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
      c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
   3. Metal Building or Structure Frame:
      a. Provide dedicated connections to both existing and new metal building or structure frame effectively grounded in accordance with NFPA 70 at nearest accessible

location.

4. Concrete-Encased Electrode:
   a. Provide connection to concrete-encased electrode consisting of not less than 20 feet of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
5. Ground Ring:
   a. Provide a ground ring encircling the building or structure consisting of bare copper conductor not less than 2 AWG in direct contact with earth, installed at a depth of not less than 30 inches.
   b. Where location is not indicated, locate ground ring conductor at least 24 inches outside building perimeter foundation.
   c. Provide connection from ground ring conductor to:
      1) Ground rod electrodes located as indicated.
6. Ground Rod Electrode(s):
   a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.
   b. Space electrodes not less than 10 feet from each other and any other ground electrode.
   c. Where location is not indicated, locate electrode(s) at least 5 feet outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.
7. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
8. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.
   a. Ground Bar Size: Per plans unless otherwise indicated or required.
   b. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.

G. Service-Supplied System Grounding:
   1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
   2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.

H. Separately Derived System Grounding:
   1. Separately derived systems include, but are not limited to:
      a. Generators, when neutral is switched in the transfer switch.
   2. Provide grounding electrode conductor to connect derived system grounded conductor to nearest effectively grounded metal building frame. Unless otherwise indicated, make connection at neutral (grounded) bus in source enclosure.
   3. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, where not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.
   4. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.

5. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.

I. Bonding and Equipment Grounding:
1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
7. Provide bonding for metal building frame where not used as a grounding electrode.

J. Communications Systems Grounding and Bonding:
1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.
2. Provide bonding jumper in raceway from intersystem bonding termination to each communications room or backboard and provide ground bar for termination.
   a. Bonding Jumper Size: As indicated.
   b. Raceway Size: 3/4 inch unless otherwise indicated or required.
   c. Ground Bar Size: Per plans unless otherwise indicated or required.
   d. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.

2.02 GROUNDING AND BONDING COMPONENTS

A. General Requirements:
1. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated.
2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in addition to requirements of Section 260519:
1. Use insulated copper conductors unless otherwise indicated.
   a. Exceptions:
      1) Use bare copper conductors where installed underground in direct contact with earth.
      2) Use bare copper conductors where directly encased in concrete (not in raceway).

C. Connectors for Grounding and Bonding:
1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
4. Manufacturers - Mechanical and Compression Connectors:
   a. Harger Lightning & Grounding: www.harger.com/#sle.

b. Thomas & Betts Corporation: www.tnb.com/#sle.

5. Manufacturers - Exothermic Welded Connections:
   a. Cadweld, a brand of Erico International Corporation: www.erico.com/#sle.
   b. ThermOweld, a brand of Continental Industries, Inc: www.thermoweld.com/#sle.

D. Ground Bars:
   1. Description: Copper rectangular ground bars with mounting brackets and insulators.
   2. Size: As indicated.
   3. Holes for Connections: As indicated or as required for connections to be made.

E. Ground Rod Electrodes:
   1. Comply with NEMA GR 1.
   2. Material: Copper-bonded (copper-clad) steel.
   3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.

F. Ground Plate Electrodes:
   1. Material: Copper.
   2. Size: 24 by 24 by 1/4 inches, unless otherwise indicated.

G. Ground Enhancement Material:
   1. Description: Factory-mixed conductive material designed for permanent and maintenance-free improvement of grounding effectiveness by lowering resistivity.
   2. Resistivity: Not more than 20 ohm-cm in final installed form.

2.03 MANUFACTURERS

A. Cooper Power Systems: www.cooperpower.com.

B. Framatome Connectors International: www.fciconnect.com.

C. Erico: www.erico.com.

2.04 ELECTRODES

A. Rod Electrodes: Copper.
   1. Diameter: 3/4 inch.
   2. Length: 10 feet.

2.05 CONNECTORS AND ACCESSORIES

A. Mechanical Connectors: Bronze.

B. Exothermic Connections:

C. Wire: Stranded copper.

D. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that work likely to damage grounding and bonding system components has been completed.

B. Verify that field measurements are as shown on the drawings.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install grounding and bonding system components in a neat and workmanlike manner in accordance with NECA 1.

C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70.

1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.
2. Indoor Installations: Unless otherwise indicated, install with 4 inches of top of rod exposed.

D. Ground Plate Electrodes: Unless otherwise indicated, install ground plate electrodes at a depth of not less than 30 inches.

E. Make grounding and bonding connections using specified connectors.
1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

F. Identify grounding and bonding system components in accordance with Section 260553.

G. Install 4 AWG bare copper wire in foundation footing where indicated.

3.03 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA STD ATS except Section 4.

B. Perform inspections and tests listed in NETA STD ATS, Section 7.13.

C. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.

D. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

E. Submit detailed reports indicating inspection and testing results and corrective actions taken.

**END OF SECTION 26 05 26**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Support and attachment components for equipment, conduit, cable, boxes, and other electrical work.

1.03 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 260533.13 - Conduit: Additional support and attachment requirements for conduits.

C. Section 260533.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.

D. Section 265100 - Interior Lighting: Additional support and attachment requirements for interior luminaires.

E. Section 265600 - Exterior Lighting: Additional support and attachment requirements for exterior luminaires.

1.04 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.

B. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2019.

C. MFMA-4 - Metal Framing Standards Publication 2004.

D. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

E. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 033000.

1.06 SUBMITTALS

A. See Section 01 33 00 - Submittial Procedures, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, non-penetrating rooftop supports, and post-installed concrete and masonry anchors.

C. Installer's Qualifications: Include evidence of compliance with specified requirements.

D. Product Data: Provide manufacturer's catalog data for fastening systems.

E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.07 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with applicable building code.

C. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
   2. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated, where applicable.
   3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of [_____]. Include consideration for vibration, equipment operation, and shock loads where applicable.
   4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
   5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
   6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
      a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
      b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
      c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
      d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
   1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
   2. Conduit Clamps: Bolted type unless otherwise indicated.

C. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.

D. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
   1. Comply with MFMA-4.
   2. Channel Material:
      a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
      b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
   3. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.
   4. Manufacturers:

a. Cooper B-Line, a division of Cooper Industries: www.cooperindustries.com/#sle.
b. Thomas & Betts Corporation: www.tnb.com/#sle.
c. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
d. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.

E. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.

F. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
2. Hollow Masonry: Use toggle bolts.
3. Hollow Stud Walls: Use toggle bolts.
4. Steel: Use beam clamps, machine bolts, or welded threaded studs.
5. Wood: Use wood screws.

2.02 MANUFACTURERS

A. Thomas & Betts Corporation: www.tnb.com.

B. Threaded Rod Company: www.threadedrod.com.

C. Caddy Fasteners: www.erico.com.

2.03 MATERIALS

A. Hangers, Supports, Anchors, and Fasteners - General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.

B. Supports: Fabricated of structural steel or formed steel members; galvanized.

C. Anchors and Fasteners:
1. Obtain permission from Architect before using powder-actuated anchors.
2. Concrete Structural Elements: Use precast inserts, expansion anchors, powder-actuated anchors, or preset inserts.
3. Steel Structural Elements: Use beam clamps, steel spring clips, steel ramset fasteners, or welded fasteners.
4. Concrete Surfaces: Use self-drilling anchors or expansion anchors.
5. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts or hollow wall fasteners.
6. Solid Masonry Walls: Use expansion anchors or preset inserts.
7. Sheet Metal: Use sheet metal screws.
8. Wood Elements: Use wood screws.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install support and attachment components in a neat and workmanlike manner in accordance with NECA 1.

C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

F. Do not penetrate or otherwise notch or cut structural members without written approval of Structural Engineer.

G. Equipment Support and Attachment:
   1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
   2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
   3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
   4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 3 inch high concrete pad constructed in accordance with Section 033000.
   5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

H. Conduit Support and Attachment: Also comply with Section 260533.13.

I. Box Support and Attachment: Also comply with Section 260533.16.

J. Interior Luminaire Support and Attachment: Also comply with Section 265100.

K. Exterior Luminaire Support and Attachment: Also comply with Section 265600.

L. Secure fasteners according to manufacturer's recommended torque settings.

M. Remove temporary supports.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

**END OF SECTION 26 05 29**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Galvanized steel rigid metal conduit (RMC).

B. PVC-coated galvanized steel rigid metal conduit (RMC).

C. Flexible metal conduit (FMC).

D. Liquidtight flexible metal conduit (LFMC).

E. Electrical metallic tubing (EMT).

F. Rigid polyvinyl chloride (PVC) conduit.

G. Conduit fittings.

H. Accessories.

I. Conduit, fittings and conduit bodies.

1.03 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.

B. Section 260526 - Grounding and Bonding for Electrical Systems.
   1. Includes additional requirements for fittings for grounding and bonding.

C. Section 260529 - Hangers and Supports for Electrical Systems.

D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

1.04 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC) 2015.

B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S) 2015.

C. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit (EIMC) 2018.

D. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

E. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT) 2013.

F. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC) 2017.

G. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable 2014.

H. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit 2018.

I. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit 2020.

J. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing 2016.

K. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

L. UL 1 - Flexible Metal Conduit Current Edition, Including All Revisions.

M. UL 6 - Electrical Rigid Metal Conduit-Steel Current Edition, Including All Revisions.

N. UL 360 - Liquid-Tight Flexible Steel Conduit Current Edition, Including All Revisions.

O. UL 514B - Conduit, Tubing, and Cable Fittings Current Edition, Including All Revisions.

P. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings Current Edition, Including All Revisions.

Q. UL 797 - Electrical Metallic Tubing-Steel Current Edition, Including All Revisions.

R. UL 1242 - Electrical Intermediate Metal Conduit-Steel Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
   4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
   5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.06 SUBMITTALS

A. See Section 01 33 00 - Submittial Procedures, for submittals procedures.

B. Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 2 inch (53 mm) trade size and larger.

C. Product Data: Provide for metallic conduit, flexible metal conduit, liquidtight flexible metal conduit, metallic tubing, nonmetallic conduit, flexible nonmetallic conduit, nonmetallic tubing, fittings, and conduit bodies.

D. Project Record Documents: Accurately record actual routing of conduits larger than 2 inches.

1.07 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and shown.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

B. Accept conduit on site. Inspect for damage.

C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

D. Protect PVC conduit from sunlight.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.

B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.

C. Underground:
   1. Under Slab on Grade: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, or rigid PVC conduit.

2. Exterior, Direct-Buried: Use galvanized steel rigid metal conduit, intermediate metallic conduit (IMC), PVC-coated galvanized steel rigid metal conduit, or rigid PVC conduit.
3. Exterior, Embedded Within Concrete: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, or rigid PVC conduit.
4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from underground.
5. Where rigid polyvinyl (PVC) conduit larger than 2 inch (53 mm) trade size is provided, use galvanized steel rigid metal conduit elbows for bends.
6. Where steel conduit is installed in direct contact with earth where soil has a resistivity of less than 2000 ohm-centimeters or is characterized as severely corrosive based on soils report or local experience, use corrosion protection tape to provide supplementary corrosion protection or use PVC-coated galvanized steel rigid metal conduit.
7. Where steel conduit emerges from concrete into soil, use corrosion protection tape to provide supplementary corrosion protection for a minimum of 4 inches on either side of where conduit emerges or use PVC-coated galvanized steel rigid metal conduit.

D. Embedded Within Concrete:
   1. Within Slab on Grade: Not permitted.
   2. Within Slab Above Ground: Not permitted.
   3. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from concrete.

E. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

F. Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

G. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

H. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).

I. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

J. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
   1. Locations subject to physical damage include, but are not limited to:
      a. Where exposed below 8 feet, except within electrical and communication rooms or closets.

K. Exposed, Exterior: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or PVC-coated galvanized steel rigid metal conduit.

L. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).

M. Corrosive Locations Above Ground: Use PVC-coated galvanized steel rigid metal conduit or aluminum rigid metal conduit.

N. Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit.
   1. Maximum Length: 6 feet.

O. Connections to Vibrating Equipment:
   1. Dry Locations: Use flexible metal conduit.
   2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
   3. Maximum Length: 6 feet unless otherwise indicated.
   4. Vibrating equipment includes, but is not limited to:
      a. Transformers.

b. Motors.

P. Fished in Existing Walls, Where Necessary: Use flexible metal conduit.

2.02 CONDUIT REQUIREMENTS

A. Electrical Service Conduits: Also comply with Section 262100.

B. Communications Systems Conduits: Also comply with Section 271000.

C. Fittings for Grounding and Bonding: Also comply with Section 260526.

D. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.

E. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated.

F. Minimum Conduit Size, Unless Otherwise Indicated:
1. Branch Circuits: 3/4 inch (21 mm) trade size.
2. Underground, Interior: 1 inch (27 mm) trade size.
3. Underground, Exterior: 1 inch (27 mm) trade size.

G. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:
1. Allied Tube & Conduit: www.alliedeg.com/#sle.
2. Republic Conduit: www.republic-conduit.com/#sle.
3. Wheatland Tube Company: www.wheatland.com/#sle.

B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

C. Fittings:
1. Manufacturers:
a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com/#sle.
c. Thomas & Betts Corporation: www.tnb.com/#sle.
2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.
4. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.04 INTERMEDIATE METAL CONDUIT (IMC)

A. Manufacturers:
1. Allied Tube & Conduit: www.alliedeg.com/#sle.
2. Republic Conduit: www.republic-conduit.com/#sle.
3. Wheatland Tube Company: www.wheatland.com/#sle.

B. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.

C. Fittings:
1. Manufacturers:
a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com/#sle.
c. Thomas & Betts Corporation: www.tnb.com/#sle.
2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.

3. Material: Use steel or malleable iron.
4. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.05 METAL CONDUIT

A. Manufacturers:
1. Allied Tube & Conduit: www.alliedtube.com.
2. Beck Manufacturing, Inc: www.beckmfg.com.
3. Wheatland Tube Company: www.wheatland.com.

2.06 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:
1. Thomas & Betts Corporation: www.tnb.com/#sle.
2. Robroy Industries: www.robroy.com/#sle.

B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.

C. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil.

D. PVC-Coated Fittings:
1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
2. Non-Hazardous Locations: Use fittings listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.
4. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil.

E. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil.

2.07 FLEXIBLE METAL CONDUIT (FMC)

A. Manufacturers:
1. AFC Cable Systems, Inc: www.afcweb.com/#sle.
2. Electri-Flex Company: www.electriflex.com/#sle.
3. International Metal Hose: www.metalhose.com/#sle.

B. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.

C. Fittings:
1. Manufacturers:
a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com/#sle.
c. Thomas & Betts Corporation: www.tnb.com/#sle.
2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.

D. Description: Interlocked steel construction.

E. Fittings: NEMA FB 1.

2.08 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Manufacturers:
1. AFC Cable Systems, Inc: www.afcweb.com/#sle.
2. Electri-Flex Company: www.electriflex.com/#sle.
3. International Metal Hose: www.metalhose.com/#sle.

B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.

C. Fittings:
   1. Manufacturers:
      a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
      b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
   2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   3. Material: Use steel or malleable iron.

D. Description: Interlocked steel construction with PVC jacket.

E. Fittings: NEMA FB 1.

2.09 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:
   1. Allied Tube & Conduit: www.alliedeg.com/#sle.
   2. Republic Conduit: www.republic-conduit.com/#sle.
   3. Wheatland Tube Company: www.wheatland.com/#sle.

B. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

C. Fittings:
   1. Manufacturers:
      a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
      b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
   2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   3. Material: Use steel or malleable iron.
   4. Connectors and Couplings: Use compression (gland) or set-screw type.
      a. Do not use indenter type connectors and couplings.
   5. Damp or Wet Locations (where permitted): Use fittings listed for use in wet locations.

2.10 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

A. Manufacturers:
   1. Cantex Inc: www.cantexinc.com/#sle.
   2. JM Eagle: www.jmeagle.com/#sle.
   3. Lamson & Sessions (Carlon); www.carlon.com

B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.

C. Fittings:
   1. Manufacturer: Same as manufacturer of conduit to be connected.
   2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.11 ACCESSORIES

A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil.

B. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.

C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

D. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force.

E. Sealing Compound for Sealing Fittings: Listed for use with the particular fittings to be installed.

F. Modular Seals for Conduit Penetrations: Rated for minimum of 40 psig; Suitable for the conduits to be installed.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on drawings.

B. Verify that mounting surfaces are ready to receive conduits.

C. Verify that conditions are satisfactory for installation prior to starting work.

D. Verify routing and termination locations of conduit prior to rough-in.

E. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install conduit in a neat and workmanlike manner in accordance with NECA 1.

C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.

D. Install intermediate metal conduit (IMC) in accordance with NECA 101.

E. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by the manufacturer.

F. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.

G. Conduit Routing:
   1. Unless dimensioned, conduit routing indicated is diagrammatic.
   2. When conduit destination is indicated and routing is not shown, determine exact routing required.
   3. Conceal all conduits unless specifically indicated to be exposed.
   4. Conduits in the following areas may be exposed, unless otherwise indicated:
      a. Electrical rooms.
   5. Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
   6. Arrange conduit to maintain adequate headroom, clearances, and access.
   7. Arrange conduit to provide no more than the equivalent of four 90 degree bends between pull points.
   8. Arrange conduit to provide no more than 150 feet between pull points.
   9. Route conduits above water and drain piping where possible.
   10. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
   11. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
   12. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
      a. Heaters.
      b. Hot water piping.
      c. Flues.
   13. Group parallel conduits in the same area together on a common rack.

H. Conduit Support:
   1. Secure and support conduits in accordance with NFPA 70 and Section 260529 using suitable supports and methods approved by the authority having jurisdiction.

2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
4. Use conduit strap to support single surface-mounted conduit.
   a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
5. Use metal channel (strut) with accessory conduit clamps to support multiple parallel surface-mounted conduits.
6. Use conduit clamp to support single conduit from beam clamp or threaded rod.
7. Use trapeze hangers assembled from threaded rods and metal channel (strut) with accessory conduit clamps to support multiple parallel suspended conduits.
8. Use non-penetrating rooftop supports to support conduits routed across rooftops (only where approved).
9. Use of spring steel conduit clips for support of conduits is not permitted.
10. Use of wire for support of conduits is not permitted.
11. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with the most stringent requirements.

I. Connections and Terminations:
1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
3. Use suitable adapters where required to transition from one type of conduit to another.
4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
6. Where spare conduits stub up through concrete floors and are not terminated in a box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.
7. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
8. Secure joints and connections to provide maximum mechanical strength and electrical continuity.

J. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
4. Conceal bends for conduit risers emerging above ground.
5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
6. Provide suitable modular seal where conduits penetrate exterior wall below grade.
7. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
8. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.
9. Provide metal escutcheon plates for conduit penetrations exposed to public view.

10. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.

K. Underground Installation:
   1. Provide underground warning tape in accordance with Section 260553 along entire conduit length for service entrance where not concrete-encased.

L. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide concrete in accordance with Section 033000 with minimum concrete cover of 3 inches on all sides unless otherwise indicated.

M. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
   1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
   2. Where conduits are subject to earth movement by settlement or frost.

N. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
   1. Where conduits pass from outdoors into conditioned interior spaces.
   2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.

O. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.

P. Provide grounding and bonding in accordance with Section 260526.

Q. Identify conduits in accordance with Section 260553.

3.03 FIELD QUALITY CONTROL

A. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

B. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.

C. Correct deficiencies and replace damaged or defective conduits.

3.04 CLEANING

A. Clean interior of conduits to remove moisture and foreign matter.

3.05 PROTECTION

A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

B. Install conduit securely, in a neat and workmanlike manner.

3.06 INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

B. Route conduit through roof openings for piping and ductwork wherever possible. Where separate roofing penetration is required, coordinate location and installation method with roofing installation specified.

**END OF SECTION 26 05 34**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.

B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.

C. Underground boxes/enclosures.

D. Wall and ceiling outlet boxes.

E. Floor boxes.

F. Pull and junction boxes.

1.03 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete.

B. Section 07 84 00 - Firestopping.

C. Section 083100 - Access Doors and Panels: Panels for maintaining access to concealed boxes.

D. Section 260526 - Grounding and Bonding for Electrical Systems.

E. Section 260529 - Hangers and Supports for Electrical Systems.

F. Section 260533.13 - Conduit:
   1. Conduit bodies and other fittings.
   2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.

G. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

H. Section 262726 - Wiring Devices:
   1. Wall plates.
   2. Additional requirements for locating boxes for wiring devices.

I. Section 262813 - Fuses: Spare fuse cabinets.

J. Section 262716 - Electrical Cabinets and Enclosures.

K. Section 262726 - Wiring Devices: Wall plates in finished areas.

1.04 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices 2010.

C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable 2014.

D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports 2013.

E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2018.

F. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.

H. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.

I. UL 508A - UL Standard for Safety Industrial Control Panels 2018.

J. UL 514A - Metallic Outlet Boxes Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
   4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
   5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
   6. Coordinate the work with other trades to preserve insulation integrity.
   7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
   8. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.06 SUBMITTALS

A. See Section 01 33 00 - Submittial Procedures, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for underground handhole enclosures, underground handhole enclosures, underground handhole enclosures, and underground handhole enclosures.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

D. Project Record Documents: Record actual locations for underground handhole enclosures, underground handhole enclosures, underground handhole enclosures, underground handhole enclosures, and underground handhole enclosures.

E. Maintenance Materials: Furnish the following for Architect's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Keys for Lockable Enclosures: Two of each different key.

F. Project Record Documents: Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.

1.07 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 BOXES

A. General Requirements:
   1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
   2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.

3. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated.
4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
3. Use suitable concrete type boxes where flush-mounted in concrete.
4. Use suitable masonry type boxes where flush-mounted in masonry walls.
5. Use raised covers suitable for the type of wall construction and device configuration where required.
6. Use shallow boxes where required by the type of wall construction.
7. Do not use "through-wall" boxes designed for access from both sides of wall.
8. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
9. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
10. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
11. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes.
12. Minimum Box Size, Unless Otherwise Indicated:
    a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 2-1/8 inch deep (100 by 54 mm) trade size.
    b. Ceiling Outlets: 4 inch octagonal or square by 2-1/8 inch deep (100 by 54 mm) trade size.
13. Wall Plates: Comply with Section 262726.
14. Manufacturers:
    a. Cooper Crouse-Hinds, a division of Cooper Industries: www.cooperindustries.com/#sle.
    b. Hubbell Incorporated; RACO Products: www.hubbell-raco.com/#sle.
    c. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com/#sle.
    d. Thomas & Betts Corporation: www.tnb.com/#sle.

C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
2. NEMA 250 Environment Type, Unless Otherwise Indicated:
    a. Indoor Clean, Dry Locations: Type 1, painted steel.
    b. Outdoor Locations: Type 3R, painted steel.
3. Junction and Pull Boxes Larger Than 100 cubic inches:
    a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
    a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
5. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.
6. Manufacturers:

a. Cooper B-Line, a division of Cooper Industries: www.cooperindustries.com/#sle.
b. Hoffman, a brand of Pentair Technical Products: www.hoffmanonline.com/#sle.
c. Hubbell Incorporated; Wiegmann Products: www.hubbell-wiegmann.com/#sle.

D. Underground Boxes/Enclosures:
1. Description: In-ground, open bottom boxes furnished with flush, non-skid covers with legend indicating type of service and stainless steel tamper resistant cover bolts.
2. Size: As indicated on drawings.
3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 12 inches.
4. Provide logo on cover to indicate type of service.
5. Applications:
a. Sidewalks and Landscaped Areas Subject Only to Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 8 load rating.
b. Parking Lots, in Areas Subject Only To Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 15 load rating.
c. Do not use polymer concrete enclosures in areas subject to deliberate vehicular traffic.
6. Polymer Concrete Underground Boxes/Enclosures: Comply with SCTE 77.
a. Manufacturers:
1) Hubbell Incorporated; Quazite Products: www.hubbellpowersystems.com/#sle.

2.02 MANUFACTURERS

A. Appleton Electric: www.appletonelec.com.

B. Arc-Co./Division of Arcade Technology: www.arc-co.com.

C. Unity Manufacturing: www.unitymfg.com.

2.03 OUTLET BOXES

A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
1. Concrete Ceiling Boxes: Concrete type.

B. Cast Boxes: NEMA FB 1, Type FD, aluminum. Provide gasketed cover by box manufacturer. Provide threaded hubs.

C. Wall Plates for Finished Areas: As specified in Section 262726.

2.04 PULL AND JUNCTION BOXES

A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.

B. Hinged Enclosures: As specified in Section 262716.

C. Surface Mounted Cast Metal Box: NEMA 250, Type 4X; flat-flanged, surface mounted junction box:
1. Material: Cast aluminum.
2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

D. In-Ground Cast Metal Box: NEMA 250, Type 6, outside flanged, recessed cover box for flush mounting:
1. Material: Cast aluminum.
2. Cover: Smooth cover with neoprene gasket and stainless steel cover screws.
3. Cover Legend: "ELECTRIC".

E. Fiberglass Handholes: Die molded glass fiber hand holes:
1. Cable Entrance: Pre-cut 6 x 6 inch cable entrance at center bottom of each side.
2. Cover: Glass fiber weatherproof cover with nonskid finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on drawings.

B. Verify that mounting surfaces are ready to receive boxes.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide separate boxes for emergency power and normal power systems.

E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.

F. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.

G. Box Locations:
   1. Locate boxes to be accessible. Provide access panels in accordance with Section 083100 as required where approved by the Architect.
   2. Unless dimensioned, box locations indicated are approximate.
   3. Locate boxes as required for devices installed under other sections or by others.
      a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 262726.
   4. Locate boxes so that wall plates do not span different building finishes.
   5. Locate boxes so that wall plates do not cross masonry joints.
   6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
   7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
   8. Fire-Resistance-Rated Walls: Install flush-mounted boxes such that the required fire-resistance will not be reduced.
      a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
      b. Do not install flush-mounted boxes with area larger than 16 square inches or such that the total aggregate area of openings exceeds 100 square inches for any 100 square feet of wall area.
   9. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 260533.13.
   10. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
      a. Concealed above accessible suspended ceilings.
      b. Within joists in areas with no ceiling.
      c. Electrical rooms.
      d. Mechanical equipment rooms.

H. Box Supports:
   1. Secure and support boxes in accordance with NFPA 70 and Section 260529 using suitable supports and methods approved by the authority having jurisdiction.

2. Provide independent support from building structureexcept for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
4. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.

I. Install boxes plumb and level.

J. Flush-Mounted Boxes:
1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.

K. Floor-Mounted Cabinets: Mount on properly sized 3 inch high concrete pad constructed in accordance with Section 033000.

L. Install boxes as required to preserve insulation integrity.

M. Underground Boxes/Enclosures:
1. Install enclosure on gravel base, minimum 6 inches deep.
2. Flush-mount enclosures located in concrete or paved areas.
3. Mount enclosures located in landscaped areas with top at 1 inch above finished grade.
4. Provide cast-in-place concrete collar constructed in accordance with Section 033000, minimum 10 inches wide by 12 inches deep, around enclosures that are not located in concrete areas.
5. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.

N. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

O. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.

P. Close unused box openings.

Q. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.

R. Provide grounding and bonding in accordance with Section 260526.

S. Install boxes securely, in a neat and workmanlike manner, as specified in NECA 1.

T. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and as required by NFPA 70.

U. Coordinate installation of outlet boxes for equipment connected under Section 262717.

V. Set wall mounted boxes at elevations to accommodate mounting heights indicated.

W. Electrical boxes are shown on Drawings in approximate locations unless dimensioned.
1. Adjust box locations up to 10 feet if required to accommodate intended purpose.

X. Orient boxes to accommodate wiring devices oriented as specified in Section 262726.

Y. Maintain headroom and present neat mechanical appearance.

Z. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

AA. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.

BB. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07841.

CC. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.

DD. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.

EE. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

FF. Use flush mounting outlet box in finished areas.

GG. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

HH. Provide separate boxes for emergency power and normal power systems.

II. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.

JJ. Locate outlet boxes so that wall plates do not span different building finishes.

KK. Locate outlet boxes so that wall plates do not cross masonry joints.

LL. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches separation.

MM. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches separation. Provide minimum 24 inches separation in acoustic rated walls.

NN. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

OO. Use stamped steel bridges to fasten flush mounting outlet box between studs.

PP. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

QQ. Use adjustable steel channel fasteners for hung ceiling outlet box.

RR. Do not fasten boxes to ceiling support wires.

SS. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches of box.

TT. Use gang box where more than one device is mounted together. Do not use sectional box.

UU. Use gang box with plaster ring for single device outlets.

VV. Use cast outlet box in exterior locations exposed to the weather and wet locations.

WW. Use cast floor boxes for installations in slab on grade; formed steel boxes are acceptable for other installations.

XX. Set floor boxes level.

YY. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

ZZ. Identify boxes in accordance with Section 26 0553.

3.03 ADJUSTING

A. Adjust flush-mounting outlets to make front flush with finished wall material.

B. Install knockout closures in unused box openings.

3.04 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.05 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

**END OF SECTION 26 05 37**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Electrical identification requirements.

B. Identification nameplates and labels.

C. Wire and cable markers.

D. Voltage markers.

E. Underground warning tape.

F. Warning signs and labels.

1.03 RELATED REQUIREMENTS

A. Section 099000 - Painting and Coating.

B. Section 260519 - Low-Voltage Power Conductors & Cables (600 V & Less): Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.

C. Section 262726 - Wiring Devices: Device and wallplate finishes; factory pre-marked wallplates.

1.04 REFERENCE STANDARDS

A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs 2011.

B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels 2011.

C. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. UL 969 - Marking and Labeling Systems Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.

B. Sequencing:
   1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
   2. Do not install identification products until final surface finishes and painting are complete.

1.06 SUBMITTALS

A. See Section 01 33 00 - Submittial Procedures, for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.

C. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.

D. Product Data: Provide catalog data for nameplates, labels, and markers.

E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation and installation of product.

1.07 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

1.08 FIELD CONDITIONS

A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

A. Existing Work: Unless specifically excluded, identify existing elements to remain that are not already identified in accordance with specified requirements.

B. Identification for Equipment:
   1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
      a. Panelboards:
         1) Identify ampere rating.
         2) Identify voltage and phase.
         3) Identify power source and circuit number. Include location when not within sight of equipment.
         4) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
         5) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
         6) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
      b. Enclosed switches, circuit breakers, and motor controllers:
         1) Identify power source and circuit number. Include location when not within sight of equipment.
         2) Identify load(s) served. Include location when not within sight of equipment.
      c. Time Switches:
         1) Identify load(s) served and associated circuits controlled. Include location.
      d. Enclosed Contactors:
         1) Identify ampere rating.
         2) Identify voltage and phase.
         3) Identify configuration, e.g., E.O.E.H. (electrically operated, electrically held) or E.O.M.H. (electrically operated, mechanically held).
         4) Identify coil voltage.
         5) Identify load(s) and associated circuits controlled. Include location.
      e. Transfer Switches:
         1) Identify voltage and phase.
         2) Identify power source and circuit number for both normal power source and standby power source. Include location when not within sight of equipment.
         3) Identify load(s) served. Include location when not within sight of equipment.
      f. Electricity Meters:
         1) Identify load(s) metered.
   2. Service Equipment:
      a. Use identification nameplate to identify each service disconnecting means.
   3. Emergency & Standby System Equipment:
      a. Use identification nameplate or voltage marker to identify emergency & standby system equipment in accordance with NFPA 70.
      b. Use identification nameplate at each piece of service equipment to identify type and location of on-site emergency & standby power sources.
   4. Use voltage marker to identify highest voltage present for each piece of electrical equipment.

5. Use identification nameplate to identify equipment utilizing series ratings, where permitted, in accordance with NFPA 70.
6. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
7. Use identification label on inside of door at each fused switch to identify required NEMA fuse class and size.
8. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
9. Use warning signs to identify electrical hazards for entrances to all rooms and other guarded locations that contain exposed live parts operating at 600 V nominal or less with the word message "DANGER; Electrical hazard; Authorized personnel only" or approved equivalent.
10. Use warning labels, identification nameplates, or identification labels to identify electrical hazards for equipment where multiple power sources are present with the word message "DANGER; Hazardous voltage; Multiple power sources may be present; Disconnect all electric power including remote disconnects before servicing" or approved equivalent.

C. Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less: Comply with Section 260519.
2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
3. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
   a. At each source and load connection.
   b. Within boxes when more than one circuit is present.
   c. Within equipment enclosures when conductors and cables enter or leave the enclosure.
4. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.
5. Use underground warning tape to identify direct buried cables.

D. Identification for Raceways:
1. Use voltage markers to identify highest voltage present for accessible conduits at maximum intervals of 20 feet.
2. Use voltage markers or color-coded bands to identify systems other than normal power system for accessible conduits at maximum intervals of 20 feet.
   a. Color-Coded Bands: Use field-painting or vinyl color coding electrical tape to mark bands 3 inches wide.
      1) Color Code:
         (a) Fire Alarm System: Red.
      2) Field-Painting: Comply with Section 099000.
      3) Vinyl Color Coding Electrical Tape: Comply with Section 260519.
3. Use identification labels or plastic marker tags to identify circuits enclosed for accessible conduits at wall penetrations, at floor penetrations, at roof penetrations, and at equipment terminations when source is not within sight.
4. Use underground warning tape to identify underground raceways.

E. Identification for Boxes:
1. Use voltage markers to identify highest voltage present.
2. Use voltage markers or color coded boxes to identify systems other than normal power system.
   a. Color-Coded Boxes: Field-painted in accordance with Section 099000 per the same color code used for raceways.

F. Buried Electrical Lines: Underground warning tapes.

G. Communication Cabinets: Nameplates.
H. Conduit: Conduit markers.
I. Control Device Station: Labels.
J. Electrical Distribution and Control Equipment Enclosures: Nameplates.
K. Junction Box Load Connections: Wire markers.
L. Outlet Box Load Connections: Wire markers.
M. Panel Gutter Load Connections: Wire markers.
N. Pull Box Load Connections: Wire markers.

2.02 MANUFACTURERS

A. Brady Corporation: www.bradycorp.com.
B. Seton Identification Products: www.seton.com/aec.
C. HellermannTyton: www.hellermanntyton.com.

2.03 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:
    1. Manufacturers:
        a. Brimar Industries, Inc: www.brimar.com/#sle.
        b. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
        c. Seton Identification Products: www.seton.com/#sle.
    2. Materials:
        a. Indoor Clean, Dry Locations: Use plastic nameplates.
        b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
    3. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
    4. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
    5. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
    6. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.
B. Identification Labels:
    1. Manufacturers:
        a. Brady Corporation: www.bradyid.com/#sle.
        b. Brother International Corporation: www.brother-usa.com/#sle.
        c. Panduit Corp: www.panduit.com/#sle.
    2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
    3. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.
C. Format for Equipment Identification:
    1. Minimum Size: 1 inch by 2.5 inches.
    2. Legend:
        a. System designation where applicable:
            1) Fire Alarm System: Identify with text "FIRE ALARM".
        b. Equipment designation or other approved description.
    3. Text: All capitalized unless otherwise indicated.
    4. Minimum Text Height:
        a. System Designation: 1 inch.

b. Equipment Designation: 1/2 inch.
c. Other Information: 1/4 inch.
d. Exception: Provide minimum text height of 1 inch for equipment located more than 10 feet above floor or working platform.

5. Color:
a. Normal Power System: White text on black background.
b. Fire Alarm System: White text on red background.

D. Format for General Information and Operating Instructions:
1. Minimum Size: 1 inch by 2.5 inches.
2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/4 inch.
5. Color: Black text on white background unless otherwise indicated.
a. Exceptions:
1) Provide white text on red background for general information or operational instructions for fire alarm systems.

E. Format for Receptacle Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
2. Legend: Power source and circuit number or other designation indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch.
5. Color: Black text on clear background.

F. Format for Fire Alarm Device Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
2. Legend: Designation indicated and device zone or address.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch.
5. Color: Red text on white background.

G. Nameplates: Engraved three-layer laminated plastic, black letters on white background.

H. Plastic: Conform to ASTM D 709.

I. Locations:
1. Each electrical distribution and control equipment enclosure.
2. Communication cabinets.

J. Letter Size:
1. Use 1/8 inch letters for identifying individual equipment and loads.
2. Use 1/4 inch letters for identifying grouped equipment and loads.

2.04 WIRE AND CABLE MARKERS

A. Manufacturers:
1. Brady Corporation: www.bradyid.com/#sle.
2. HellermannTyton: www.hellermanntyton.com/#sle.
3. Panduit Corp: www.panduit.com/#sle.

B. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.

C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.

D. Legend: Power source and circuit number or other designation indicated.

E. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.

F. Minimum Text Height: 1/8 inch.

G. Color: Black text on white background unless otherwise indicated.

H. Color: Black on white.

I. Description: Cloth type wire markers.

J. Locations: Each conductor at panelboard gutters, pull boxes, outlet boxes, and junction boxes each load connection.

K. Legend:
   1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.
   2. Control Circuits: Control wire number indicated on schematic and interconnection diagrams on drawings.

2.05 VOLTAGE MARKERS

A. Manufacturers:
   1. Brady Corporation: www.bradyid.com/#sle.
   2. Brimar Industries, Inc: www.brimar.com/#sle.
   3. Seton Identification Products: www.seton.com/#sle.

B. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.

C. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.

D. Minimum Size:
   1. Markers for Equipment: 1 1/8 by 4 1/2 inches.
   2. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
   3. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.
   4. Markers for Junction Boxes: 1/2 by 2 1/4 inches.

E. Legend:
   1. Markers for Voltage Identification: Highest voltage present.
   2. Markers for System Identification:
      a. Emergency Power System: Text "EMERGENCY".

F. Color: Black text on orange background unless otherwise indicated.

G. Description: Cloth type conduit markers.

H. Location: Furnish markers for each conduit longer than 6 feet.

I. Spacing: 20 feet on center.

J. Color:
   1. 208 Volt System: Orange.
   2. Fire Alarm System: Red.
   3. Telephone System: Gray.

K. Legend:
   1. 208 Volt System: 208 volts.
   2. Fire Alarm System: Fire Alarm.
   3. Telephone System: Telephone.

2.06 UNDERGROUND WARNING TAPE

A. Manufacturers:
   1. Brady Corporation; Model [_____]: www.bradyid.com/#sle.
   2. Brimar Industries, Inc: www.brimar.com/#sle.
   3. Seton Identification Products; Model [_____]: www.seton.com/#sle.

B. Materials: Use foil-backed detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.

C. Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.

D. Legend: Type of service, continuously repeated over full length of tape.

E. Color:
   1. Tape for Buried Power Lines: Black text on red background.
   2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.07 WARNING SIGNS AND LABELS

A. Manufacturers:
   1. Brimar Industries, Inc: www.brimar.com/#sle.
   2. Clarion Safety Systems, LLC: www.clarionsafety.com/#sle.
   3. Seton Identification Products: www.seton.com/#sle.

B. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

C. Warning Signs:
   1. Materials:
      a. Indoor Dry, Clean Locations: Use factory pre-printed rigid aluminum, rigid plastic, or self-adhesive vinyl signs.
      b. Outdoor Locations: Use factory pre-printed rigid aluminum signs.
   2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
   3. Minimum Size: 7 by 10 inches unless otherwise indicated.

D. Warning Labels:
   1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
      a. Do not use labels designed to be completed using handwritten text.
   2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
   3. Minimum Size: 2 by 4 inches unless otherwise indicated.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

B. Degrease and clean surfaces to receive nameplates and labels.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
   1. Surface-Mounted Equipment: Enclosure front.
   2. Flush-Mounted Equipment: Inside of equipment door.
   3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
   4. Elevated Equipment: Legible from the floor or working platform.
   5. Branch Devices: Adjacent to device.
   6. Interior Components: Legible from the point of access.
   7. Conduits: Legible from the floor.
   8. Boxes: Outside face of cover.
   9. Conductors and Cables: Legible from the point of access.

C. Install identification products centered, level, and parallel with lines of item being identified.

D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using Stainless Steel Screws.

E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

F. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.

G. Secure rigid signs using stainless steel screws.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

C. Secure nameplates to equipment front using screws. Adhesive backed nameplates will not be accepted.

**END OF SECTION 26 05 53**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes computer-based, fault-current and overcurrent protective device coordination studies, and the setting of these devices and an Arc Flash Hazard Analysis.
   1. Prepare a fault-current and coordination study and an Arc Flash Hazard Analysis for all existing and new electrical equipment and overcurrent devices to be installed under this project to assure proper equipment and personnel protection.
      a. Study shall be inclusive of all services being cutover to new transformer.
   2. The study shall present an organized time-current analysis of each protective device in series from the individual device back to the utility and the on-site generator sources. The study shall reflect the operation of each device during normal and abnormal current conditions.
   3. Provide study reports with Professional Engineer's seal verifying calculations. Certification shall be by a Professional Electrical Engineer with P.E. registration in the state in which the project is located. One copy is to have live seal. The remaining copies may have photocopies of the Engineer's seal.

1.03 SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.

C. Qualification Data: For coordination-study specialist.

D. Other Action Submittals:
   1. Coordination-study input data, including completed computer program input data sheets.
   2. Fault-current and coordination-study report.
   3. Equipment evaluation report.
   4. Setting report.
   5. Arc Flash Hazard Analysis results report.

1.04 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.

B. Coordination-Study Specialist Qualifications: An organization experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

C. Testing Agency Qualifications: Member company of the International Electrical Testing Association.
   1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association to supervise testing specified in Part 3.

D. Comply with IEEE 399 for general study procedures.

E. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

PART 2 - PRODUCTS

2.01 COMPUTER SOFTWARE DEVELOPERS

A. Computer Software Developer: Subject to compliance with requirements, provide computer software program by SKM Systems Analysis, Inc.

2.02 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

A. Comply with IEEE 399.

B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399, Table 7-4.

C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices.
   1. Optional Features:
      a. Arcing faults.
      b. Simultaneous faults.
      c. Explicit negative sequence.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance.

B. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices not submitted for approval with coordination study may not be used in study.

3.02 FAULT-CURRENT STUDY

A. Source Impedance: Utility Company's fault-current contribution as provided by local utility company.

B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project and use approved computer software program to calculate values. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

C. Calculate momentary and interrupting duties on the basis of maximum available fault current.

D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with the following:
   1. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.50.
   2. Low-Voltage Fuses: IEEE C37.46.
   3. Circuit Breakers: IEEE C37.13.

E. Study Report: Enter calculated X/R ratios and interrupting (5-cycle) fault currents on electrical distribution system one-line diagram of the report. List other output values from computer analysis, including momentary (1/2-cycle), interrupting (5-cycle), and 30-cycle fault-current values for 3-phase, 2-phase, and phase-to-ground faults.

F. Equipment Evaluation Report: Prepare a report on the adequacy of overcurrent protective devices and conductors by comparing fault-current ratings of these devices with calculated fault-current momentary and interrupting duties.

3.03 3.3

3.04 COORDINATION STUDY

A. Gather and tabulate the following input data to support coordination study:
   1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
   2. Impedance of utility service entrance.

3. Electrical distribution system one-line diagram showing the following:
   a. Load current that is the basis for sizing continuous ratings of circuits for cables and equipment.
   b. Circuit-breaker and fuse-current ratings and types.
   c. Relays and associated power and current transformer ratings and ratios.
   d. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
   e. Generator kilovolt amperes, size, voltage, and source impedance.
   f. Cables. Indicate conduit material, sizes of conductors, conductor insulation, and length.
   g. Busway ampacity and impedance.
   h. Motor horsepower and code letter designation according to NEMA MG 1.
4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram:
   a. Special load considerations, including starting inrush currents and frequent starting and stopping.
   b. Magnetic inrush current overload capabilities of transformers.
   c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
   d. Ratings, types, and settings of utility company's overcurrent protective devices.
   e. Special overcurrent protective device settings or types stipulated by utility company.
   f. Time-current-characteristic curves of devices indicated to be coordinated.
   g. Manufacturer, frame size, interrupting rating in amperes RMS symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
   h. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
   i. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes RMS symmetrical.

B. Perform coordination study and prepare a written report using the results of fault-current study and approved computer software program. Comply with IEEE 399.

C. Comply with NFPA 70 for overcurrent protection of circuit elements and devices.

D. Comply with IEEE 242 recommendations for fault currents and time intervals.

E. Transformer Primary Overcurrent Protective Devices:
   1. Device shall not operate in response to the following:
      a. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
      b. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
   2. Device shall protect transformer according to IEEE C57.12.00, for fault currents.

F. Motors served by voltages more than 600 V shall be protected according to IEEE 620.

G. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Verify adequacy of phase conductors at maximum three-phase bolted fault currents, equipment grounding conductors, and grounding electrode conductors at maximum ground-fault currents.

H. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
   1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
      a. Device tag.
      b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.

c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
d. Fuse-current rating and type.
e. Ground-fault relay-pickup and time-delay settings.

2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between series devices, including power utility company's upstream devices. Show the following specific information:
   a. Device tag.
   b. Voltage and current ratio for curves.
   c. Three-phase and single-phase damage points for each transformer.
   d. No damage, melting, and clearing curves for fuses.
   e. Cable damage curves.
   f. Transformer inrush points.
   g. Maximum fault-current cutoff point.
3. Completed data sheets for setting of overcurrent protective devices.

3.05 ARC FLASH HAZARD ANALYSIS STUDY

A. Provide an Arc Flash Hazard Analysis of the electrical distribution system. The Arc Flash Hazard Analysis will include the following:
   1. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for project and use approved compute software program to calculate values. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.
   2. Perform calculations based on compliance with NEC 110.16, OSHA, NFPA 70E and IEEE 1584 standards.
   3. Perform calculations of the potential incident energy that someone can be exposed to at the equipment locations during a fault event.
   4. Specify hazard category to determine the proper PPE (personal protective equipment) required.
   5. Specify the limited approach, restricted approach and prohibited approach boundaries for the specified hazard category.
   6. Provide PDF files ready for printing of equipment labels for each equipment identifying the above information.
   7. Provide printed adhesive labels to attach to each piece of equipment included in the analysis identifying the above hazard information.
   8. Provide a summary table of all equipment included in the analysis.
   9. Document results of the analysis in a report format, which will summarize the results of the analysis, PPE required, and define approach boundaries for all equipment analyzed.

3.06 OVERCURRENT PROTECTIVE DEVICE SETTING

A. Testing: Engage a qualified testing agency to perform the following device setting and to prepare test reports.
   1. After installing overcurrent protective devices and during energizing process of electrical distribution system, perform the following:
      a. Verify that overcurrent protective devices meet parameters used in studies.
      b. Adjust devices to values listed in study results.
   2. Adjust devices according to recommendations in Chapter 7, "Inspection and Test Procedures," and Tables 10.7 and 10.8 in NETA ATS.

**END OF SECTION 260574**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Electrical connections to equipment.

1.03 RELATED REQUIREMENTS

A. Section 260533.13 - Conduit for Electrical Systems.

B. Section 260533.16 - Boxes for Electrical Systems.

C. Section 262726 - Wiring Devices.

D. Section 262816.16 - Enclosed Switches.

E. Section 262913 - Enclosed Controllers.

1.04 REFERENCE STANDARDS

A. NEMA WD 1 - General Color Requirements for Wiring Devices 1999 (Reaffirmed 2015).

B. NEMA WD 6 - Wiring Devices - Dimensional Specifications 2016.

C. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
   2. Determine connection locations and requirements.

B. Sequencing:
   1. Install rough-in of electrical connections before installation of equipment is required.
   2. Make electrical connections before required start-up of equipment.

1.06 SUBMITTALS

A. See Section 01 33 00 - Submittial Procedures, for submittal procedures.

B. Product Data: Provide wiring device manufacturer’s catalog information showing dimensions, configurations, and construction.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.07 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.08 COORDINATION

A. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.

B. Determine connection locations and requirements.

C. Sequence rough-in of electrical connections to coordinate with installation of equipment.

D. Sequence electrical connections to coordinate with start-up of equipment.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
   1. Colors: Conform to NEMA WD 1.
   2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
   3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

B. Disconnect Switches: As specified in Section 262818 and in individual equipment sections.

C. Wiring Devices: As specified in Section 262726.

D. Flexible Conduit: As specified in Section 260533.13.

E. Wire and Cable: As specified in Section 260519.

F. Boxes: As specified in Section 260533.16.

2.02 EQUIPMENT CONNECTIONS

A. Electrical Connection: Cord and plug (NEMA 6-20R).

B. Provide field-installed disconnect switch.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 ELECTRICAL CONNECTIONS

A. Make electrical connections in accordance with equipment manufacturer's instructions.

B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.

C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.

D. Provide receptacle outlet to accommodate connection with attachment plug.

E. Provide cord and cap where field-supplied attachment plug is required.

F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.

H. Install terminal block jumpers to complete equipment wiring requirements.

I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

**END OF SECTION 26 27 17**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Occupancy sensors.

B. Outdoor motion sensors.

C. Time switches.

D. In-wall time switches.

E. Outdoor photo controls.

F. Daylighting controls.

G. Lighting contactors.

H. Accessories.

1.03 RELATED REQUIREMENTS

A. Section 260529 - Hangers and Supports for Electrical Systems

B. Section 260533.16 - Boxes for Electrical Systems.

C. Section 260573 - Overcurrent Protective Device Coordination and Arc Flash Hazard Analysis.

D. Section 262726 - Wiring Devices: Devices for manual control of lighting, including wall switches, wall dimmers, and fan speed controllers.

E. Section 265100 - Interior Lighting.

1.04 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices 2010.

C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2018.

D. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts 2016.

E. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts 2000, with Errata (2008).

F. NEMA ICS 6 - Industrial Control and Systems: Enclosures 1993 (Reaffirmed 2016).

G. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. UL 916 - Energy Management Equipment Current Edition, Including All Revisions.

I. UL 917 - Clock-Operated Switches Current Edition, Including All Revisions.

J. UL 1472 - Solid-State Dimming Controls Current Edition, Including All Revisions.

K. UL 60947-1 - Low-Voltage Switchgear and Controlgear - Part 1: General Rules Current Edition, Including All Revisions.

L. UL 60947-4-1 - Low-Voltage Switchgear and Controlgear - Part 4-1: Contactors and Motor-starters - Electromechanical Contactors and Motor-starters Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.

2. Coordinate the placement of wall switch occupancy sensors with actual installed door swings.
3. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.
4. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.06 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
   1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.

C. Shop Drawings:
   1. Daylighting Controls: Provide lighting plan indicating location, model number, and orientation of each photo sensor and associated system component.

D. Field Quality Control Reports.

E. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F. Operation and Maintenance Data: Include detailed information on device programming and setup.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Indicating Lights: Two of each different type.

H. Project Record Documents: Record actual installed locations and settings for lighting control devices.

1.07 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.08 DELIVERY, STORAGE, AND PROTECTION

A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.09 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.10 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer warranty for all occupancy sensors.

C. Provide five year manufacturer warranty for utility grade locking receptacle-mounted outdoor photo controls.

PART 2 PRODUCTS

2.01 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.

C. Products for Switching of Electronic Ballasts/Drivers: Tested and rated to be suitable for peak inrush currents specified in NEMA 410.

2.02 OCCUPANCY SENSORS

A. Manufacturers:
   1. Design Basis:

B. All Occupancy Sensors:
   1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
   2. Sensor Technology:
      a. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and ultrasonic technologies.
      b. Passive Infrared/Acoustic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and audible sound sensing technologies.
   3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
   4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.
   5. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
   6. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.

C. Wall Switch Occupancy Sensors:
   1. All Wall Switch Occupancy Sensors:
      a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
      b. Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.
   2. Passive Infrared/Ultrasonic Dual Technology Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.

D. Wall Dimmer Occupancy Sensors:
   1. General Requirements:
      a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated dimming control capability , and no leakage current to load in off mode.
      b. Dimmer: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, and listed as complying with UL 1472; type and rating suitable for load controlled.

E. Ceiling Mounted Occupancy Sensors:
   1. All Ceiling Mounted Occupancy Sensors:
      a. Description: Low profile occupancy sensors designed for ceiling installation.
      b. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
      c. Provide field selectable setting for disabling LED motion detector visual indicator.
      d. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.
   2. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
      a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
      b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
   3. Passive Infrared/Acoustic Dual Technology Ceiling Mounted Occupancy Sensors:
      a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
      b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 9 feet.

F. Luminaire Mounted Occupancy Sensors: Designed for direct luminaire installation and control, suitable for use with specified luminaires.

G. Power Packs for Low Voltage Occupancy Sensors:
   1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.
   2. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
   3. Input Supply Voltage: Dual rated for 120/277 V ac.
   4. Load Rating: As required to control the load indicated on drawings.

2.03 OUTDOOR MOTION SENSORS

A. Description: Factory-assembled wet location listed device suitable for wall or ceiling/eave mounting, with integral swivel for field adjustment of coverage, capable of detecting motion for automatic control of load indicated.

B. Sensor Technology: Passive Infrared (PIR) designed to detect occupancy by sensing movement of thermal energy between zones.

C. Operation: Unless otherwise indicated, motion sensor to turn load on when motion is detected and to turn load off when no motion is detected during an adjustable turn-off delay time interval.

D. Turn-Off Delay: Field adjustable, with time delay settings available up to 15 minutes.

E. Integral Photocell: For dusk to dawn operation.

F. Manual Override: Activated by switching power off to unit and then back on.

G. Load Rating: 1,000 W incandescent and fluorescent load at 120 V ac.

H. Coverage: Capable of detecting motion within a distance of 50 feet at a mounting height of 8 feet, with a field of view of 270 degrees.

2.04 TIME SWITCHES

A. Manufacturers:
   1. Intermatic, Inc: www.intermatic.com/#sle.
   2. Tork, a division of NSI Industries LLC; www.tork.com/#sle.
   3. Substitutions: See Section 016000 - Product Requirements.

B. Digital Electronic Time Switches:

1. Description: Factory-assembled solid state programmable controller with LCD display, listed and labeled as complying with UL 916 or UL 917.
2. Program Capability:
3. Schedule Capacity: Not less than 16 programmable on/off operations.
4. Provide automatic daylight savings time and leap year compensation.
5. Provide power outage backup to retain programming and maintain clock.
6. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.
7. Provide remote photocell input with light level adjustment.
8. Input Supply Voltage: As indicated on the drawings.
9. Provide lockable enclosure; environmental type per NEMA 250 as specified for the following installation locations:
    a. Indoor clean, dry locations: Type 1.
    b. Outdoor locations: Type 3R.

2.05 IN-WALL TIME SWITCHES

A. Manufacturers:
1. Intermatic, Inc: www.intermatic.com/#sle.
2. Tork, a division of NSI Industries LLC: www.tork.com/#sle.

2.06 OUTDOOR PHOTO CONTROLS

A. Manufacturers:
1. Intermatic, Inc: www.intermatic.com/#sle.
2. Tork, a division of NSI Industries LLC: www.tork.com/#sle.
3. Substitutions: See Section 016000 - Product Requirements.

2.07 DAYLIGHTING CONTROLS

A. System Description: Control system consisting of photo sensors and compatible control modules and power packs, contactors, or relays as required for automatic control of load indicated according to available natural light; capable of integrating with occupancy sensors and manual override controls.

B. Dimming Photo Sensors: Photo sensor units with integral controller compatible with specified dimming ballasts, for direct continuous dimming of up to 50 ballasts.

C. Daylighting Control Switching Modules for Low Voltage Sensors: Low voltage class 2 control unit compatible with specified photo sensors, for switching of compatible power packs, contactors, or relays in response to changes in measured light levels according to selected settings.
1. Operation: Unless otherwise indicated, load to be turned on when light level is below selected low set point and load to be turned off when light level is above selected high set point, with a no switching dead band between set points to prevent unwanted cycling.
2. Input Delay: To prevent unwanted cycling due to intermittent light level fluctuations.
3. Control Capability:

2.08 LIGHTING CONTACTORS

A. Description: Magnetic lighting contactors complying with NEMA ICS 2, and listed and labeled as complying with UL 60947-1 and UL 60947-4-1; noncombination type unless otherwise indicated; ratings, configurations and features as indicated on the drawings.

B. Short Circuit Current Rating:
1. Provide contactors with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 260573.

C. Enclosures:
1. Comply with NEMA ICS 6.

2. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
3. Finish: Manufacturer's standard unless otherwise indicated.

2.09 ACCESSORIES

A. Fire-Rated Device Enclosures:
1. Provide as required to preserve fire resistance rating of building elements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.

F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.

G. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of lighting control devices provided under this section.

C. Install lighting control devices in accordance with manufacturer's instructions.

D. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

E. Install lighting control devices plumb and level, and held securely in place.

F. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 262726.

G. Provide required supports in accordance with Section 260529.

H. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

I. Occupancy Sensor Locations:
1. Location Adjustments: Within the design intent, reasonably minor adjustments to locations may be made in order to optimize coverage and avoid conflicts or problems affecting coverage.
2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors a minimum of 4 feet from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.

J. Outdoor Photo Control Locations:
   1. Where possible, locate outdoor photo controls with photo sensor facing north. If north facing photo sensor is not possible, install with photo sensor facing east, west, or down.
   2. Locate outdoor photo controls so that photo sensors do not face artificial light sources, including light sources controlled by the photo control itself.

K. Install outdoor photo controls so that connections are weatherproof. Do not install photo controls with conduit stem facing up in order to prevent infiltration of water into the photo control.

L. Daylighting Control Photo Sensor Locations:
   1. Unless otherwise indicated, locate photo sensors for closed loop systems to accurately measure the light level controlled at the designated task location, while minimizing the measured amount of direct light from natural or artificial sources such as windows or pendant luminaires.
   2. Unless otherwise indicated, locate photo sensors for open loop systems to accurately measure the level of daylight coming into the space, while minimizing the measured amount of lighting from artificial sources.

M. Lamp Burn-In: Operate lamps at full output for minimum of 100 hours or prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

N. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel in inaccessible ceiling near the sensor location.

O. Unless otherwise indicated, install switches on load side of power packs so that switch does not turn off power pack.

## 3.04 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect each lighting control device for damage and defects.

C. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.

D. Test time switches to verify proper operation.

E. Test outdoor photo controls to verify proper operation, including time delays where applicable.

F. Test daylighting controls to verify proper operation, including light level measurements and time delays where applicable. Record test results in written report to be included with submittals.

G. Correct wiring deficiencies and replace damaged or defective lighting control devices.

## 3.05 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect.

C. Adjust position of directional occupancy sensors and outdoor motion sensors to achieve optimal coverage as required.

D. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.

E. Adjust time switch settings to achieve desired operation schedule as indicated or as directed by Architect. Record settings in written report to be included with submittals.

F. Adjust daylighting controls under optimum lighting conditions after all room finishes, furniture, and window treatments have been installed to achieve desired operation as indicated or as directed by Architect. Record settings in written report to be included with submittals. Readjust

controls calibrated prior to installation of final room finishes, furniture, and window treatments that do not function properly as determined by Architect.

3.06 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.07 COMMISSIONING

A. See Section 019113 - General Commissioning Requirements for commissioning requirements.

3.08 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of lighting control devices to Architect, and correct deficiencies or make adjustments as directed.

B. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of two hours of training.
   3. Instructor: Qualified contractor familiar with the project and with sufficient knowledge of the installed lighting control devices.
   4. Location: At project site.

**END OF SECTION**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Electrical service requirements.

1.03 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Materials and installation requirements for cast-in-place concrete equipment pads.

B. Section 260519 - Low-Voltage Power Conductors & Cables (600 V & Less).

C. Section 260526 - Grounding and Bonding for Electrical Systems.

D. Section 260529 - Hangers and Supports for Electrical Systems.

E. Section 260533.13 - Conduit for Electrical Systems.

F. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

G. Section 262416 - Panelboards: Service entrance equipment.

H. Section 263213 - Engine Generators: Emergency/standby power systems for interconnection with normal utility electrical supply.

I. Section 263600 - Transfer Switches: Service entrance equipment.

J. Section 264300 - Surge Protective Devices: Service entrance surge protective devices.

K. Section 312316 - Excavation.

L. Section 312323 - Fill: Bedding and backfilling.

1.04 PRICE AND PAYMENT PROCEDURES

A. Allowances:
   1. See Section 012100 - Allowances, for allowances affecting this section.
   2. Include cash allowance for Utility Company charges associated with providing service.

1.05 DEFINITIONS

A. Service Point: The point of connection between the facilities of the serving utility and the premises wiring as defined in NFPA 70, and as designated by the Utility Company.

1.06 REFERENCE STANDARDS

A. IEEE C2 - National Electrical Safety Code 2017.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

C. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.07 ADMINISTRATIVE REQUIREMENTS

A. No later than two weeks following date of the Agreement, notify Utility Company of anticipated date of service.

B. Coordination:
   1. Verify the following with Utility Company representative:
      a. Utility Company requirements, including division of responsibility.
      b. Exact location and details of utility point of connection.
      c. Utility easement requirements.
      d. Utility Company charges associated with providing service.
   2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for electrical service and associated equipment.

3. Coordinate arrangement of service entrance equipment with the dimensions and clearance requirements of the actual equipment to be installed.
4. Coordinate the work with other installers to provide communication lines required for Utility Company meters.
5. Notify architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

C. Arrange for Utility Company to provide permanent electrical service. Prepare and submit documentation required by Utility Company.

D. Utility Company charges associated with providing permanent service to be paid by Owner.

E. Preinstallation Meeting: Convene one week prior to commencing work of this section to review service requirements and details with Utility Company representative.

F. Scheduling:
1. Where work of this section involves interruption of existing electrical service, arrange service interruption with owner.
2. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.08 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product. Include ratings, configurations, standard wiring diagrams, outline and support point dimensions, finishes, weights, service condition requirements, and installed features.

C. Shop Drawings: Include dimensioned plan views and sections indicating locations and arrangement of Utility Company and service entrance equipment, metering provisions, required clearances, and proposed service routing.
1. Obtain Utility company approval of shop drawings prior to submittal.

D. Project Record Documents: Record actual locations of equipment and installed service routing.

1.09 QUALITY ASSURANCE

A. Comply with the following:
1. IEEE C2 (National Electrical Safety Code).
2. NFPA 70 (National Electrical Code).
3. The requirements of the Utility Company.
4. The requirements of the local authorities having jurisdiction.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

B. Store products indoors in a clean, dry space having a uniform temperature to prevent condensation (including outdoor rated products which are not weatherproof until completely and properly installed). Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle products carefully to avoid damage to internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 ELECTRICAL SERVICE REQUIREMENTS

A. Provide new electrical service consisting of all required conduits, conductors, equipment, metering provisions, supports, accessories, etc. as necessary for connection between Utility Company point of supply and service entrance equipment for each new and reconnected service affected by this project.

B. Electrical Service Characteristics: As indicated on drawings.

C. Utility Company: NYSEG.
   1. Point of Contact: Steve Imperiale.
   2. Address: 35 Milan Rd, Brewster, NY 10509.
   3. Phone: 585-484-2334.
   4. Email: simperiale@nyseg.com.

D. Division of Responsibility:
   1. Pad-Mounted Utility Transformers:
      a. Transformer Vaults and Pads: Furnished and installed by Contractor per Utility Company requirements.
      b. Transformers: Furnished and installed by Utility Company.
      c. Transformer Grounding Provisions: Furnished and installed by Contractor per Utility Company requirements.
      d. Transformer Protective Bollards: Furnished and installed by Contractor per Utility Company requirements.
      e. Primary:
         1) Trenching and Backfilling: Provided by Contractor.
         2) Conduits: Furnished and installed by Contractor.
         3) Conductors: Furnished and installed by Utility Company.
      f. Secondary:
         1) Trenching and Backfilling: Provided by Contractor.
         2) Conduits: Furnished and installed by Contractor.
         3) Conductors: Furnished and installed by Contractor (Service Point at transformer).
   2. Terminations at Service Point: Provided by Utility Company.
   3. Metering Provisions:
      a. Meter Bases: Furnished by Utility Company and installed by Contractor.
      b. Metering Transformer Cabinets: Furnished by Utility Company and Installed by Contractor.
      c. Metering Compartments in Service Entrance Equipment: Furnished by Utility Company and Installed by Contractor.
      d. Metering Transformers: Furnished and installed by Utility Company.
      e. Conduits Between Metering Transformers and Meters: Furnished and installed by Contractor per Utility Company requirements.
      f. Wiring Between Metering Transformers and Meters: Furnished and installed by Utility Company.
      g. Communications Conduits for Meters: Furnished and installed by Contractor per Utility Company requirements.

E. Products Furnished by Contractor: Comply with Utility Company requirements.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that ratings and configurations of service entrance equipment are consistent with the indicated requirements.

C. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 PREPARATION

### 3.03 INSTALLATION

A. Install products in accordance with manufacturer's instructions and Utility Company requirements.

B. Coordinate with utility company for all requirements.

C. Perform work in accordance with NECA 1 (general workmanship).

D. Arrange equipment to provide minimum clearances and required maintenance access.

E. Provide required trenching and backfilling in accordance with Section 312316 and Section 312323.

F. Construct cast-in-place concrete pads for utility equipment in accordance with Utility Company requirements and Section 033000.

G. Provide required protective bollards in accordance with Utility Company requirements.

H. Provide required support and attachment components in accordance with Section 260529.

I. Provide grounding and bonding for service entrance equipment in accordance with Section 260526.

J. Identify service entrance equipment, including main service disconnect(s) in accordance with Section 260553.

3.04 PROTECTION

A. Protect installed equipment from subsequent construction operations.

**END OF SECTION**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Power distribution panelboards.

B. Lighting and appliance panelboards.

C. Overcurrent protective devices for panelboards.

1.03 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.

B. Section 260529 - Hangers and Supports for Electrical Systems.

C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

D. Section 260573 - Overcurrent Protective Device Coordination Study.

E. Section 262813 - Fuses: Fuses for fusible switches and spare fuse cabinets.

F. Section 264300 - Surge Protective Devices.

1.04 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service 2013e (Amended 2017).

B. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

C. NECA 407 - Standard for Installing and Maintaining Panelboards 2015.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2018.

E. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts 2000, with Errata (2008).

F. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum) 2013.

G. NEMA PB 1 - Panelboards 2011.

H. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less 2013.

I. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems 2017.

J. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

K. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.

L. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.

M. UL 67 - Panelboards Current Edition, Including All Revisions.

N. UL 98 - Enclosed and Dead-Front Switches Current Edition, Including All Revisions.

O. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures Current Edition, Including All Revisions.

P. UL 869A - Reference Standard for Service Equipment Current Edition, Including All Revisions.

Q. UL 943 - Ground-Fault Circuit-Interrupters Current Edition, Including All Revisions.

R. UL 1053 - Ground-Fault Sensing and Relaying Equipment Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
   4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
   5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.06 SUBMITTALS

A. See Section 01 33 00 - Submittial Procedures, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.

C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
   1. Include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.
   2. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.

F. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

G. Maintenance Materials: Furnish the following for TOwner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Panelboard Keys: Two of each different key.
   3. See Section 262813 for requirements for spare fuses and spare fuse cabinets.

1.07 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.09 FIELD CONDITIONS

A. Maintain ambient temperature within the following limits during and after installation of panelboards:
   1. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

1.10 MAINTENANCE MATERIALS

A. See Section 016000 - Product Requirements, for additional provisions.

B. Furnish two of each panelboard key.

1.11 COMMISSIONING

A. Where indicated in the equipment or commissioning specifications, engage a factory-authorized service representative, to perform startup service as per functional test sheets and requirements of Section 01 91 13 - General Commissioning Requirements.

B. Complete installation, startup checks and functional tests according to Section 01 91 13 - General Commissioning Requirements and manufacturers written instructions.

C. Operational Test: After electrical system has been energized, start units to confirm proper unit operation. Rectify malfunctions, replace defective parts with new ones and repeat the start up procedure.

D. Verify that equipment is installed and commissioned as per requirements of Section 01 91 13 and manufacturers written instructions/requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Schneider Electric; Square D Products[<>]: www.schneider-electric.us/#sle.

B. Eaton Corporation; Cutler-Hammer Products: www.eaton.com/#sle.

C. Siemens; www.siemens.com.

D. Source Limitations: Furnish panelboards and associated components produced by a single manufacturer and obtained from a single supplier.

2.02 ALL PANELBOARDS

A. Provide products listed and labeled by Underwriters Laboratories Inc. as suitable for the purpose indicated.

B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6,600 feet.
   2. Ambient Temperature:
      a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

C. Short Circuit Current Rating:
   1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 260573.

D. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.

E. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.

F. Bussing: Sized in accordance with UL 67 temperature rise requirements.
   1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
   2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.

G. Conductor Terminations: Suitable for use with the conductors to be installed.

H. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1.
      b. Outdoor Locations: Type 3R.
   2. Boxes: Galvanized steel unless otherwise indicated.
      a. Provide wiring gutters sized to accommodate the conductors to be installed.
      b. Increase gutter space as required where sub-feed lugs, feed-through lugs, gutter taps, or oversized lugs are provided.
      c. Provide painted steel boxes for surface-mounted panelboards where indicated, finish to match fronts.
   3. Fronts:
      a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
      b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
      c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.
   4. Lockable Doors: All locks keyed alike unless otherwise indicated.

I. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

J. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 264300, list and label panelboards as a complete assembly including surge protective device.

K. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
   1. Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.

L. Multi-Section Panelboards: Provide enclosures of the same height, with feed-through lugs or sub-feed lugs and feeders as indicated or as required to interconnect sections.

M. Load centers are not acceptable.

N. Provide the following features and accessories where indicated or where required to complete installation:
   1. Feed-through lugs.
   2. Sub-feed lugs.

2.03 POWER DISTRIBUTION PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Conductor Terminations:
   1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
   2. Main and Neutral Lug Type: Mechanical.

C. Bussing:
   1. Phase and Neutral Bus Material: Aluminum.
   2. Ground Bus Material: Aluminum.

D. Circuit Breakers:
   1. Provide bolt-on type or plug-in type secured with locking mechanical restraints.

E. Enclosures:
   1. Provide flush-mounted enclosures unless otherwise indicated.

2. Fronts: Provide lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
3. Provide clear plastic circuit directory holder mounted on inside of door.

F. Description: NEMA PB 1, circuit breaker type.

G. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard.

H. Minimum integrated short circuit rating:
1. 208 Volt Panelboards: 65,000 amperes rms symmetrical.

I. Molded Case Circuit Breakers: With integral thermal and instantaneous magnetic trip in each pole; UL listed. For air conditioning equipment branch circuits provide circuit breakers UL listed as Type HACR.

J. Controllers: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower, with bimetal overload relay.
1. Coil operating voltage: 120 volts, 60 Hz.
2. Coil operating voltage: 120 volts, DC.
3. Size as shown on Drawings.
4. Provide unit mounted control power transformer, RED indicating light in front cover.

K. Circuit Breaker Accessories: Trip units and auxiliary switches as indicated.

L. Enclosure: NEMA PB 1, Type 1, 9.5 inches deep, 44.25 inches wide minimum, cabinet box.

M. Cabinet Front: Flush or surface type, fastened with concealed trim clamps, hinged door with flush lock, metal directory frame, finished in manufacturer's standard gray enamel.

2.04 LIGHTING AND APPLIANCE PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Conductor Terminations:
1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
2. Main and Neutral Lug Type: Mechanical.

C. Bussing:
1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
2. Phase and Neutral Bus Material: Aluminum.
3. Ground Bus Material: Aluminum.

D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.

E. Enclosures:
1. Provide surface-mounted or flush-mounted enclosures as indicated.
2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
3. Provide clear plastic circuit directory holder mounted on inside of door.

F. Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.

G. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard ; provide insulated ground bus where scheduled.

H. Minimum Integrated Short Circuit Rating:
1. 208 Volt Panelboards: 65,000 amperes rms symmetrical.

I. Molded Case Circuit Breakers: Thermal magnetic trip circuit breakers, bolt-on type, with common trip handle for all poles; UL listed.
1. Type SWD for lighting circuits.

2. Type HACR for air conditioning equipment circuits.
3. Class A ground fault interrupter circuit breakers where scheduled.
4. Do not use tandem circuit breakers.

J. Enclosure: NEMA PB 1, Type 1.

K. Cabinet Box: 6 inches deep, 20 inches wide for 240 volt and less panelboards, 20 inches wide for 480 volt panelboards.

L. Cabinet Front: Flush cabinet front with door in door construction, concealed hinge, metal directory frame, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

2.05 OVERCURRENT PROTECTIVE DEVICES

A. Fusible Switches:
1. Description: Quick-make, quick-break, dead-front fusible switch units complying with NEMA KS 1, and listed and labeled as complying with UL 98; ratings, configurations, and features as indicated on the drawings.
2. Fuse Clips: As required to accept indicated fuses.
a. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.
3. Provide externally operable handle with means for locking in the OFF position. Provide means for locking switch cover in the closed position. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
4. Conductor Terminations:
a. Provide mechanical lugs unless otherwise indicated.
b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

B. Molded Case Circuit Breakers:
1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
2. Interrupting Capacity:
a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated.
b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
3. Conductor Terminations:
a. Provide mechanical lugs unless otherwise indicated.
b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
5. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
6. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
7. Provide the following circuit breaker types where indicated:
a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
b. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.
c. 100 Percent Rated Circuit Breakers: Listed for application within the panelboard where installed at 100 percent of the continuous current rating.
d. Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle wave of the symmetrical prospective current when operating within its current limiting range.

8. Provide listed switching duty rated circuit breakers with SWD marking for all branch circuits serving fluorescent lighting.
9. Do not use tandem circuit breakers.
10. Do not use handle ties in lieu of multi-pole circuit breakers.
11. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.
12. Provide the following features and accessories where indicated or where required to complete installation:
    a. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
    b. Handle Pad-Lock Provision: For locking circuit breaker handle in OFF position.

2.06 SOURCE QUALITY CONTROL

A. Factory test panelboards according to NEMA PB 1.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive panelboards.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install panelboards securely, in a neat and workmanlike manner in accordance with NECA 1 (general workmanship), NECA 407 (panelboards), NEMA PB 1.1, NECA 1 (general workmanship), NECA 407 (panelboards), NEMA PB 1.1, NECA 1 (general workmanship), NECA 407 (panelboards), and NEMA PB 1.1.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required supports in accordance with Section 260529.

E. Install panelboards plumb.

F. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.

G. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.

H. Mount floor-mounted power distribution panelboards on properly sized 3 inch high concrete pad constructed in accordance with Section 033000.

I. Provide minimum of six spare 1 inch trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.

J. Provide grounding and bonding in accordance with Section 260526.
    1. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on isolated/insulated ground bus.

K. Install all field-installed branch devices, components, and accessories.

L. Provide fuses complying with Section 262813 for fusible switches as indicated.

M. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

N. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed according to Section 260573.

O. Set field-adjustable ground fault protection pickup and time delay settings as indicated.

P. Install panelboards in accordance with NEMA PB 1.1 and NECA 1.

Q. Install panelboards plumb. Install recessed panelboards flush with wall finishes.

R. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.

S. Provide filler plates to cover unused spaces in panelboards.

T. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated. Also provide for the following:
   1. Emergency and night lighting circuits.
   2. Fire detection and alarm circuits.
   3. Communications equipment circuits.
   4. Intrusion detection and access control system circuits.
   5. Video surveillance system circuits.

U. Identify panelboards in accordance with Section 260553.

V. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.

W. Provide engraved plastic nameplates under the provisions of Section 260553.

X. Provide spare conduits out of each recessed panelboard to an accessible location above ceiling. Identify each as SPARE.

Y. Ground and bond panelboard enclosure according to Section 260526.

3.03 FIELD QUALITY CONTROL

A. Perform field inspection and testing in accordance with Section 014000.

B. Inspect and test in accordance with NETA STD ATS, except Section 4.

C. Fusible Switches: Perform inspections and tests listed in NETA STD ATS, Section 7.5.1.1.

D. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA STD ATS, Section 7.6.1.1 for all main circuit breakers. Tests listed as optional are not required.

E. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.

F. Test GFCI circuit breakers to verify proper operation.

G. Test shunt trips to verify proper operation.

H. Procure services of a qualified manufacturer's representative to observe installation and assist in inspection, testing, and adjusting. Include manufacturer's reports with field quality control submittals.

I. Correct deficiencies and replace damaged or defective panelboards or associated components.

J. Perform inspections and tests listed in NETA STD ATS, Section 7.5 for switches, Section 7.6 for circuit breakers.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of panelboard fronts.

C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 10 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.05 CLEANING

A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

**END OF SECTION 26 24 16**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Wall switches.

B. Wall dimmers.

C. Fan speed controllers.

D. Receptacles.

E. Wall plates.

1.03 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.

B. Section 07 84 00 - Firestopping

C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

1.04 REFERENCE STANDARDS

A. FS W-C-596 - Connector, Electrical, Power, General Specification for 2017h.

B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush-mounted (General Specification) 2017g.

C. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

D. NEMA WD 1 - General Color Requirements for Wiring Devices 1999 (Reaffirmed 2015).

E. NEMA WD 6 - Wiring Devices - Dimensional Specifications 2016.

F. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. UL 20 - General-Use Snap Switches Current Edition, Including All Revisions.

H. UL 498 - Attachment Plugs and Receptacles Current Edition, Including All Revisions.

I. UL 514D - Cover Plates for Flush-Mounted Wiring Devices Current Edition, Including All Revisions.

J. UL 943 - Ground-Fault Circuit-Interrupters Current Edition, Including All Revisions.

K. UL 1472 - Solid-State Dimming Controls Current Edition, Including All Revisions.

L. UL 1917 - Solid-State Fan Speed Controls Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
5. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

B. Sequencing:

1. Do not install wiring devices until final surface finishes and painting are complete.

1.06 SUBMITTALS

A. See Section 01 33 00 - Submittial Procedures, for submittal procedures.

B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

D. Operation and Maintenance Data:
   1. Wall Dimmers: Include information on operation and setting of presets.
   2. GFI Receptacles: Include information on status indicators and testing procedures and intervals.

E. Project Record Documents: Record actual installed locations of wiring devices.

F. Maintenance Materials: Furnish the following for owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.

1.07 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.08 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

1.09 EXTRA MATERIALS

A. See Section 016000 - Product Requirements, for additional provisions.

B. Furnish two of each style, size, and finish wall plate.

C. Provide two protective rings.

PART 2 PRODUCTS

2.01 APPLICATIONS

A. Provide wiring devices suitable for intended use and with ratings adequate for load served.

B. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.

C. Provide weather resistant GFI receptacles with specified weatherproof covers for all receptacles installed outdoors or in damp or wet locations.

D. Provide GFI protection for all receptacles installed within 6 feet of sinks.

E. Provide GFI protection for all receptacles installed in kitchens.

F. Provide GFI protection for all receptacles serving electric drinking fountains.

G. Provide GFI protection for all receptacles serving electric apparatus bay.

H. Unless noted otherwise, do not use combination switch/receptacle devices.

2.02 WIRING DEVICE FINISHES:

2.03 WALL SWITCHES

A. All Wall Switches: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20and where applicable FS W-S-896; types as indicated on the drawings.

1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.

B. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

C. Wall Switches: Heavy Duty, AC only general-use snap switch, complying with NEMA WD 6 and WD 1.
1. Ratings:
a. Voltage: 120 - 277 volts, AC.
b. Current: 20 amperes.

D. Switch Types: Single pole, double pole, 3-way, 4-way, pilot gang, and locking types.

2.04 WALL DIMMERS

A. All Wall Dimmers: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1472; types and ratings suitable for load controlled as indicated on the drawings.

B. Control: Slide control type with separate on/off switch.

C. Power Rating, Unless Otherwise Indicated or Required to Control the Load Indicated on the Drawings:

2.05 FAN SPEED CONTROLLERS

A. Description: 120 V AC, solid-state, full-range variable speed, slide control type with separate on/off switch, with integral radio frequency interference filtering, fan hum elimination circuitry, field-adjustable trim, power failure preset memory, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1917.
1. Current Rating: 1.5 A unless otherwise indicated or required to control the load indicated on the drawings.

2.06 RECEPTACLES

A. All Receptacles: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498and where applicable FS W-C-596; types as indicated on the drawings.
1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
2. NEMA configurations specified are according to NEMA WD 6.

B. Convenience Receptacles:
1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
2. Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, , listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.
3. Tamper Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, , listed and labeled as tamper resistant type; single or duplex as indicated on the drawings.
4. Tamper Resistant and Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, , listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.

C. GFI Receptacles:
1. All GFI Receptacles: Provide with feed-through protection, light to indicate ground fault tripped condition and loss of protection, and list as complying with UL 943, class A.

a. Provide test and reset buttons of same color as device.

2. Standard GFI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
3. Weather Resistant GFI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.
4. Tamper Resistant GFI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type.
5. Tamper Resistant and Weather Resistant GFI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.

D. Locking Receptacles: Industrial specification grade, configuration as indicated on the drawings.
1. Standard Locking Convenience Receptacles: Single, 20A, 125V, NEMA L5-20R.

E. Clock Hanger Receptacles: Single, 15A, 125V, NEMA 5-15R.

F. Receptacles: Heavy duty, complying with NEMA WD 6 and WD 1.
1. Configuration: NEMA WD 6, type as specified and indicated.

2.07 WALL PLATES

A. All Wall Plates: Comply with UL 514D.
1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
2. Size: Standard;.
3. Screws: Metal with slotted heads finished to match wall plate finish.

B. Nylon Wall Plates: Smooth finish, high-impact thermoplastic.

C. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.

D. Galvanized Steel Wall Plates: Rounded corners and edges, with corrosion resistant screws.

E. Weatherproof Cover Plates: Gasketed cast metal with hinged cover rated "Weatherproof while in use".

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that wall openings are neatly cut and will be completely covered by wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

F. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of wiring devices provided under this section.

1. Mounting Heights: Unless otherwise indicated, as follows:
   a. Wall Switches: 48 inches above finished floor.
   b. Receptacles: 18 inches above finished floor or 6 inches above counter.
2. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
3. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
4. Locate wall switches on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.
5. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.

C. Install wiring devices in accordance with manufacturer's instructions.

D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

E. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.

F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.

G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

H. For isolated ground receptacles, connect wiring device grounding terminal only to identified branch circuit isolated equipment grounding conductor. Do not connect grounding terminal to outlet box or normal branch circuit equipment grounding conductor.

I. Provide GFI receptacles with integral GFI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.

J. Install securely, in a neat and workmanlike manner, as specified in NECA 1.

K. Install wiring devices plumb and level with mounting yoke held rigidly in place.

L. Install wall switches with OFF position down.

M. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.

N. Do not share neutral conductor on branch circuits utilizing wall dimmers.

O. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.

P. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

Q. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

R. Identify wiring devices in accordance with Section 260553.

S. Install receptacles with grounding pole on top.

T. Connect wiring device grounding terminal to outlet box with bonding jumper.

U. Install decorative plates on switch, receptacle, and blank outlets in finished areas.

V. Connect wiring devices by wrapping conductor around screw terminal.

W. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

3.04 FIELD QUALITY CONTROL

A. Inspect each wiring device for damage and defects.

B. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.

C. Operate each wall switch with circuit energized and verify proper operation.

D. Verify that each receptacle device is energized.

E. Test each receptacle to verify operation and proper polarity.

F. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.

G. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.05 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

B. Adjust presets for wall dimmers according to manufacturer's instructions as directed by Architect.

3.06 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

**END OF SECTION 26 27 26**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Fuses.

B. Spare fuse cabinet.

1.03 RELATED REQUIREMENTS

A. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

B. Section 262816.16 - Enclosed Switches: Fusible switches.

1.04 REFERENCE STANDARDS

A. NEMA FU 1 - Low Voltage Cartridge Fuses 2012.

B. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements Current Edition, Including All Revisions.

D. UL 248-4 - Low-Voltage Fuses - Part 4: Class CC Fuses Current Edition, Including All Revisions.

E. UL 248-8 - Low-Voltage Fuses - Part 8: Class J Fuses Current Edition, Including All Revisions.

F. UL 248-10 - Low-Voltage Fuses - Part 10: Class L Fuses Current Edition, Including All Revisions.

G. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses Current Edition, Including All Revisions.

H. UL 248-15 - Low-Voltage Fuses - Part 15: Class T Fuses Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
3. Notify architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.06 SUBMITTALS

A. See Section 01 33 00 - Submittial Procedures, for submittal procedures.

B. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.

1. Spare Fuse Cabinet: Include dimensions.

C. Maintenance Materials: Furnish the following for owner's use in maintenance of project.

1. Spare Fuse Cabinet Keys: Two.

1.07 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles of Project.

D. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

1.08 MAINTENANCE MATERIALS

A. See Section 016000 - Product Requirements, for additional provisions.

B. Furnish two fuse pullers.

C. Furnish three of each size and type fuse installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Cutler-Hammer: www.cutler-hammer.eaton.com.

B. Littlefuse; www.littlefuse.com.

C. Bussman; www.bussman.com

2.02 APPLICATIONS

A. Feeders:
1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.

B. General Purpose Branch Circuits: Class RK1, time-delay.

C. Individual Motor Branch Circuits: Class RK1, time-delay.

2.03 FUSES

A. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose indicated.

B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.

C. Provide fuses of the same type, rating, and manufacturer within the same switch.

D. Comply with UL 248-1.

E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.

F. Voltage Rating: Suitable for circuit voltage.

G. Class R Fuses: Comply with UL 248-12.
1. Class RK1, Time-Delay Fuses:

H. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

I. Provide the following accessories where indicated or where required to complete installation:
1. Fuseholders: Compatible with indicated fuses.

J. Motor Branch Circuits: Class L time delay.

2.04 SPARE FUSE CABINET

A. Description: Wall-mounted sheet metal cabinet with shelves and hinged door with cylinder lock, suitably sized to store spare fuses and fuse pullers specified.

B. Finish: Manufacturer's standard, factory applied grey finish unless otherwise indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.

B. Verify that mounting surfaces are ready to receive spare fuse cabinet.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Do not install fuses until circuits are ready to be energized.

B. Install fuses with label oriented such that manufacturer, type, and size are easily read.

C. Install spare fuse cabinet as directed.

**END OF SECTION 26 28 13**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Enclosed safety switches.

B. Fusible switches.

C. Nonfusible switches.

1.03 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.

B. Section 260529 - Hangers and Supports for Electrical Systems.

C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

D. Section 260573 - Overcurrent Protective Device Coordination Study.

E. Section 262813 - Fuses.

1.04 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2018.

C. NEMA FU 1 - Low Voltage Cartridge Fuses; National Electrical Manufacturers Association; 2002.

D. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum) 2013.

E. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.

G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.

H. UL 98 - Enclosed and Dead-Front Switches Current Edition, Including All Revisions.

I. UL 869A - Reference Standard for Service Equipment Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.06 SUBMITTALS

A. See Section 01 33 00 - Submittial Procedures, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.

C. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and

installed features and accessories.

D. Project Record Documents: Record actual locations of enclosed switches.

E. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. See Section 262813 for requirements for spare fuses and spare fuse cabinets.

1.07 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

1.09 FIELD CONDITIONS

A. Maintain ambient temperature between -22 degrees F and 104 degrees F during and after installation of enclosed switches.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Schneider Electric; Square D Products[<>]: www.schneider-electric.us/#sle.

B. Eaton Corporation; Cutler-Hammer Products: www.eaton.com/#sle.

C. Siemens; www.siemens.com.

2.02 ENCLOSED SAFETY SWITCHES

A. Description: Quick-make, quick-break, enclosed safety switches complying with NEMA KS 1, type HD (heavy duty), and listed and labeled as complying with UL 98; ratings, configurations, and features as indicated on the drawings.

B. Provide products listed and labeled by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6,600 feet.
   2. Ambient Temperature: Between -22 degrees F and 104 degrees F.

D. Horsepower Rating: Suitable for connected load.

E. Voltage Rating: Suitable for circuit voltage.

F. Short Circuit Current Rating:
   1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 260573.

G. Enclosed Safety Switches Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

H. Provide with switch blade contact position that is visible when the cover is open.

I. Fuse Clips for Fusible Switches: As required to accept fuses indicated.
   1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.

J. Conductor Terminations: Suitable for use with the conductors to be installed.

K. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.

L. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.

M. Enclosures: Comply with NEMA KS 1 and NEMA 250, and list and label as complying with UL 50 and UL 50E.
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1.
      b. Outdoor Locations: Type 3R.
   2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.

N. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

O. Heavy Duty Switches:
   1. Conductor Terminations:
      a. Provide mechanical lugs unless otherwise indicated.
      b. Lug Material: Copper suitable for terminating copper conductors only.
   2. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.
      a. Provide means for locking handle in the ON position where indicated.

2.03 COMPONENTS

A. Fusible Switch Assemblies: NEMA KS 1, Type HD enclosed load interrupter knife switch.
   1. Externally operable handle interlocked to prevent opening front cover with switch in ON position.
   2. Handle lockable in OFF position.
   3. Fuse clips: Designed to accommodate NEMA FU1, Class R fuses.

B. Nonfusible Switch Assemblies: NEMA KS 1, Type HD enclosed load interrupter knife switch.
   1. Externally operable handle interlocked to prevent opening front cover with switch in ON position.
   2. Handle lockable in OFF position.

C. Enclosures: NEMA KS 1.
   1. Interior Dry Locations: Type 1.
   2. Exterior Locations: Type 3R.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive enclosed safety switches.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install enclosed switches in accordance with manufacturer's instructions.

B. Install enclosed switches securely, in a neat and workmanlike manner in accordance with NECA 1.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required supports in accordance with Section 260529.

E. Install enclosed switches plumb.

F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.

G. Provide grounding and bonding in accordance with Section 260526.

H. Provide fuses complying with Section 262813 for fusible switches as indicated or as required by equipment manufacturer's recommendations.

I. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

J. Identify enclosed switches in accordance with Section 260553.

K. Install fuses in fusible disconnect switches.

L. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.03 FIELD QUALITY CONTROL

A. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

**END OF SECTION 26 28 18**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

1.03 RELATED REQUIREMENTS

A. Section 260529 - Hangers and Supports for Electrical Systems.

B. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

C. Section 262813 - Fuses.

1.04 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

B. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts 2000, with Errata (2008).

C. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices 2017.

D. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum) 2013.

E. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems 2017.

F. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.05 SUBMITTALS

A. See Section 01 33 00 - Submittial Procedures, for submittal procedures.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles of Project.

1.07 COMMISSIONING

A. Where indicated in the equipment or commissioning specifications, engage a factory-authorized service representative, to perform startup service as per functional test sheets and requirements of Section 01 91 13 - General Commissioning Requirements.

B. Complete installation, startup checks and functional tests according to Section 01 91 13 - General Commissioning Requirements and manufacturers written instructions.

C. Operational Test: After electrical system has been energized, start units to confirm proper unit operation. Rectify malfunctions, replace defective parts with new ones and repeat the start up procedure.

D. Verify that equipment is installed and commissioned as per requirements of Section 01 91 13 and manufacturers written instructions/requirements.

E. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

F. Contractor shall replace all damaged components and components that failed the inspections at no additional charge.

G. Inspections by the Commissioning Agent shall be on “spot check basis”. Commissioning process does not reduce responsibility of installing contractors to provide a finished and fully functioning product.

H. This section shall in no way diminish the responsibility of the Contractors, Sub-contractors and Suppliers in performing all aspects of work and testing as outlined in the Contract Documents. Any requirements outlined in this section are in addition to requirements outlined in related specifications.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Eaton Corporation; Cutler-Hammer Product: www.eaton.com/#sle.

B. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.

C. Siemens; www.siemens.com.

D. Selector Switches: H-O-A Rotary type.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install enclosed controllers where indicated, in accordance with manufacturer's instructions.

B. Install securely, in a neat and workmanlike manner, as specified in NECA 1.

C. Provide supports in accordance with Section 260529.

D. Provide fuses for fusible switches; refer to Section 262813 for product requirements.

E. Identify enclosed controllers in accordance with Section 260553.

F. Provide engraved plastic nameplates; refer to Section 260553 for product requirements and location.

G. Neatly type label inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place label in clear plastic holder.

3.02 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA STD ATS, except Section 4.

**END OF SECTION 26 29 13**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including GeneralConditions and Division 1 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Packaged engine generator set.

B. Exhaust silencer and fittings.

C. Skid mounted fuel tank.

D. Remote control panel.

E. Battery and charger.

F. Weatherproof, sound attenuating enclosure.

1.03 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 220548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.

C. Section 220719 - Plumbing Piping Insulation.

D. Section 233100 - HVAC Ducts and Casings.

E. Section 263600 - Transfer Switches.

1.04 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

B. NECA/EGSA 404 - Standard for Installing Generator Sets 2014.

C. NEMA MG 1 - Motors and Generators 2018.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association; 2008.

E. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures; National Fire Protection Association; 2009.

G. NFPA 110 - Standard for Emergency and Standby Power Systems 2019.

H. UL 142 - Steel Aboveground Tanks for Flammable and Combustible Liquids Current Edition, Including All Revisions.

I. UL 1236 - Battery Chargers for Charging Engine-Starter Batteries Current Edition, Including All Revisions.

J. UL 2200 - Stationary Engine Generator Assemblies Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate compatibility of generator sets to be installed with work provided under other sections or by others.
    a. Transfer Switches: See Section 263600.
2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment or other potential obstructions within the spaces dedicated for engine generator system.
3. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.
4. Coordinate the work to provide electrical circuits suitable for the power requirements of the actual auxiliary equipment and accessories to be installed.

5. Notify architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Preinstallation Meeting: Convene one week before starting work of this section; require attendance of all affected installers.

1.06 SUBMITTALS

A. See Section 01 33 00 - Submittial Procedures, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features. Include alternator starting capabilities, engine fuel consumption rates, and cooling, combustion air, and exhaust requirements.
   1. Include generator set sound level test data.
   2. Include characteristic trip curves for overcurrent protective devices upon request.
   3. Include alternator thermal damage curve upon request.

C. Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing all factory and field connections.

D. Derating Calculations: Indicate ratings adjusted for applicable service conditions.

E. Fuel Storage Tank Calculations: Indicate maximum running time for generator set configuration provided.

F. Specimen Warranty: Submit sample of manufacturer's warranty.

G. Evidence of qualifications for installer.

H. Evidence of qualifications for maintenance contractor (if different entity from installer).

I. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.

J. Manufacturer's factory emissions certification.

K. Manufacturer's certification that products meet or exceed specified requirements.

L. Source quality control test reports.

M. Provide NFPA 110 required documentation from manufacturer where requested by authorities having jurisdiction, including but not limited to:
   1. Certified prototype tests.
   2. Torsional vibration compatibility certification.
   3. NFPA 110 compliance certification.
   4. Certified rated load test at rated power factor.

N. Manufacturer’s detailed field testing procedures.

O. Field quality control test reports.

P. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
   1. Include contact information for entity that will be providing contract maintenance and trouble call-back service.

Q. Executed Warranty: Submit documentation of final executed warranty completed in owner's name and registered with manufacturer.

R. Maintenance contracts.

S. Project Record Documents: Record actual locations of system components, installed circuiting arrangements and routing, and final equipment settings.

T. Maintenance Materials: Furnish the following for owner's use in maintenance of project.

1. See Section 016000 - Product Requirements, for additional provisions.
2. Extra Filter Elements: One of each type, including fuel, oil and air.

U. Shop Drawings: Indicate electrical characteristics and connection requirements. Show plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, electrical diagrams including schematic and interconnection diagrams.

V. Product Data: Provide data showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, control panel, battery, battery rack, battery charger, exhaust silencer, vibration isolators, day tank, and remote radiator.

W. Test Reports: Indicate results of performance testing.

X. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

Y. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

Z. Manufacturer's Field Reports: Indicate procedures and findings.

AA. Operation Data: Include instructions for normal operation.

BB. Maintenance Data: Include instructions for routine maintenance requirements, service manuals for engine and day tank, oil sampling and analysis for engine wear, and emergency maintenance procedures.

1.07 QUALITY ASSURANCE

A. Comply with the following:
1. NFPA 70 (National Electrical Code).
2. NFPA 37 (Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines).
3. NFPA 30 (Flammable and Combustible Liquids Code).

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
1. Authorized service facilities located within 200 miles of project site.

D. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience with engine generator systems of similar size, type, and complexity; manufacturer's authorized installer.

E. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.

F. Products: Listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authorities having jurisdiction as suitable for the purpose indicated.

G. Conform to requirements of NFPA 70.
1. Maintain one copy of each document on site.

H. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience with service facilities within 100 miles of Project.

I. Supplier Qualifications: Authorized distributor of specified manufacturer with minimum three years documented experience.

J. Products: Furnish products listed and classified by Underwriters Laboratories as suitable for purpose specified and indicated.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store generator sets in accordance with manufacturer's instructions and NECA/EGSA 404.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's instructions to avoid damage to generator set components, enclosure, and finish.

1.09 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.10 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Provide minimum five year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

C. Furnish service and maintenance of engine generator for two years from Date of Substantial Completion.

1.11 COMMISSIONING

A. Where indicated in the equipment or commissioning specifications, engage a factory-authorized service representative, to perform startup service as per functional test sheets and requirements of Section 01 91 13 - General Commissioning Requirements.

B. Complete installation, startup checks and functional tests according to Section 01 91 13 - General Commissioning Requirements and manufacturers written instructions.

C. Operational Test: After electrical system has been energized, start units to confirm proper unit operation. Rectify malfunctions, replace defective parts with new ones and repeat the start up procedure.

D. Verify that equipment is installed and commissioned as per requirements of Section 01 91 13 and manufacturers written instructions/requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Packaged Engine Generator Set - Basis of Design: Cummins Power Generation Inc<>: www.cumminspower.com/#sle..

B. Substitutions: Not Permitted.

2.02 PACKAGED ENGINE GENERATOR SYSTEM

A. Provide new engine generator system consisting of all required equipment, sensors, conduit, boxes, wiring, piping, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. System Description:
   1. Application: Emergency/standby.
   2. Configuration: Single packaged engine generator set operated independently (not in parallel).

D. Packaged Engine Generator Set:
   1. Type: Diesel (compression ignition).

E. Generator Set General Requirements:
   1. Prototype tested in accordance with NFPA 110 for Level 1 systems.
   2. Factory-assembled, with components mounted on suitable base.

3. List and label engine generator assembly as complying with UL 2200.
4. Power Factor: Unless otherwise indicated, specified power ratings are at 0.8 power factor for three phase voltages and 1.0 power factor for single phase voltages.
5. Provide suitable guards to protect personnel from accidental contact with rotating parts, hot piping, and other potential sources of injury.
6. Main Line Circuit Breakers: Provide factory-installed line side connections with suitable lugs for load side connections.

F. Service Conditions: Provide engine generator system and associated components suitable for operation under the service conditions at the installed location.

G. Starting and Load Acceptance Requirements:
1. Cranking Method: Cycle cranking complying with NFPA 110 (15 second crank period, followed by 15 second rest period, with cranking limiter time-out after 3 cycles), unless otherwise required.
2. Cranking Limiter Time-Out: If generator set fails to start after specified cranking period, indicate overcrank alarm condition and lock-out generator set from further cranking until manually reset.
3. Start Time: Capable of starting and achieving conditions necessary for load acceptance within 10 seconds (NFPA 110, Type 10).
4. Maximum Load Step: Supports 100 percent of rated load in one step.

H. Exhaust Emissions Requirements:
1. Comply with federal (EPA), state, and local regulations applicable at the time of commissioning; include factory emissions certification with submittals.
2. Do not make modifications affecting generator set factory emissions certification without approval of manufacturer and Engineer. Where such modifications are made, provide field emissions testing as necessary for certification.

I. Sound Level Requirements:
1. Comply with applicable noise level regulations.

J. Description: NFPA 110, engine generator system to provide source of power for Level 1 applications conforming to NFPA 99.

K. System Capacity: 400 kW, 500 kVA at elevation of 5000 feet above sea level, continuous rating using engine-mounted radiator.

2.03 ENGINE AND ENGINE ACCESSORY EQUIPMENT

A. Provide engine with adequate horsepower to achieve specified power output at rated speed, accounting for alternator efficiency and parasitic loads.

B. Engine Fuel System - Diesel (Compression Ignition):
1. Fuel Storage: Sub-base fuel tank.
2. Engine Fuel Supply: Provide engine-driven, positive displacement fuel pump with replaceable fuel filter(s), water separator, check valve to secure prime, manual fuel priming pump, and relief-bypass valve. Provide fuel cooler where recommended by manufacturer.
3. Engine Fuel Connections: Provide suitable, approved flexible fuel lines for coupling engine to fuel source.
4. Sub-Base Fuel Tank:
a. Provide sub-base mounted, double-wall fuel tank with secondary containment; listed and labeled as complying with UL 142.
b. Tank Capacity: Size for minimum of 72 hours of continuous engine generator operation at 100 percent rated load, but not larger than permissible by applicable codes.
c. Features:
1) Direct reading fuel level gauge.
2) Normal atmospheric vent.

3) Emergency pressure relief vent.
4) Fuel fill opening with lockable cap.
5) Dedicated electrical conduit stub-up area.
6) Low fuel level switch.
7) Leak detection switch; located within secondary containment interstitial space for detection of primary tank fuel leak.

C. Engine Starting System:
1. System Type: Electric, with DC solenoid-activated starting motor(s).
2. Battery(s):
a. Battery Type: Lead-acid.
b. Battery Capacity: Size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature; capable of providing cranking through two complete periods of cranking limiter time-outs without recharging.
c. Provide battery rack, cables, and connectors suitable for the supplied battery(s); size battery cables according to manufacturer's recommendations for cable length to be installed.
3. Battery-Charging Alternator: Engine-driven, with integral solid-state voltage regulation.
4. Battery Charger:
a. Provide dual rate battery charger with automatic float and equalize charging modes and minimum rating of 10 amps; suitable for maintaining the supplied battery(s) at full charge without manual intervention.
b. Capable of returning supplied battery(s) from fully discharged to fully charged condition within 24 hours, as required by NFPA 110 for Level 1 applications while carrying normal loads.
c. Recognized as complying with UL 1236.
d. Furnished with integral overcurrent protection; current limited to protect charger during engine cranking; reverse polarity protection.
e. Provide integral DC output ammeter and voltmeter with five percent accuracy.
f. Provide alarm output contacts as necessary for alarm indications.
5. Battery Heater: Provide thermostatically controlled battery heater to improve starting under cold ambient conditions.

D. Engine Speed Control System (Governor):
1. Single Engine Generator Sets (Not Operated in Parallel): Provide electronic isochronous governor for controlling engine speed/alternator frequency.
2. Frequency Regulation, Electronic Isochronous Governors: No change in frequency from no load to full load; plus/minus 0.25 percent at steady state.

E. Engine Lubrication System:
1. System Type: Full pressure, with engine-driven, positive displacement lubrication oil pump, replaceable full-flow oil filter(s), and dip-stick for oil level indication. Provide oil cooler where recommended by manufacturer.

F. Engine Cooling System:
1. System Type: Closed-loop, liquid-cooled, with unit-mounted radiator/fan and engine-driven coolant pump; suitable for providing adequate cooling while operating at full load under worst case ambient temperature.
2. Fan Guard: Provide suitable guard to protect personnel from accidental contact with fan.
3. Coolant Heater: Provide thermostatically controlled coolant heater to improve starting under cold ambient conditions; size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature.

G. Engine Air Intake and Exhaust System:
1. Air Intake Filtration: Provide engine-mounted, replaceable, dry element filter.

2. Engine Exhaust Connection: Provide suitable, approved flexible connector for coupling engine to exhaust system.

H. Type: Water-cooled inline or V-type, four stroke cycle, compression ignition Diesel internal combustion engine.

I. Rating: Sufficient to operate under 10 percent overload for one hour in an ambient of 95 degrees F at elevation of 5000 feet.

J. Fuel System: No. 2 fuel oil.

K. Engine speed: 1800 rpm.

L. Governor: Electronic type to maintain engine speed within 0.5 percent, steady state, and 0.5 percent, no load to full load, with recovery to steady state within 2 seconds following sudden load changes. Equip governor with means for manual operation and adjustment.

M. Safety Devices: Engine shutdown on high water temperature, low oil pressure, overspeed, and engine overcrank. Limits as selected by manufacturer.

N. Engine Starting: DC starting system with positive engagement, number and voltage of starter motors in accordance with manufacturer's instructions. Include remote starting control circuit, with MANUAL-OFF-REMOTE selector switch on engine-generator control panel.

O. Engine Jacket Heater: Thermal circulation type water heater with integral thermostatic control, sized to maintain engine jacket water at 90 degrees F, and suitable for operation on 120 volts AC.

P. Radiator: Radiator using glycol coolant, with blower type fan, sized to maintain safe engine temperature in ambient temperature of 110 degrees F. Radiator air flow restriction 0.5 inches of water maximum.

Q. Engine Accessories: Fuel filter, lube oil filter, intake air filter, lube oil cooler, fuel transfer pump, fuel priming pump, gear-driven water pump. Include fuel pressure gage, water temperature gage, and lube oil pressure gage on engine/generator control panel.

R. Mounting: Provide unit with suitable spring-type vibration isolators and mount on structural steel base.

2.04 GENERATOR SET CONTROL SYSTEM

A. Provide microprocessor-based control system for automatic control, monitoring, and protection of generator set. Include sensors, wiring, and connections necessary for functions/indications specified.

B. Control Panel:
1. Control Panel Mounting: Unit-mounted unless otherwise indicated; vibration isolated.
2. Generator Set Control Functions:
a. Automatic Mode: Initiates generator set start/shutdown upon receiving corresponding signal from remote device (e.g. automatic transfer switch).
b. Manual Mode: Initiates generator set start/shutdown upon direction from operator.
c. Reset Mode: Clears all faults, allowing generator set restart after a shutdown.
d. Emergency Stop: Immediately shuts down generator set (without time delay) and prevents automatic restarting until manually reset.
e. Cycle Cranking: Programmable crank time, rest time, and number of cycles.
f. Time Delay: Programmable for shutdown (engine cooldown) and start (engine warmup).
g. Voltage Adjustment: Adjustable through range of plus/minus 5 percent.
3. Generator Set Status Indications:
a. Voltage (Volts AC): Line-to-line, line-to-neutral for each phase.
b. Current (Amps): For each phase.
c. Frequency (Hz).
d. Real power (W/kW).
e. Reactive power (VAR/kVAR).

f. Apparent power (VA/kVA).
g. Power factor.
h. Duty Level: Actual load as percentage of rated power.
i. Engine speed (RPM).
j. Battery voltage (Volts DC).
k. Engine oil pressure.
l. Engine coolant temperature.
m. Engine run time.
n. Generator powering load (position signal from transfer switch).

4. Generator Set Protection and Warning/Shutdown Indications:
   a. Comply with NFPA 110; configurable for NFPA 110 Level 1 or Level 2, or NFPA 99 systems including but not limited to the following protections/indications:
      1) Overcrank (shutdown).
      2) Low coolant temperature (warning).
      3) High coolant temperature (warning).
      4) High coolant temperature (shutdown).
      5) Low oil pressure (warning).
      6) Low oil pressure (shutdown).
      7) Overspeed (shutdown).
      8) Low fuel level (warning).
      9) Low coolant level (warning/shutdown).
      10) Generator control not in automatic mode (warning).
      11) High battery voltage (warning).
      12) Low cranking voltage (warning).
      13) Low battery voltage (warning).
      14) Battery charger failure (warning).
   b. In addition to NFPA 110 requirements, provide the following protections/indications:
      1) High AC voltage (shutdown).
      2) Low AC voltage (shutdown).
      3) High frequency (shutdown).
      4) Low frequency (shutdown).
      5) Overcurrent (shutdown).
      6) Fuel tank leak (warning), where applicable.
   c. Provide contacts for local and remote common alarm.
   d. Provide lamp test function that illuminates all indicator lamps.
5. Other Control Panel Features:
   a. Event log.

C. Remote Annunciator:
1. Remote Annunciator Mounting: Wall-mounted; Provide flush-mounted annunciator for finished areas and surface-mounted annunciator for non-finished areas unless otherwise indicated.
2. Generator Set Status Indications:
   a. Generator powering load (via position signal from transfer switch).
   b. Communication functional.
3. Generator Set Warning/Shutdown Indications:
   a. Comply with NFPA 110 for Level 1 systems including but not limited to the following indications:
      1) Overcrank (shutdown).
      2) Low coolant temperature (warning).
      3) High coolant temperature (warning).
      4) High coolant temperature (shutdown).
      5) Low oil pressure (warning).
      6) Low oil pressure (shutdown).

7) Overspeed (shutdown).
8) Low fuel level (warning).
9) Low coolant level (warning/shutdown).
10) Generator control not in automatic mode (warning).
11) High battery voltage (warning).
12) Low cranking voltage (warning).
13) Low battery voltage (warning).
14) Battery charger failure (warning).
15) [_____].

b. Provide audible alarm with silence function.
c. Provide lamp test function that illuminates all indicator lamps.

D. Remote Emergency Stop: Provide approved red, mushroom style remote emergency stop button where indicated or required by authorities having jurisdiction. Coordinate location with owner.

2.05 GENERATOR SET ENCLOSURE

A. Enclosure Type: Sound attenuating, weather protective.

B. Enclosure Material: Steel or aluminum.

C. Hardware Material: Stainless steel.

D. Color: Manufacturer's standard.

E. Access Doors: Lockable, with all locks keyed alike.

F. Openings: Designed to prevent bird/rodent entry.

G. External Drains: Extend oil and coolant drain lines to exterior of enclosure for maintenance service.

H. Sound Attenuating Enclosures: Line enclosure with non-hydroscopic, self-extinguishing sound-attenuating material.

I. Enclosure Space Heater: Provide thermostatically controlled enclosure space heater to prevent condensation and improve starting under cold ambient conditions; size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature.

J. Provide power actuated, spring open louvers to minimize heat loss from space heater.

2.06 SOURCE QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Perform production tests on generator sets at factory to verify operation and performance characteristics prior to shipment. Include certified test report with submittals.

C. Generator Set production testing to include, at a minimum:
1. Operation at rated load and rated power factor.
2. Single step load pick-up.
3. Transient and steady state voltage and frequency performance.
4. Operation of safety shutdowns.

D. Diesel Fuel Storage Tanks: Perform pressurized leak test prior to shipment.

2.07 ACCESSORIES

A. Skid-Mounted Fuel Tank: 1000 gallon steel tank, with fill and vent.

B. Exhaust Silencer: Critical type silencer, with muffler companion flanges and flexible stainless steel exhaust fitting, sized in accordance with engine manufacturer's instructions.

C. Batteries: Heavy duty, diesel starting type lead-acid storage batteries, 170 ampere-hours minimum capacity. Match battery voltage to starting system. Include necessary cables and clamps.

D. Battery Tray: Treated for electrolyte resistance, constructed to contain spillage.

E. Battery Charger: Current limiting type designed to float at 2.17 volts per cell and equalize at 2.33 volts per cell. Include overload protection, full wave rectifier, DC voltmeter and ammeter, and 120 volts AC fused input. Provide wall-mounted enclosure to meet NEMA 250, Type 1 requirements.

F. Line Circuit Breaker: Molded case circuit breaker on generator output with integral thermal and instantaneous magnetic trip in each pole, sized in accordance with NFPA 70; UL listed. Include battery-voltage operated shunt trip, connected to open circuit breaker on engine failure. Unit mount in enclosure to meet NEMA 250, Type 1 requirements.
   1. Must comply with all recommendations in: Overcurrent Protective Device Coordination And Arc Flash Hazard Analysis.

G. Engine-Generator Control Panel: NEMA 250, Type 1 remote wall mounted control panel enclosure with engine and generator controls and indicators. Include provision for padlock and the following equipment and features:
   1. Frequency Meter: 45-65 Hz. range, 3.5 inch dial.
   2. AC Output Voltmeter: 3.5 inch dial, 2 percent accuracy, with phase selector switch.
   3. AC Output Ammeter: 3.5 inch dial, 2 percent accuracy, with phase selector switch.
   4. Output voltage adjustment.
   5. Push-to-test indicator lamps, one each for low oil pressure, high water temperature, overspeed, and overcrank.
   6. Engine start/stop selector switch.
   7. Engine running time meter.
   8. Oil pressure gage.
   9. Water temperature gage.
   10. Auxiliary Relay: 3PDT, operates when engine runs, with contact terminals prewired to terminal strip.
   11. Additional visual indicators and alarms as required by NFPA 110.
   12. Remote Alarm Contacts: Pre-wire SPDT contacts to terminal strip for remote alarm functions required by NFPA 110.

H. Remote Annunciator Panel: Surface mounted panel with brushed stainless steel. Provide alarm horn, and indicators and alarms as follows:
   1. High battery voltage (alarm).
   2. Low battery voltage (alarm).
   3. Low fuel (alarm).
   4. System ready.
   5. Anticipatory-high water temperature.
   6. Anticipatory-low oil pressure.
   7. Low coolant temperature.
   8. Switch in off position (alarm).
   9. Overcrank (alarm).
   10. Emergency stop (alarm).
   11. High water temperature (alarm).
   12. Overspeed (alarm).
   13. Low oil pressure (alarm).
   14. Line power available.
   15. Generator power available.
   16. Lamp test and horn silence switch.

I. Weather-Protective, sound attenuating enclosure: Reinforced steel housing allowing access to control panel and service points, with lockable doors and panels. Include louvers, battery rack, and silencer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that the ratings and configurations of generator sets and auxiliary equipment are consistent with the indicated requirements.

C. Verify that rough-ins for field connections are in the proper locations.

D. Verify that mounting surfaces are ready to receive equipment.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in a neat and workmanlike manner in accordance with NECA 1.

B. Install products in accordance with manufacturer's instructions.

C. Install generator sets and associated accessories in accordance with NECA/EGSA 404.

D. Arrange equipment to provide minimum clearances and required maintenance access.

E. Unless otherwise indicated, mount generator set on properly sized 6 inch high concrete pad constructed in accordance with Section 033000. Provide suitable vibration isolators, where not factory installed.

F. Provide required support and attachment in accordance with Section 260529.

G. Use manufacturer's recommended oil and coolant, suitable for the worst case ambient temperatures.

H. Provide diesel fuel piping and venting in accordance with Section 232113, where not factory installed.

I. Provide engine exhaust piping in accordance with Section 235100, where not factory installed.
   1. Include piping expansion joints, piping insulation, thimble, condensation trap/drain, rain cap, hangers/supports, etc. as indicated or as required.
   2. Do not exceed manufacturer's maximum back pressure requirements.

J. Provide grounding and bonding in accordance with Section 260526.

K. Identify system wiring and components in accordance with Section 260553.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Provide services of a manufacturer's authorized representative to prepare and start systems and perform inspection and testing. Include manufacturer's detailed testing procedures and field reports with submittals.

C. Notify owner and architect at least two weeks prior to scheduled inspections and tests.

D. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.

E. Provide all equipment, tools, and supplies required to accomplish inspection and testing, including load bank and fuel.

F. Preliminary inspection and testing to include, at a minimum:
   1. Inspect each system component for damage and defects.
   2. Verify tightness of mechanical and electrical connections are according to manufacturer's recommended torque settings.
   3. Check for proper oil and coolant levels.

G. Prepare and start system in accordance with manufacturer's instructions.

H. Perform acceptance test in accordance with NFPA 110.

I. Inspection and testing to include, at a minimum:

1. Verify compliance with starting and load acceptance requirements.
2. Verify voltage and frequency; make required adjustments as necessary.
3. Verify phase sequence.
4. Verify control system operation, including safety shutdowns.
5. Verify operation of auxiliary equipment and accessories (e.g. battery charger, heaters, etc.).
6. Perform load tests in accordance with NFPA 110 (1.5 hour building load test followed by 2 hour full load test).

J. Provide field emissions testing where necessary for certification.

K. Sound Level Tests: Measure sound levels for compliance with specified requirements. Identify and report ambient noise conditions.

L. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.

M. Submit detailed reports indicating inspection and testing results and corrective actions taken.

N. Provide the services of manufacturer's representative to prepare and start system.

O. Perform field inspection and testing in accordance with Section 014000.

P. Provide full load test utilizing portable test bank, if required, for four hours minimum. Simulate power failure including operation of transfer switch, automatic starting cycle, and automatic shutdown and return to normal.

Q. Record in 20 minute intervals during four hour test:
1. Kilowatts.
2. Amperes.
3. Voltage.
4. Coolant temperature.
5. Room temperature.
6. Frequency.
7. Oil pressure.

R. Test alarm and shutdown circuits by simulating conditions.

3.04 ADJUSTING

A. Adjust generator output voltage and engine speed.

3.05 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.06 CLOSEOUT ACTIVITIES

A. See Section 017800 - Closeout Submittals, for closeout submittals.

B. See Section 017900 - Demonstration and Training, for additional requirements.

C. Demonstration: Demonstrate proper operation of system to owner, and correct deficiencies or make adjustments as directed.

D. Training: Train owner's personnel on operation, adjustment, and maintenance of system.
1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Provide minimum of four hours of training.
3. Instructor: Manufacturer's authorized representative.
4. Location: At project site.

E. After successful acceptance test and just prior to Substantial Completion, replace air, oil, and fuel filters and fill fuel storage tank.

3.07 PROTECTION

A. Protect installed engine generator system from subsequent construction operations.

3.08 MAINTENANCE

A. See Section 017000 - Execution Requirements, for additional requirements relating to maintenance service.

B. Provide to owner a proposal as an alternate to the base bid, a separate maintenance contract for the service and maintenance of engine generator system for two years from date of Substantial Completion; Include a complete description of preventive maintenance, systematic examination, adjustment, inspection, and testing, with a detailed schedule.
   1. Maintenance must include all tests for NFPA compliance.

C. Provide trouble call-back service upon notification by owner:
   1. Provide on-site response within 4 hours of notification.
   2. Include allowance for call-back service during normal working hours at no extra cost to owner..
   3. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.

D. Maintain an on-site log listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced.

E. Provide a separate maintenance contract for specified maintenance service.

F. Provide service and maintenance of engine generator for one year from Date of Substantial Completion.

**END OF SECTION 26 32 13**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Transfer switches for low-voltage (600 V and less) applications and associated accessories:
   1. Automatic transfer switches.
   2. Non-automatic transfer switches.
   3. Remote annunciators.

1.03 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Housekeeping pads.

B. Section 260526 - Grounding and Bonding for Electrical Systems.

C. Section 260529 - Hangers and Supports for Electrical Systems.

D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

E. Section 260573 - Power System Studies.

F. Section 263213 - Engine Generators: For interface with transfer switches.

1.04 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2018.

C. NEMA ICS 10 Part 1 - Industrial Control and Systems Part 1: Electromechanical AC Transfer Switch Equipment 2020.

D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems 2017.

E. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. NFPA 110 - Standard for Emergency and Standby Power Systems 2019.

G. UL 1008 - Transfer Switch Equipment Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate compatibility of transfer switches to be installed with work provided under other sections or by others.
      a. Engine Generators: See Section 263213.
   2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
   3. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   4. Coordinate the work with placement of supports, anchors, etc. required for mounting.
   5. Notify H2M Architects + Engineers of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Preinstallation Meeting: Convene one week before starting work of this section; require attendance of all affected installers.

C. Where work of this section involves interruption of existing electrical service, arrange service interruption with Owner.

1.06 SUBMITTALS

A. See Section 01 33 00 - Submittial Procedures, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features.

C. Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing all factory and field connections.

D. Evidence of qualifications for installer.

E. Evidence of qualifications for maintenance contractor (if different entity from installer).

F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.

G. Manufacturer's certification that products meet or exceed specified requirements.

H. Source quality control test reports.

I. Manufacturer’s detailed field testing procedures.

J. Field quality control test reports.

K. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
   1. Include contact information for entity that will be providing contract maintenance and trouble call-back service.
   2. Include information for local service contract to provide all nfpa required testing for 3 years.

L. Executed Warranty: Submit documentation of final executed warranty completed in Owner's name and registered with manufacturer.

M. Maintenance contracts.

N. Project Record Documents: Record actual locations of system components, installed circuiting arrangements and routing, and final equipment settings.

1.07 QUALITY ASSURANCE

A. Comply with the following:
   1. NFPA 70 (National Electrical Code).
   2. NFPA 110 (Standard for Emergency and Standby Power Systems); meet requirements for system Level specified in Section 263213.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
   1. Authorized service facilities located within 100 miles of project site.

D. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience with power transfer systems of similar size, type, and complexity; manufacturer's authorized installer.

E. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.
   1. Contract maintenance office located within 100 miles of project site.

F. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having

jurisdiction.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store transfer switches in accordance with manufacturer's instructions.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's instructions to avoid damage to transfer switch components, enclosure, and finish.

1.09 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.10 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Provide minimum five year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

1.11 COMMISSIONING

A. Where indicated in the equipment or commissioning specifications, engage a factory-authorized service representative, to perform startup service as per functional test sheets and requirements of Section 01 91 13 - General Commissioning Requirements.

B. Complete installation, startup checks and functional tests according to Section 01 91 13 - General Commissioning Requirements and manufacturers written instructions.

C. Operational Test: After electrical system has been energized, start units to confirm proper unit operation. Rectify malfunctions, replace defective parts with new ones and repeat the start up procedure.

D. Verify that equipment is installed and commissioned as per requirements of Section 01 91 13 and manufacturers written instructions/requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Transfer Switches - Basis of Design: ASCO.

B. Transfer Switches:
1. ASCO Power Technologies, a brand of Emerson Network Power; 300 Series: www.emersonnetworkpower.com/#sle.
2. Eaton Corporation: www.eaton.com/#sle.
3. Same as manufacturer of engine generator(s) used for this project.

C. Substitutions: Not permitted.

2.02 TRANSFER SWITCHES

A. Provide complete power transfer system consisting of all required equipment, conduit, boxes, wiring, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Applications:
1. Utilize open transition transfer unless otherwise indicated or required.
2. Neutral Switching (Single Phase, Three Wire and Three Phase, Four Wire Systems):
   a. Unless otherwise indicated or required, provide solid (unswitched) neutral.
3. Provide signal before transfer contacts for transfer switches serving elevators.

D. Construction Type: Only "contactor type" (open contact) transfer switches are acceptable. Do not use "breaker type" (enclosed contact) transfer switches.

E. Automatic Transfer Switch:
   1. Basis of Design: ASCO 300.
   2. Transfer Switch Type: As indicated on the drawings.
   3. Transition Configuration: Open-transition (no neutral position), utilizing in-phase monitor.
   4. Voltage: As indicated on the drawings.
   5. Ampere Rating: As indicated on the drawings.
   6. Neutral Configuration: Solid neutral (unswitched), except as indicated.
   7. Load Served: As indicated on the drawings.

F. Non-Automatic Transfer Switch [_____]:
   1. Basis of Design: ASCO 300NTS.
   2. Transfer Switch Type: As indicated on the drawings.
   3. Transition Configuration: As indicated on the drawings.
   4. Voltage: As indicated on the drawings.
   5. Ampere Rating: As indicated on the drawings.
   6. Neutral Configuration: Solid neutral (unswitched), except as indicated.
   7. Load Served: As indicated on the drawings.

G. Comply with NEMA ICS 10 Part 1, and list and label as complying with UL 1008 for the classification of the intended application (e.g. emergency, optional standby).

H. Do not use double throw safety switches or other equipment not specifically designed for power transfer applications and listed as transfer switch equipment.

I. Load Classification: Classified for total system load (any combination of motor, electric discharge lamp, resistive, and tungsten lamp loads with tungsten lamp loads not exceeding 30 percent of the continuous current rating) unless otherwise indicated or required.

J. Switching Methods:
   1. Open Transition:
      a. Provide break-before-make transfer without a neutral position that is not connected to either source, and with interlocks to prevent simultaneous connection of the load to both sources.
      b. Where in-phase transfer is indicated, utilize in-phase monitor to initiate transfer when phase angle difference between sources is near zero to limit in-rush currents.
   2. Obtain control power for transfer operation from line side of source to which the load is to be transferred.

K. Service Conditions: Provide transfer switches suitable for continuous operation at indicated ratings under the service conditions at the installed location.

L. Enclosures:
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
   2. Finish: Manufacturer's standard unless otherwise indicated.

M. Short Circuit Current Rating:
   1. Withstand and Closing Rating: Provide transfer switches, when protected by the supply side overcurrent protective devices to be installed, with listed withstand and closing rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 260573.

N. Automatic Transfer Switches:
   1. Description: Transfer switches with automatically initiated transfer between sources; electrically operated and mechanically held.
   2. Control Functions:
      a. Automatic mode.

b. Test Mode: Simulates failure of primary/normal source.
c. Voltage and Frequency Sensing:
1) Undervoltage sensing for each phase of primary/normal source; adjustable dropout/pickup settings.
2) Undervoltage sensing for alternate/emergency source; adjustable dropout/pickup settings.
3) Underfrequency sensing for alternate/emergency source; adjustable dropout/pickup settings.
d. Outputs:
1) Contacts for engine start/shutdown (except where direct generator communication interface is provided).
2) Auxiliary contacts; one set(s) for each switch position.
e. Adjustable Time Delays:
1) Engine generator start time delay; delays engine start signal to override momentary primary/normal source failures.
2) Transfer to alternate/emergency source time delay.
3) Retransfer to primary/normal source time delay.
4) Engine generator cooldown time delay; delays engine shutdown following retransfer to primary/normal source to permit generator to run unloaded for cooldown period.
f. In-Phase Monitor (Open Transition Transfer Switches): Monitors phase angle difference between sources for initiating in-phase transfer.
g. Engine Exerciser: Provides programmable scheduled exercising of engine generator selectable with or without transfer to load; provides memory retention during power outage.
3. Status Indications:
a. Connected to alternate/emergency source.
b. Connected to primary/normal source.
c. Alternate/emergency source available.
4. Automatic Sequence of Operations:
a. Upon failure of primary/normal source for a programmable time period (engine generator start time delay), initiate starting of engine generator where applicable.
b. When alternate/emergency source is available, transfer load to alternate/emergency source after programmable time delay.
c. When primary/normal source has been restored, retransfer to primary/normal source after a programmable time delay. Bypass time delay if alternate/emergency source fails and primary/normal source is available.
d. Where applicable, initiate shutdown of engine generator after programmable engine cooldown time delay.

O. Non-Automatic Transfer Switches:
1. Description: Transfer switches with manually initiated transfer between sources; electrically operated and mechanically held.
2. Control Functions:
a. Manual source selection.
b. Outputs:
1) Auxiliary contacts; one set for each switch position.
3. Status Indications:
a. Connected to alternate/emergency source.
b. Connected to primary/normal source.
c. Alternate/emergency source available.

P. Remote Annunciators:
1. Remote Annunciator Mounting: Wall-mounted; Provide flush-mounted annunciator for finished areas and surface-mounted annunciator for non-finished areas unless otherwise

indicated.

2. Transfer Switch Status Indications:
   a. Connected to alternate/emergency source.
   b. Connected to primary/normal source.
   c. Alternate/emergency source available.

Q. Interface with Other Work:
   1. Interface with engine generators as specified in Section 263213.
   2. Interface with elevators as specified in Section 142010.
   3. Interface with Existing Work: [_____].

2.03 SOURCE QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Perform production tests on transfer switches at factory to verify operation and performance characteristics prior to shipment. Include certified test report with submittals.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that the ratings and configurations of transfer switches are consistent with the indicated requirements.

B. Verify that rough-ins for field connections are in the proper locations.

C. Verify that surface is suitable for transfer switch installation.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in a neat and workmanlike manner in accordance with NECA 1.

B. Install in accordance with manufacturer's instructions.

C. Arrange equipment to provide minimum clearances and required maintenance access.

D. Provide required support and attachment in accordance with Section 260529.

E. Install transfer switches plumb and level.

F. Unless otherwise indicated, mount floor-mounted transfer switches on properly sized 3 inch high concrete pad constructed in accordance with Section 033000.

G. Provide grounding and bonding in accordance with Section 260526.

H. Identify transfer switches in accordance with Section 260553.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Provide services of a manufacturer's authorized representative to observe installation and assist in inspection and testing. Include manufacturer's detailed testing procedures and field reports with submittals.

C. Prepare and start system in accordance with manufacturer's instructions.

D. Automatic Transfer Switches:
   1. Inspect and test in accordance with NETA ATS, except Section 4.
   2. Perform inspections and tests listed in NETA ATS, Section 7.22.3. The control wiring insulation-resistance tests listed as optional are not required.
      a. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.

E. Provide additional inspection and testing as required for completion of associated engine generator testing as specified in Section 263213.

F. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.

G. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.04 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.05 CLOSEOUT ACTIVITIES

A. See Section 017800 - Closeout Submittals, for closeout submittals.

B. See Section 017900 - Demonstration and Training, for additional requirements.

C. Demonstration: Demonstrate proper operation of transfer switches to Owner, and correct deficiencies or make adjustments as directed.

D. Training: Owner's personnel on operation, adjustment, and maintenance of transfer switches.

E. Coordinate with related generator demonstration and training as specified in Section 263213.

3.06 PROTECTION

A. Protect installed transfer switches from subsequent construction operations.

3.07 MAINTENANCE

A. See Section 017000 - Execution Requirements, for additional requirements relating to maintenance service.

B. Provide to Owner a proposal as an alternate to the base bid, a separate maintenance contract for the service and maintenance of transfer switches for three years from date of Substantial Completion; Include a complete description of preventive maintenance, systematic examination, adjustment, inspection, and testing (for NFPA Compliance), with a detailed schedule.

C. Conduct site visit at least once every three months to perform inspection, testing, and preventive maintenance. Submit report to Owner indicating maintenance performed along with evaluations and recommendations.

D. Maintain an on-site log listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced.

**END OF SECTION 26 36 00**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Surge protective devices for service entrance locations.

B. Surge protective devices for distribution locations.

C. Surge protective devices for branch panelboard locations.

1.03 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.

B. Section 262416 - Panelboards.

1.04 ABBREVIATIONS AND ACRONYMS

A. EMI/RFI: Electromagnetic Interference/Radio Frequency Interference.

B. SPD: Surge Protective Device.

1.05 REFERENCE STANDARDS

A. MIL-STD-220 - Method of Insertion Loss Measurement 2009c (Validated 2014).

B. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2018.

D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems 2017.

E. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 1283 - Standard for Electromagnetic Interference Filters Current Edition, Including All Revisions.

G. UL 1449 - Standard for Surge Protective Devices Current Edition, Including All Revisions.

1.06 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate size and location of overcurrent device compatible with the actual surge protective device and location to be installed. Notify architect of any conflicts or deviations from Contract Documents to obtain direction prior to ordering equipment.

1.07 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Include detailed component information, voltage, surge current ratings, repetitive surge current capacity, voltage protection rating (VPR) for all protection modes, maximum continuous operating voltage (MCOV), nominal discharge current (I-n), short circuit current rating (SCCR), connection means including any required external overcurrent protection, enclosure ratings, outline and support point dimensions, weight, service condition requirements, and installed features.
   1. SPDs with EMI/RFI filter: Include noise attenuation performance.

C. Shop Drawings: Include wiring diagrams showing all factory and field connections with wire and circuit breaker/fuse sizes.

D. Certificates: Manufacturer's documentation of listing for compliance with the following standards:
   1. UL 1449.
   2. UL 1283 (for Type 2 SPDs).

E. Field Quality Control Test Reports.

F. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

G. Operation and Maintenance Data: Include information on status indicators and recommended maintenance procedures and intervals.

H. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in owner's name and registered with manufacturer.

I. Project Record Documents: Record actual connections and locations of surge protective devices.

1.08 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.09 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in accordance with manufacturer's written instructions.

1.10 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.11 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Manufacturer's Warranty: Provide minimum five year warranty covering repair or replacement of surge protective devices showing evidence of failure due to defective materials or workmanship.

C. Exclude surge protective devices from any clause limiting warranty responsibility for acts of nature, including lightning, stated elsewhere.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Schneider Electric; Square D Brand Surgelogic Products : www.surgelogic.com/#sle..

B. Field-installed, Externally Mounted Surge Protective Devices:
   1. Current Technology; a brand of Thomas & Betts Power Solutions: www.tnbpowersolutions.com/#sle.
   2. Schneider Electric; Square D Brand Surgelogic Products: www.surgelogic.com/#sle.
   3. Surge Suppression, LLC (SSI): www.surgesuppression.com/#sle.

C. Factory-installed, Internally Mounted Surge Protective Devices:
   1. Same as manufacturer of equipment containing surge protective device, to provide a complete listed assembly including SPD.

D. Substitutions: See Section 016000 - Product Requirements.

E. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.

F. Source Limitations: Furnish surge protective devices produced by a single manufacturer and obtained from a single supplier.

2.02 SURGE PROTECTIVE DEVICES - GENERAL REQUIREMENTS

A. Description: Factory-assembled surge protective devices (SPDs) for 60 Hz service; listed, classified, and labeled as suitable for the purpose intended; system voltage as indicated on the drawings.

B. Unless otherwise indicated, provide factory-installed, internally-mounted SPDs.

C. List and label as complying with UL 1449, Type 1 when connected on line side of service disconnect overcurrent device and Type 1 or 2 when connected on load side of service disconnect overcurrent device.

D. Protected Modes:
   1. Wye Systems: L-N, L-G, N-G, L-L.

E. UL 1449 Voltage Protection Ratings (VPRs):

F. UL 1449 Maximum Continuous Operating Voltage (MCOV): Not less than 115% of nominal system voltage.

G. Enclosure Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
   1. Indoor clean, dry locations: Type 1.
   2. Outdoor locations: Type 3R.

H. Mounting for Field-installed, Externally Mounted SPDs: Unless otherwise indicated, as specified for the following locations:
   1. Provide surface-mounted SPD where mounted in non-public areas or adjacent to surface-mounted equipment.
   2. Provide flush-mounted SPD where mounted in public areas or adjacent to flush-mounted equipment.

I. Equipment Containing Factory-installed, Internally Mounted SPDs: Listed and labeled as a complete assembly including SPD.
   1. Panelboards: See Section 262416.
   2. Transfer Switches. See Section 263600.

2.03 SURGE PROTECTIVE DEVICES FOR SERVICE ENTRANCE LOCATIONS

2.04 SURGE PROTECTIVE DEVICES FOR DISTRIBUTION LOCATIONS

A. Distribution locations include SPDs connected to distribution panelboards, motor control centers, and busway.

B. Surge Protective Device:
   1. Basis of Design: Schneider Electric; Square D Brand Surgelogic Products : www.surgelogic.com/#sle..
   2. Protection Circuits: Field-replaceable modular or non-modular.
   3. Surge Current Rating: Not less than 160 kA per mode/320 kA per phase.
   4. Repetitive Surge Current Capacity: Not less than 3,500 impulses.
   5. UL 1449 Nominal Discharge Current (I-n): 20 kA.
   6. UL 1449 Short Circuit Current Rating (SCCR): Not less than the available fault current at the installed location as indicated on the drawings.
   7. EMI/RFI Filtering: Provide EMI/RFI filter to attenuate electrical noise; listed as complying with UL 1283 for Type 2 SPDs (UL 1283 listing not available for Type 1 SPDs).
      a. Noise Attenuation: Not less than 40 dB at 100 kHz using MIL-STD-220 insertion loss test method.
   8. Diagnostics:
      a. Protection Status Monitoring: Provide indicator lights to report the protection status for each phase.

b. Alarm Notification: Provide indicator light and audible alarm to report alarm condition. Provide button to manually silence audible alarm.
c. Remote Status Monitoring: Provide Form C dry type contacts (normally open and normally closed) for remote annunciation of status.
d. Surge Counter: Provide surge event counter with manual reset button, surge count retention upon power loss, and six digit LCD display that indicates quantity of surge events.

9. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch or not direct bus connected.

2.05 SURGE PROTECTIVE DEVICES FOR BRANCH PANELBOARD LOCATIONS

A. Surge Protective Device:
1. Basis of Design: Schneider Electric; Square D Brand Surgelogic Products;____: www.surgelogic.com/#sle..
2. Protection Circuits: Field-replaceable modular or non-modular.
3. Surge Current Rating: Not less than 120 kA per mode/240 kA per phase.
4. Repetitive Surge Current Capacity: Not less than 2,000 impulses.
5. UL 1449 Nominal Discharge Current (I-n): 20 kA.
6. UL 1449 Short Circuit Current Rating (SCCR): Not less than the available fault current at the installed location as indicated on the drawings.
7. EMI/RFI Filtering: Provide EMI/RFI filter to attenuate electrical noise; listed as complying with UL 1283 for Type 2 SPDs (UL 1283 listing not available for Type 1 SPDs).
a. Noise Attenuation: Not less than 40 dB at 100 kHz using MIL-STD-220 insertion loss test method.
8. Diagnostics:
a. Protection Status Monitoring: Provide indicator lights to report the protection status for each phase.
b. Alarm Notification: Provide indicator light and audible alarm to report alarm condition. Provide button to manually silence audible alarm.
c. Remote Status Monitoring: Provide Form C dry type contacts (normally open and normally closed) for remote annunciation of status.
d. Surge Counter: Provide surge event counter with manual reset button, surge count retention upon power loss, and six digit LCD display that indicates quantity of surge events.
9. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch or not direct bus connected.

B. Products - Field-installed, Externally Mounted Surge Protective Devices:
1. Surge Suppression, LLC (SSI) Advantage Series; SKLx/CKLx (120 kA per phase).
2. Surge Suppression, LLC (SSI) SpecPRO Series; SSM/CSM (120 kA per phase).
3. Current Technology: Transguard TG3 (125 kA).

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the service voltage and configuration marked on the SPD are consistent with the service voltage and configuration at the location to be installed.

C. Verify that electrical equipment is ready to accept connection of the SPD and that installed overcurrent device is consistent with requirements of drawings and manufacturer's instructions.

D. Verify system grounding and bonding is in accordance with Section 260526, including bonding of neutral and ground for service entrance and separately derived systems where applicable. Do not energize SPD until deficiencies have been corrected.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Unless indicated otherwise, connect service entrance surge protective device on load side of service disconnect main overcurrent device.

E. Provide conductors with minimum ampacity as indicated on the drawings, as required by NFPA 70, and not less than manufacturer's recommended minimum conductor size.

F. Install conductors between SPD and equipment terminations as short and straight as possible, not exceeding manufacturer's recommended maximum conductor length. Breaker locations may be reasonably rearranged in order to provide leads as short and straight as possible. Twist conductors together to reduce inductance.

G. Do not energize SPD until bonding of neutral and ground for service entrance and separately derived systems is complete in accordance with Section 260526 where applicable. Replace SPDs damaged by improper or missing neutral-ground bond.

H. Disconnect SPD prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPD connected.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS Section 7.19.1.

D. Procure services of a qualified manufacturer's representative to observe installation and assist in inspection, testing, and adjusting. Include manufacturer's reports with field quality control submittals.

3.04 CLEANING

A. Repair scratched or marred exterior surfaces to match original factory finish.

**END OF SECTION**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Interior luminaires.

B. Emergency lighting units.

C. Exit signs.

D. Ballasts and drivers.

E. Fluorescent emergency power supply units.

F. Lamps.

1.03 RELATED REQUIREMENTS

A. Section 01 91 13 - General Commissioning Requirements.

B. Section 092116 - Gypsum Board Assemblies: Additional requirements for support of ceiling mounted fixtures.

C. Section 095100 - Acoustical Ceilings: Additional requirements for support of ceiling mounted fixtures.

D. Section 260533.16 - Boxes.

E. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

F. Section 260919 - Enclosed Contactors: Lighting contactors.

G. Section 260923 - Lighting Control Devices: Automatic controls for lighting including occupancy sensors and time switches.

H. Section 262726 - Wiring Devices: Manual wall switches and wall dimmers.

I. Section 265600 - Exterior Lighting.

1.04 REFERENCE STANDARDS

A. ANSI C78.379 - American National Standard for Electric Lamps -- Reflector Lamps -- Classification of Beam Patterns; 1994 (R 2003).

B. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

C. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems 2006.

D. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems 2006.

E. NEMA WD 6 - Wiring Devices - Dimensional Requirements; National Electrical Manufacturers Association; 2002.

F. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. UL 924 - Emergency Lighting and Power Equipment Current Edition, Including All Revisions.

I. UL 1598 - Luminaires Current Edition, Including All Revisions.

J. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
4. Notify H2M Architects of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

1.06 SUBMITTALS

A. See Section 01 33 00 - Submittial Procedures, for submittal procedures.

B. Shop Drawings:
   1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
   2. Provide photometric calculations where luminaires are proposed for substitution.

C. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.

D. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
   1. LED Luminaires:
      a. Include estimated useful life, calculated based on IES LM-80 test data.

E. Certificates for Dimming Ballasts: Manufacturer's documentation of compatibility with dimming controls to be installed.

F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

G. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

H. Product Cut Sheets for all materials that meet the LEED BUILDING Performance criteria identified in each specification.

I. Material Safety Data Sheets, for all applicable products. Material Safety Data Sheets shall indicate the rated hours of life, the mercury content in the bulbs, and total lumen hours of light output for bulbs. (If an MSDS does not include the necessary information, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS for submittal).

J. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.

1.07 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Conform to requirements of NFPA 70 and NFPA 101.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having

jurisdiction.

1.08 DELIVERY, STORAGE, AND PROTECTION

A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.

B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.09 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.10 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

1.11 EXTRA MATERIALS

A. See Section 016000 - Product Requirements, for additional provisions.

B. Furnish four of each plastic lens type.

C. Furnish ten replacement lamps for each lamp type.

D. Furnish four of each ballast type.

E. Low-Mercury Lamps: weighted average for all lamps containing mercury shall not exceed 80 picograms per lumen hour of light output.

F. Comply with EPA's toxicity characteristic leaching procedure test shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.

G. 0 to less than 25-watt compact fluorescent lamp: 5 mg total mercury.

1.12 COMMISSIONING

A. Engage a factory-authorized service representative, to perform startup service as per functional requirements.

B. Complete installation, startup checks and functional tests according manufacturers written instructions.

C. Operational Test: After electrical system has been energized, start units to confirm proper unit operation. Rectify malfunctions, replace defective parts with new ones and repeat the start up procedure.

D. Verify that equipment is installed and commissioned as per manufacturers written instructions/requirements.

E. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

F. Contractor shall replace all damaged components and components that failed the inspections at no additional charge.

G. Inspections shall be on “spot check basis” and shall not reduce responsibility of installing contractors to provide a finished and fully functioning product.

H. This section shall in no way diminish the responsibility of the Contractors, Sub-contractors and Suppliers in performing all aspects of work and testing as outlined in the Contract Documents. Any requirements outlined in this section are in addition to requirements outlined in related specifications.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

A. Furnish products as indicated in luminaire schedule included on the drawings.

B. Substitutions: Not Permitted.

2.02 LUMINAIRES

A. Provide products that comply with requirements of NFPA 70.

B. Provide products that are listed and labeled as complying with UL 1598, where applicable.

C. Provide products that comply with requirements of NFPA 70 and NFPA 101.

D. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

E. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

F. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.

G. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

H. LED Luminaires:
   1. Components: UL 8750 recognized or listed as applicable.
   2. Tested in accordance with IES LM-79 and IES LM-80.
   3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

I. Luminaires Mounted in Continuous Rows: Provide quantity of units required for length indicated, with all accessories required for joining and aligning.

2.03 EMERGENCY LIGHTING UNITS

A. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.

B. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.

C. Battery:
   1. Size battery to supply all connected lamps, including emergency remote heads where indicated.

D. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.

E. Provide low-voltage disconnect to prevent battery damage from deep discharge.

F. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101 where indicated; provide indicator light(s) to report test and diagnostic status.

G. Accessories:
   1. Provide compatible accessory mounting brackets where indicated or required to complete installation.
   2. Where indicated, provide emergency remote heads that are compatible with the emergency lighting unit they are connected to and suitable for the installed location.

2.04 LUMINAIRES

A. Furnish products as indicated in Schedule included on the Drawings.

2.05 FLUORESCENT EMERGENCY POWER SUPPLY UNITS

A. Description: Self-contained fluorescent emergency power supply units suitable for use with indicated luminaires, complying with NFPA 101 and all applicable state and local codes, and

listed and labeled as complying with UL 924.

B. Compatibility:
   1. Ballasts: Compatible with electronic, standard magnetic, energy saving, and dimming AC ballasts, including those with end of lamp life shutdown circuits.

C. Operation: Upon interruption of normal power source, solid-state control automatically switches connected lamp(s) to the fluorescent emergency power supply for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.

D. Battery: Sealed maintenance-free high-temperature nickel cadmium unless otherwise indicated.

E. Diagnostics: Provide accessible and visible multi-chromatic combination test switch/indicator light to display charge, test, and diagnostic status and to manually activate emergency operation.

F. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101 where indicated; provide indicator light(s) to report test and diagnostic status and field selectable audible alert.

G. Operating Temperature: From 32 degrees F to 122 degrees F unless otherwise indicated or required for the installed location.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.

C. Verify that suitable support frames are installed where required.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.

E. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

### 3.03 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of luminaires provided under this section.

B. Install products according to manufacturer's instructions.

C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 1 (general workmanship), NECA 1 (general workmanship), and NECA 1 (general workmanship).

D. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

E. Suspended Ceiling Mounted Luminaires:
   1. Do not use ceiling tiles to bear weight of luminaires.
   2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
   3. Secure surface-mounted and recessed luminaires to ceiling support channels or framing members or to building structure.
   4. Secure pendant-mounted luminaires to building structure.
   5. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.

6. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gage, connected from opposing corners of each recessed luminaire to building structure.
7. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.

F. Recessed Luminaires:
1. Install trims tight to mounting surface with no visible light leakage.
2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.

G. Suspended Luminaires:
1. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
2. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet in length, with no more than 4 feet between supports.
3. Unless otherwise indicated, support pendants from swivel hangers.

H. Install fixtures securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting).

I. Surface Mounted Fixtures: Install plumb and square and aligned with building lines and with each other; secure to prevent movement.

J. Suspended Ceiling Mounted Fixtures:
1. Install at locations indicated on reflected ceiling plan.
2. Support fixtures larger than 2 by 4 feet in size independent of ceiling framing.
3. Fixtures Recessed in Ceilings: Install to permit removal from below.
4. Lay-In Ceiling Mounted Fixtures:
   a. Install clips to secure fixtures in place.
5. Suspended Fixtures: Install using pendants supported from swivel hangers, with pendant length as required for indicated height.

K. Wall Mounted Fixtures: Install at height as indicated on the drawings.

L. Install accessories furnished with each luminaire.

M. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within fixture; use flexible conduit.

N. Connect luminaires and exit signs to branch circuit outlets provided under Section 260537 using flexible conduit.

O. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

P. Bond products and metal accessories to branch circuit equipment grounding conductor.

Q. Install specified lamps in each emergency lighting unit, exit sign, and luminaire.

R. Emergency Lighting Units:
1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
2. Install lock-on device on branch circuit breaker serving units.

S. Exit Signs:
1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
2. Install lock-on device on branch circuit breaker serving units.

T. Fluorescent Emergency Power Supply Units:

U. Install lamps in each luminaire.

3.04 FIELD QUALITY CONTROL

A. Inspect each product for damage and defects.

B. Operate each luminaire after installation and connection to verify proper operation.

C. Test self-powered exit signs, emergency lighting units, and fluorescent emergency power supply units to verify proper operation upon loss of normal power supply.

D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by H2M Architects.

3.05 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by H2M Architects. Secure locking fittings in place.

B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by H2M Architects or authority having jurisdiction.

C. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by H2M Architects or authority having jurisdiction.

D. Aim and adjust luminaires as directed.

E. Position exit sign directional chevrons as indicated.

3.06 CLEANING

A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

B. Clean electrical parts to remove conductive and deleterious materials.

C. Remove dirt and debris from enclosures.

D. Clean photometric control surfaces as recommended by manufacturer.

E. Clean finishes and touch up damage.

3.07 CLOSEOUT ACTIVITIES

A. See Section 017800 - Closeout Submittals, for closeout submittals.

B. Demonstration: Demonstrate proper operation of luminaires to Thompsonville Fire Department, and correct deficiencies or make adjustments as directed.

C. Just prior to Substantial Completion, replace all lamps that have failed.

3.08 PROTECTION

A. Protect installed luminaires from subsequent construction operations.

3.09 SCHEDULE - SEE DRAWINGS

**END OF SECTION 26 51 00**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Exterior luminaires.

B. Ballasts.

C. Lamps.

1.03 RELATED REQUIREMENTS

A. Section 03300 - Cast-in-Place Concrete: Foundations for poles.

B. Section 260526 - Grounding and Bonding for Electrical Systems.

C. Section 260533.16 - Boxes.

D. Section 260923 - Lighting Control Devices: Automatic controls for lighting including outdoor motion sensors, time switches, and outdoor photo controls.

E. Section 262726 - Wiring Devices: Receptacles for installation in poles.

F. Section 265100 - Interior Lighting.

1.04 UNIT PRICES

A. See Section 012200 - Unit Prices, for additional unit price requirements.

B. Exterior Lighting Unit:
   1. Basis of Measurement: Each.

1.05 REFERENCE STANDARDS

A. ANSI O5.1 - American National Standard for Wood Poles -- Specifications and Dimensions 2017.

B. IES RP-8 - Recommended Practice for Design and Maintenance of Roadway and Parking Facility Lighting 2018.

C. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems 2006.

D. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility 2012.

E. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 1598 - Luminaires Current Edition, Including All Revisions.

G. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products Current Edition, Including All Revisions.

1.06 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate placement of poles and associated foundations with utilities, curbs, sidewalks, trees, walls, fences, striping, etc. installed under other sections or by others. Coordinate elevation to obtain specified foundation height.
   2. Notify H2M Architects of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

1.07 SUBMITTALS

A. See Section 01 33 00 - Submittial Procedures, for submittal procedures.

B. Shop Drawings:
   1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.

2. Provide photometric calculations where luminaires are proposed for substitution upon request.
3. Provide structural calculations for each pole proposed for substitution.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.
   1. LED Luminaires:
      a. Include estimated useful life, calculated based on IES LM-80 test data.
   2. Poles: Include information on maximum supported effective projected area (EPA) and weight for the design wind speed.

D. Certificates for Poles and Accessories: Manufacturer's documentation that products are suitable for the luminaires to be installed and comply with designated structural design criteria.

E. Field Quality Control Reports.

F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

G. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

H. Project Record Documents: Record actual connections and locations of pole foundations, luminaires, and any pull or junction boxes.

1.08 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.

B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

C. Receive, handle, and store wood poles in accordance with ANSI O5.1.

1.10 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Provide three year manufacturer warranty for all LED luminaires, including drivers.

1.11 COMMISSIONING

A. Where indicated on the plans or specifications, engage a factory-authorized service representative, to perform startup service as per the functional requirements.

B. Complete installation, startup checks and functional tests according manufacturers written instructions.

C. Operational Test: After electrical system has been energized, start units to confirm proper unit operation. Rectify malfunctions, replace defective parts with new ones and repeat the start up

procedure.

D. Verify that equipment is installed and commissioned as per manufacturers written instructions/requirements.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

A. Furnish products as indicated in luminaire schedule included on the drawings.

B. Substitutions: Not permitted.

2.02 LUMINAIRES

A. Provide products that comply with requirements of NFPA 70.

B. Provide products that are listed and labeled as complying with UL 1598, where applicable.

C. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.

F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

G. Provide luminaires listed and labeled as suitable for wet locations unless otherwise indicated.

H. Recessed Luminaires:
   1. Ceiling Compatibility: Comply with NEMA LE 4.
   2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
   3. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.

I. LED Luminaires:
   1. Components: UL 8750 recognized or listed as applicable.
   2. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

J. Exposed Hardware: Stainless steel.

2.03 BALLASTS

A. All Ballasts:
   1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
   2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.

2.04 LAMPS

A. All Lamps:
   1. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.
   2. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.
   3. Minimum Efficiency: Provide lamps complying with all current applicable federal and state lamp efficiency standards.
   4. Color Temperature Consistency: Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature. Replace lamps that are determined by the Arhitect to be inconsistent in perceived color temperature.

2.05 POLES

A. All Poles:
   1. Provide poles and associated support components suitable for the luminaire(s) and associated supports and accessories to be installed.
   2. Structural Design Criteria:
      a. Comply with AASHTO LTS.
      b. Wind Load: Include effective projected area (EPA) of luminaire(s) and associated supports and accessories to be installed.
      c. Dead Load: Include weight of proposed luminaire(s) and associated supports and accessories.

B. Metal Poles: Provide ground lug, accessible from handhole or transformer base.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.

C. Verify that suitable support frames are installed where required.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of luminaires provided under this section.

B. Install products according to manufacturer's instructions.

C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 1 (general workmanship) and NECA/IESNA 501 (exterior lighting).

D. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

E. Pole-Mounted Luminaires:
   1. Grounding:
      a. Bond luminaires, metal accessories, metal poles, and foundation reinforcement to branch circuit equipment grounding conductor.
      b. Provide supplementary ground rod electrode as specified in Section 260526 at each pole bonded to grounding system as indicated.
   2. Install separate service conductors, 12 AWG copper, from each luminaire down to handhole for connection to branch circuit conductors.
   3. Install weather resistant GFI duplex receptacle with weatherproof cover as specified in Section 262726 in designated poles.

F. Install accessories furnished with each luminaire.

G. Bond products and metal accessories to branch circuit equipment grounding conductor.

H. Install lamps in each luminaire.

3.04 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect each product for damage and defects.

C. Operate each luminaire after installation and connection to verify proper operation.

D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

3.05 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.

B. Luminaires with Field-Rotatable Optics: Position optics according to manufacturer's instructions to achieve lighting distribution as indicated or as directed by Architect.

3.06 CLEANING

A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of luminaires to Architect, and correct deficiencies or make adjustments as directed.

B. Just prior to Substantial Completion, replace all lamps that have failed.

3.08 PROTECTION

A. Protect installed luminaires from subsequent construction operations.

**END OF SECTION 26 56 00**

**PAGE INTENTIONALLY BLANK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

A. Fire alarm system installation, including all components, wiring, and conduit.

B. Transmitters for communication with supervising station.

C. Maintenance of fire alarm system under contract for specified warranty period.

1.03 RELATED SECTIONS

A. Section 01 91 13 - General Commissioning Requirements.

B. Section 07 84 00 - Firestopping: Materials and methods for work to be performed by this installer.

C. Section 21 13 00 - Fire-Suppression Sprinkler Systems: Supervisory, alarm, and actuating devices installed in sprinkler system.

1.04 REFERENCES

A. IEEE C62.41 - IEEE Recommended Practice on Surge Voltages in Low-Voltage Power Circuits; 1991 (R1995).

B. NFPA 70 - National Electrical Code; 2005.

C. NFPA 72 - National Fire Alarm Code; 2002.

D. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures; 2003.

E. Connecticut State Fire Safety Code; 2005

1.05 SUBMITTALS

A. See Section 01 33 00 - Submittial Procedures, for submittal procedures.

B. Proposal Documents: Submit the following with cost/time proposal:
   1. NFPA 72 "Record of Completion", filled out to the extent known at the time.
   2. Manufacturer's detailed data sheet for each control unit, initiating device, and notification appliance.
   3. Certification by Contractor that the system will comply with the contract documents.
   4. Proposed maintenance contract.
   5. Battery calculations.

C. Design Documents: Submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, riser diagrams, and description of operation:
   1. Copy (if any) of list of data required by authority having jurisdiction.
   2. NFPA 72 "Record of Completion", filled out to the extent known at the time.
   3. Clear and concise description of operation, with input/output matrix similar to that shown in NFPA 72 Appendix A-7-5-2.2(9), and complete listing of software required.
   4. System zone boundaries and interfaces to fire safety systems.
   5. Location of all components, circuits, and raceways; mark components with identifiers used in control unit programming.
   6. Circuit layouts; number, size, and type of raceways and conductors; conduit fill calculations; spare capacity calculations; notification appliance circuit voltage drop calculations.
   7. List of all devices on each signaling line circuit, with spare capacity indicated.
   8. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.

9. Description of power supplies; if secondary power is by battery include calculations demonstrating adequate battery power.
10. Certification by either the manufacturer of the control unit or by the manufacturer of each other component that the components are compatible with the control unit.
11. Certification by the manufacturer of the control unit that the system design complies with the contract documents.
12. Certification by Contractor that the system design complies with the contract documents.
13. Do not show existing components to be removed.

D. Evidence of installer qualifications.

E. Evidence of instructor qualifications; training lesson plan outline.

F. Evidence of maintenance contractor qualifications, if different from installer.

G. Inspection and Test Reports:
1. Submit inspection and test plan prior to closeout demonstration.
2. Submit documentation of satisfactory inspections and tests.
3. Submit NFPA 72 "Inspection and Test Form," filled out.

H. Operating and Maintenance Data: See Section 017800 for additional requirements; revise and resubmit until acceptable; have one set available during closeout demonstration:
1. Complete set of specified design documents, as approved by authority having jurisdiction.
2. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
3. Contact information for firm that will be providing contract maintenance and trouble call-back service.
4. List of recommended spare parts, tools, and instruments for testing.
5. Replacement parts list with current prices, and source of supply.
6. Detailed troubleshooting guide and large scale input/output matrix.
7. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to owner.
8. Detailed but easy to read explanation of procedures to be taken by non-technical administrative personnel in the event of system trouble, when routine testing is being conducted, for fire drills, and when entering into contracts for remodeling.

I. Project Record Documents: See Section 01 77 00 for additional requirements; have one set available during closeout demonstration:
1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.
2. "As installed" wiring and schematic diagrams, with final terminal identifications.
3. "As programmed" operating sequences, including control events by device, updated input/output chart, and voice messages by event.

J. Closeout Documents:
1. Certification by manufacturer that the system has been installed in compliance with his installation requirements, is complete, and is in satisfactory operating condition.
2. NFPA 72 "Record of Completion", filled out completely and signed by installer and authorized representative of authority having jurisdiction.
3. Maintenance contract.

1.06 QUALITY ASSURANCE

A. Copies of Design Criteria Documents: Maintain at the project site for the duration of the project, bound together, an original copy of NFPA 72, the relevant portions of applicable codes, and instructions and guidelines of authorities having jurisdiction; deliver to owner upon completion.

B. Installer Qualifications: Firm with minimum 3 years documented experience installing fire alarm systems of the specified type and providing contract maintenance service as a regular part of their business.

1. Authorized representative of control unit manufacturer; submit manufacturer's certification that installer is authorized; include name and title of manufacturer's representative making certification.
2. Installer Personnel: At least 2 years of experience installing fire alarm systems.
3. Supervisor: NICET level III or IV (3 or 4) certified fire alarm technician; furnish name and address.
4. Contract maintenance office located within 50 miles of project site.
5. Certified in Carmel, New York as fire alarm installer.

C. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.

D. Instructor Qualifications: Experienced in technical instruction, understanding fire alarm theory, and able to provide the required training; trained by fire alarm control unit manufacturer.

1.07 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Provide control panel manufacturer's warranty that system components other than wire and conduit are free from defects and will remain so for 1 year after date of Substantial Completion.

C. Provide installer's warranty that the installation is free from defects and will remain so for 1 year after date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fire Alarm Control Units - Basis of Design: Notifier: www.notifier.com

B. Initiating Devices, and Notification Appliances:
1. Same manufacturer as control units.
2. Provide all initiating devices and notification appliances made by the same manufacturer.

2.02 SYSTEM DESCRIPTION

A. General:
1. Provide a complete, non-coded, addressable/conventional, microprocessor-based fire alarm system with initiating devices, notification appliances, and monitoring and control devices as indicated on the drawings and as specified herein.
2. Provide complete interconnection of all existing fire alarm system devices to new fire alarm system, including all programming, power supplies, monitor modules, control modules, sunchronizing modules, hardware and accessories required for proper operation.

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 and alphanumeric annunciation.

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.
f. Alarm Silencing: If the "Alarm Silence" button is pressed, all audible [and visible] alarm signals shall cease operation.

7. 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.
8. A manual evacuation (drill) switch shall be provided to operate the notification appliances without causing other control circuits to be activated.
9. 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 [to the Central Monitoring Station]. 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 evacuation and tone signals on loudspeakers in areas as indicated on drawings.

K. 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.

L. 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.

2.03 COMPONENTS

A. FIRE ALARM CONTROL PANEL (FACP)

1. General: Comply with UL 864, "Control Units for Fire-Protective Signaling Systems."
2. The following FACP hardware shall be provided:
   a. Power Limited base panel with beige cabinet and door, 120 VAC input power.
   b. 2,000 point capacity where (1) point equals (1) monitor (input) or (1) control (output).
   c. 2,000 points of Network Annunciation at FACP Display when applied as a Network Node
   d. 2000 points of annunciation where one (1) point of annunciation equals:
      1) 1 LED driver output on a graphic driver or 1 switch input on a graphic switch input module.
      2) 1 LED on panel or 1 switch on panel.
   e. From all battery charging circuits in the system provide battery voltage and ammeter readouts on the FCP LCD Display.
   f. Municipal City Circuit Connection with Disconnect switch, 24VDC Remote Station (reverse polarity), local energy, shunt master box, or a form "C" contact output .
   g. One Auxiliary electronically resetable fused 2A @24VDC Output, with programmable disconnect operation for 4-wire detector reset.
   h. One Auxiliary Relay, SPDT 2A @32VDC, programmable as a trouble relay, either as normally energized or de-energized, or as an auxiliary control.
   i. Where required provide Intelligent Remote Battery Charger for charging up to 110Ah batteries.
   j. Power Supplies with integral intelligent Notification Appliance Circuit [Class B][Class A] for system expansion.
   k. 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.
   l. The FACP shall support (6) RS-232-C ports and one service port.
   m. Remote Unit Interface: supervised serial communication channel for control and monitoring of remotely located annunciators and I/O panels.
   n. Programmable DACT for either Common Event Reporting or per Point Reporting.
   o. Service Port Modem for dial in passcode access to all fire control panel information.
3. 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.
4. 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.
5. Distributed Module Operation: FACP shall be capable of allowing remote location of the following modules; interface of such modules shall be through a Style 4 (Class B) supervised serial communications channel (SLC):
   a. Amplifiers, voice and telephone control circuits
   b. Addressable Signaling Line Circuits
   c. Initiating Device Circuits
   d. Notification Appliance Circuits
   e. Auxiliary Control Circuits

f. Graphic Annunciator LED/Switch Control Modules

6. 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.
7. REMOTE LCD ANNUNCIATOR
   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, waterflow).
      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.
8. EMERGENCY POWER SUPPLY
   a. General: Components include battery, charger, and an automatic transfer switch.
   b. Battery: 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.
9. ADDRESSABLE MANUAL PULL STATIONS
   a. Description: Addressable single- or double-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.

10. SMOKE SENSORS
    a. General: Comply with UL 268, "Smoke Detectors for Fire Protective Signaling Systems." Include the following features:
        1) Where indicated smoke detectors shall be integral Smoke/CO detectors with integral sounder base.
        2) Factory Nameplate: Serial number and type identification.
        3) Operating Voltage: 24 VDC, nominal.
        4) Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore normal operation.
        5) Plug-In Arrangement: Sensor and associated electronic components are mounted in a module that connects to a fixed base with a twist-locking plug connection. Base shall provide break-off plastic tab that can be removed to engage the head/base locking mechanism. No special tools shall be required to remove head once it has been locked. Removal of the detector head shall interrupt the supervisory circuit of the fire alarm detection loop and cause a trouble signal at the control unit.
        6) Quick Connect Arrangement: Photoelectric sensor and electronics in a single piece construction which shall twist-lock onto a mounting base that attaches to a standard electrical box.
        7) Each sensor base 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.
        8) Each sensor base shall contain a magnetically actuated test switch to provide for easy alarm testing at the sensor location.
        9) 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.
        10) The sensor's electronics shall be immune from false alarms caused by EMI and RFI.
        11) 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.
        12) Removal of the sensor head for cleaning shall not require the setting of addresses.
    b. Type: Smoke sensors shall be of the photoelectric or combination photoelectric / heat type. 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: 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.

11. HEAT SENSORS
    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.
12. ADDRESSABLE CIRCUIT INTERFACE MODULES
    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. Addressable Circuit Interface Modules will be capable of mounting in a standard electric outlet box. Modules will include cover plates to allow surface or flush mounting. Modules will receive their operating power from the signaling line or a separate two wire pair running from an appropriate power supply as required.
    c. There shall be the following types of modules:
        1) Type 1: Monitor Circuit Interface Module:
            (a) For conventional 2-wire smoke detector and/or contact device monitoring with Class B or Class A wiring supervision. The supervision of the zone wiring will be Class B. This module will communicate status (normal, alarm, trouble) to the FACP.
            (b) For conventional 4-wire smoke detector with Class B wiring supervision. The module will provide detector reset capability and over-current power protection for the 4-wire detector. This module will communicate status (normal, alarm, trouble) to the FACP.
        2) Type 2: Line Powered Monitor Circuit Interface Module
            (a) This type of module is an individually addressable module that has both its power and its communications supplied by the two wire multiplexing

signaling line circuit. It provides location specific addressability to an initiating device by monitoring normally open dry contacts. This module shall have the capability of communicating four zone status conditions (normal, alarm, current limited, trouble) to the FACP.

(b) This module shall provide location specific addressability for up to five initiating devices by monitoring normally closed or normally open dry contact security devices. The module shall communicate four zone status conditions (open, normal, abnormal, and short). The two-wire signaling line circuit shall supply power and communications to the module.

3) Type 3: Single Address Multi-Point Interface Modules

(a) This multipoint module shall provide location specific addressability for four initiating circuits and control two output relays from a single address. Inputs shall provide supervised monitoring of normally open, dry contacts and be capable of communicating four zone status conditions (normal, open, current limited, and short). The input circuits and output relay operation shall be controlled independently and disabled separately.

(b) This dual point module shall provide a supervised multi-state input and a relay output, using a single address. The input shall provide supervised monitoring of two normally open, dry contacts with a single point and be capable of communicating four zone status conditions (normal, open, current limited, and short). The two-wire signaling line circuit shall supply power and communications to the module.

(c) This dual point module shall monitor an unsupervised normally open, dry contact with one point and control an output relay with the other point, using a single address. The two-wire signaling line circuit shall supply power and communications to the module.

4) Type 4: Line Powered Control Circuit Interface Module

(a) This module shall provide control and status tracking of a Form "C" contact. The two-wire signaling line circuit shall supply power and communications to the module.

5) Type 5: 4-20 mA Analog Monitor Circuit Interface Module

(a) This module shall communicate the status of a compatible 4-20 mA sensor to the FACP. The FACP shall annunciate up to three threshold levels, each with custom action message; display and archive actual sensor analog levels; and permit sensor calibration date recording.

d. 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.

13. MAGNETIC DOOR HOLDERS

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.

14. ADDRESSABLE ALARM NOTIFICATION APPLIANCES

a. Addressable Notification Appliances: The Contractor shall furnish and install Addressable Notification Appliances and accessories to operate on compatible signaling line circuits (SLC).

1) Addressable Notification appliance operation shall provide power, supervision and separate control of horns and strobes over a single pair of wires. The controlling channel (SLC) digitally communicates with each appliance and receives a response to verify the appliance's presence on the channel. The

channel provides a digital command to control appliance operation. SLC channel wiring shall be unshielded twisted pair (UTP), with a capacitance rating of less than 60pf/ft and a minimum 3 twists (turns) per foot.

2) Class B (Style 4) notification appliances shall be wired without requiring traditional in/out wiring methods; addressable "T" Tapping shall be permitted. Up to 63 appliances can be supported on a single channel.
3) Each Addressable notification appliance shall contain an electronic module and a selectable address setting to allow it to occupy a unique location on the channel. This on-board module shall also allow the channel to perform appliance diagnostics that assist with installation and subsequent test operations. A visible LED on each appliance shall provide verification of communications and shall flash with the appliances address setting when locally requested using a magnetic test tool.

b. Addressable Controller: Addressable Controller shall supervise Channel (SLC) wiring, communicate with and control addressable notification appliances. It shall be possible to program the High/Lo setting of the audible (horn) appliances by channel from the addressable controller.
c. Horn: Addressable horn shall be listed to UL 464. Horn appliances shall have a High/Lo Setting, programmable by channel from the addressable controller or by appliance from the host FACP. The horn shall have a minimum sound pressure level of 83 or 89 dBA @ 24VDC. The horn shall mount directly to a standard single gang, double gang or 4" square electrical box, without the use of special adapter or trim rings. Appliances shall be wired with UTP conductors, having a minimum of 3 twists per foot.
d. Visible/Only: Addressable strobe shall be listed to UL 1971. The V/O shall consist of a xenon flash tube and associated lens/reflector 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. Appliances shall be wired with UTP conductors, having a minimum of 3 twists per foot. V/O appliances shall be provided with different minimum 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.
e. Audible/Visible: Addressable combination Audible/Visible (A/V) Notification Appliances shall be listed to UL 1971 and UL 464. The strobe light shall consist of a xenon flash tube and associated lens/reflector system. Provide a label inside the strobe lens to indicate the listed candela rating of the specific strobe. The horn shall have a minimum sound pressure level of 83 or 89 dBA @ 24VDC. The audible/visible enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. Appliances shall be wired with UTP conductors, having a minimum of 3 twists per foot. The appliance shall be capable of two-wire synchronization with one of the following options:
    1) Synchronized Strobe with Horn on steady
    2) Synchronized Strobe with Temporal Code Pattern on Horn
    3) Synchronized Strobe with March Time cadence on Horn
    4) Synchronized Strobe firing to NAC sync signal with Horn silenced
f. Isolator Module: Isolator module provides short circuit isolation for addressable notification appliance SLC wiring. Isolator shall be listed to UL 864. The Isolator shall mount directly to a minimum 2 1/8" deep, standard 4" square electrical box, without the use of special adapter or trim rings. Power and communications shall be supplied by the Addressable Controller channel SLC; dual port design shall accept communications and power from either port and shall automatically isolate one port from the other when a short circuit occurs. The following functionality shall be included in the Isolator module:
    1) Report faults to the host FACP.
    2) On-board Yellow LED provides module status.

3) After the wiring fault is repaired, the Isolator modules shall test the lines and automatically restore the connection.

g. Accessories: The contractor shall furnish the necessary accessories.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with applicable codes, NFPA 72, NFPA 70, and the contract documents.

B. Conceal all wiring, conduit, boxes, and supports where installed in finished areas.

C. Obtain Fire Marshal's approval of locations of devices, before installation.

D. Install instruction cards and labels.

3.02 INSPECTION AND TESTING FOR COMPLETION

A. Notify owner 7 days prior to beginning completion inspections and tests.

B. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.

C. Provide the services of the installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction, and adjustments.

D. Prepare for testing by ensuring that all work is complete and correct; perform preliminary tests as required.

E. Provide all tools, software, and supplies required to accomplish inspection and testing.

F. Perform inspection and testing in accordance with NFPA 72 and requirements of local authorities; document each inspection and test.

G. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.

H. Diagnostic Period: After successful completion of inspections and tests, Operate system in normal mode for at least 14 days without any system or equipment malfunctions.
   1. Record all system operations and malfunctions.
   2. If a malfunction occurs, start diagnostic period over after correction of malfunction.
   3. Schedule training to allow owner personnel to perform normal duties.
   4. At end of successful diagnostic period, fill out and submit NFPA 72 "Inspection and Testing Form."

3.03 PERSONNEL INSTRUCTION

A. Provide the following instruction to designated owner personnel:
   1. Hands-On Instruction: On-site, using operational system.
   2. Classroom Instruction: On-site or at other local facility.
   3. Factory Instruction: At control unit manufacturer's training facility.

B. Administrative: One-hour session(s) covering issues necessary for non-technical administrative staff; classroom:
   1. Initial Training: 1 session pre-closeout.
   2. Refresher Training: 1 session post-occupancy.

C. Basic Operation: One-hour sessions for attendant personnel, security officers, and engineering staff; combination of classroom and hands-on:
   1. Initial Training: 1 session pre-closeout.
   2. Refresher Training: 1 session post-occupancy.

D. Maintenance Technicians: Detailed training for electrical technicians, on programming, maintaining, repairing, and modifying; factory training:
   1. Initial Training: One 3-day session, pre-closeout.
   2. Refresher Training: One 1-day session post-occupancy.

E. Furnish the services of instructors and teaching aids; have copies of operation and maintenance data available during instruction.

F. Video tape all training sessions and provide a minimum of two copies to Owner.

3.04 CLOSEOUT

A. Closeout Demonstration: Demonstrate proper operation of all functions to owner.
   1. Be prepared to conduct any of the required tests.
   2. Have at least one copy of operation and maintenance data, preliminary copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
   3. Have authorized technical representative of control unit manufacturer present during demonstration.
   4. Demonstration may be combined with inspection and testing required by authority having jurisdiction; notify authority having jurisdiction in time to schedule demonstration.
   5. Repeat demonstration until successful.

B. Substantial Completion of the project cannot be achieved until inspection and testing is successful and:
   1. Specified diagnostic period without malfunction has been completed.
   2. Approved operating and maintenance data has been delivered.
   3. All aspects of operation have been demonstrated to owner.
   4. Final acceptance of the fire alarm system has been given by authorities having jurisdiction.
   5. Specified pre-closeout instruction is complete.

C. Perform post-occupancy instruction within 3 months after Substantial Completion.

3.05 MAINTENANCE

A. Provide to owner, at no extra cost, a written maintenance contract for 2 years, to include the work described below.

B. Perform routine inspection, testing, and preventive maintenance required by NFPA 72, including:
   1. Maintenance of fire safety interface and supervisory devices connected to fire alarm system.
   2. Repairs required, unless due to improper use, accidents, or negligence beyond the control of the maintenance contractor.
   3. Record keeping required by NFPA 72 and authorities having jurisdiction.

C. Provide trouble call-back service upon notification by owner:
   1. Provide on-site response within 2 hours of notification.
   2. Include allowance for call-back service during normal working hours at no extra cost to Owner.

D. Provide a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.

E. Maintain a log at each fire alarm control unit, listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced. Submit duplicate of each log entry to owner's representative upon completion of site visit.

F. Comply with owner's requirements for access to facility and security.

**END OF SECTION 28 31 00**

# PART 1-GENERAL

## 1.01 RELATED DOCUMENTS

A. Drawings, Division 01 General Requirements and Section 01 50 00 Temporary Facilities and Controls apply to this Section.

## 1.02 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing, and removing site utilities or abandoning site utilities in place.
7. Temporary erosion and sedimentation control measures.

## 1.03 DEFINITIONS

A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches (50 mm) in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.

D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.

E. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated.

F. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

## 1.04 MATERIAL OWNERSHIP

A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain on the Site, cleared materials shall become Contractor's property and shall be removed from the Site.

## 1.05 SUBMITTALS

A. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

## 1.06 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations per applicable Highway Permits, Division 01 General Requirements, and Drawings.

B. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

C. The following practices are prohibited within protection zones:
   1. Storage of construction materials, debris, or excavated material.
   2. Parking vehicles or equipment.
   3. Foot traffic.
   4. Erection of sheds or structures.
   5. Impoundment of water.
   6. Excavation or other digging unless otherwise indicated.
   7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

D. Do not direct vehicle or equipment exhaust towards protection zones.

E. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

F. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

## PART 2-PRODUCTS

### 2.01 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Division 31 Section 31 20 00 "Earth Moving."

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

## PART 3-EXECUTION

### 3.01 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated. Flag each tree trunk at 54 inches (1372 mm) above the ground.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

### 3.02 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide in accordance with Drawings and Section 01 50 00 Temporary Facilities and Controls.

### 3.03 TREE AND PLANT PROTECTION

A. General: Protect trees and plants remaining on-site according to Drawings.

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Landscape Architect.

### 3.04 EXISTING UTILITIES

A. Contractor (with consent of owner) shall arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing.

1. Verify that utilities have been disconnected and capped before proceeding with site clearing.

B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.

1. Arrange with utility companies to shut off indicated utilities.
2. Owner will arrange to shut off indicated utilities when requested by Contractor.

C. Locate, identify, and disconnect utilities indicated to be abandoned in place.

D. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

E. Excavate for and remove underground utilities indicated to be removed.

## 3.05 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Grind down stumps and/or remove stumps, roots, obstructions, and debris to a depth of 24 inches below exposed subgrade.
3. Use only hand methods for grubbing within protection zones.
4. Chip removed tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

## 3.06 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth of 6 inches in a manner to prevent intermingling with underlying subsoil or other waste materials.

C. Top soil material shall be screened to be 1” minus and stockpiled onsite. Topsoil shall be in accordance with Section 2.2 of Turfs and Grasses Section 32 92 00

D. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

1. Limit height of topsoil stockpiles to 72 inches, unless otherwise authorized by Engineer.
2. Do not stockpile topsoil within protection zones.
3. Stockpile surplus topsoil to allow for respreading deeper topsoil.

## 3.07 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.

## 3.08 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off the Site.

B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000

**PAGE INTENTIONALLY BLANK**

# PART 1 - GENERAL

## 1.01 RELATED DOCUMENTS

A. Drawings, Division 01 General Requirements and Section 01 50 00 Temporary Facilities and Controls apply to this Section.

## 1.02 SUMMARY

A. This Section includes the following:

1. Preparing subgrades for curbs, walks, pavements, lawns, and plantings.
2. Excavating and backfilling for stormwater practices and utility structures.
3. Subbase course for concrete walks and pavements.
4. Excavating and backfilling trenches for buried utilities and pits for buried utility structures.
5. Excavation for mass grading of site.

## 1.03 DEFINITIONS

A. Backfill: Soil materials used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.

C. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.

D. Excavation: Removal of material encountered above subgrade elevations.

1. Additional Excavation: Excavation below subgrade elevations as directed by Engineer.
2. Bulk Excavation: Excavations more than 10 feet (3 m) in width and pits more than 30 feet (9 m) in either length or width.
3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.

E. Fill: Soil materials used to raise existing grades.

F. Rock: Rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders of rock material exceeding 1 cu. yd. (0.76 cu. m) in place that cannot be

removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted.

1. Excavation of Trenches and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch- (1065-mm-) wide, short-tip-radius rock bucket; rated at not less than 120-hp (89-kW) flywheel power with bucket-curling force of not less than 25,000 lbf (111 kN) and stick-crowd force of not less than 18,700 lbf (83 kN); measured according to SAE J-1179.
2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 210-hp (157- kW) flywheel power and developing a minimum of 45,000-lbf (200-kN) breakout force; measured according to SAE J-732.

G. Structures: Slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

H. Subbase Course: Layer placed between the subgrade and asphalt paving, or layer placed be- tween the subgrade and a concrete pavement or walk.

I. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

J. Utilities: include on-site underground pipes, conduits, ducts, and cables, as well as underground services within 5 feet of the building.

1.04 SUBMITTALS

A. Product Data: For the following:

1. Each type of detectable warning tape.
2. Drainage fabric.
3. Separation fabric.

B. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:

1. Classification according to ASTM D 2487 of each on-site or borrow soil material pro- posed for fill and backfill.
2. Analytical results demonstrating imported soil meets constituent concentration requirements for “Unrestricted Use” as defined by NYSDEC Part 375 and DER-10 technical guidance documents unless another use category and alternate constituent concentrations are approved by Engineer.

C. Blasting plan approved by authorities having jurisdiction, for record purposes.

1.2 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or

others unless permitted in writing by Engineer and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Engineer not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Engineer's written permission.
3. Contact utility-locator service for area where Project is located before excavating.

B. Demolish and completely remove from site existing underground utilities indicated to be re- moved. Coordinate with utility companies to shut off services if lines are active.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not avail- able from excavations.

B. Satisfactory Soils: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM, or a combination of these group symbols; free of rock or gravel larger than 3 inches (75 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT, or a combination of these group symbols.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Backfill and Fill: Satisfactory soil materials.

E. Subbase: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; meeting the requirements of NYSDOT Item # 304.12.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch (38-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

G. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

H. Crushed Stone: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; meeting the requirements of NYSDOT Item # 623.12 and

gradation requirements of NYSDOT Item # 605.0901.

I. Rip Rap: Medium stone fill of crushed or uncrushed rock meeting the requirements of NYSDOT Item # 620.04, unless otherwise specified on the Drawings.

2.02 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, minimum 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

B. Drainage Fabric: Nonwoven geotextile, specifically manufactured as a drainage geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:

1. Grab Tensile Strength: 110 lbf (490 N); ASTM D 4632.
2. Tear Strength: 40 lbf (178 N); ASTM D 4533.
3. Puncture Resistance: 50 lbf (222 N); ASTM D 4833.
4. Water Flow Rate: 150 gpm per sq. ft. (100 L/s per sq. m); ASTM D 4491.
5. Apparent Opening Size: No. 50 (0.3 mm); ASTM D 4751.

C. Separation Fabric: Woven geotextile, specifically manufactured for use as a separation geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum proper- ties determined according to ASTM D 4759 and referenced standard test methods:

1. Grab Tensile Strength: 200 lbf (890 N); ASTM D 4632.
2. Tear Strength: 75 lbf (333 N); ASTM D 4533.
3. Puncture Resistance: 90 lbf (400 N); ASTM D 4833.
4. Water Flow Rate: 4 gpm per sq. ft. (2.7 L/s per sq. m); ASTM D 4491.
5. Apparent Opening Size: No. 30 (0.6 mm); ASTM D 4751.

PART 3 - EXECUTION

3.01 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

C. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and waterways.

## 3.02 DEWATERING

A. Provide in accordance with Section 01 50 00 Temporary Facilities and Controls.

## 3.03 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavation to subgrade elevations regardless of the character of sur- face and subsurface conditions encountered, including rock, soil materials, and obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

## 3.04 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Equipment Pads: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or mi- nus 1 inch (25 mm). Do not disturb bottom of excavations intended for bearing surface.

## 3.05 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades.

## 3.06 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit, unless otherwise indicated.

1. Clearance: As indicated.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. For pipes and conduit less than 6 inches (150 mm) in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
2. For pipes and conduit 6 inches (150 mm) or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
3. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other un- yielding bearing material to allow for bedding course.

## 3.07 APPROVAL OF SUBGRADE

A. Notify Engineer when excavations have reached required subgrade.

B. If Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof roll subgrade with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof roll wet or saturated subgrades.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer.

## 3.08 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill may be used when approved by Engineer.

1. Fill unauthorized excavations under other construction or utility pipe as directed by Engineer.

## 3.09 STORAGE OF SOIL MATERIALS

A. Stockpile borrow materials and satisfactory excavated soil materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to pre- vent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.
2. Soil material shall be screened to be 3” minus and stockpiled on site. Soil material shall be in accordance with section 2.1 of Earth Moving 31 20 00.
3. Top soil material shall be screened to be 1” minus and stockpiled onsite. Topsoil shall be in accordance with Section 2.2 of Turfs and Grasses Section 32 92 00.

## 3.10 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for record documents.
3. Inspecting and testing underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

## 3.11 UTILITY TRENCH BACKFILL

A. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fit- tings, and bodies of conduits.

B. Backfill trenches excavated under footings and within 18 inches (450 mm) of bottom of footings; fill with concrete to elevation of bottom of footings.

C. Place and compact initial backfill of subbase material, free of particles larger than 1 inch (25 mm), to a height of 12 inches (300 mm) over the utility pipe or conduit.

1. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.

D. Coordinate backfilling with utilities testing.

E. Fill voids with approved backfill materials while shoring and bracing, and as sheeting is re- moved.

F. Place and compact final backfill of satisfactory soil material to final subgrade.

G. Install warning tape directly above utilities, 18 inches below finished grade, except 6 inches be- low subgrade under pavements and slabs.

## 3.12 FILL

A. Preparation: Remove vegetation, topsoil, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface before placing fills.

B. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal, so fill material will bond with existing material.

C. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.
3. Under steps and ramps, use engineered fill.

## 3.13 MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air-dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

## 3.14 COMPACTION OF BACKFILLS AND FILLS

A. Place backfill and fill materials in layers not more than 8 inches (200 mm) in loose

depth for material compacted by heavy compaction equipment, and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil to not less than the following percentages of maximum dry unit weight according to ASTM D 698:

1. Under utility structures and paved shoulders, scarify and recompact top 12 inches (300 mm) of existing subgrade and each layer of backfill or fill material at 95 percent.
2. Under walkways, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill material at 92 percent.
3. Under lawn or unpaved areas, scarify and recompact top 6 inches (150 mm) below sub- grade and compact each layer of backfill or fill material at 90 percent.
4. Under NYSDOT travel lanes and within 1 on 1 slope of travel lanes backfill trench with select granular fill meeting NYSDOT Item #623.12 or #605.0901.

## 3.15 GRADING

A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Lawn or Unpaved Areas: Plus or minus 1 inch (25 mm).
2. Walks: Plus or minus 1 inch (25 mm).
3. Pavements: Plus or minus 1/2 inch (13 mm).

## 3.16 SUBBASE AND BASE COURSES

A. Under pavements and walks, place subbase course on prepared subgrade and as follows:

1. Place base course material over subbase.
2. Compact subbase and base courses at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight ac- cording to ASTM D 1557.
3. Shape subbase and base to required crown elevations and cross-slope grades.

4. When thickness of compacted subbase or base course is 6 inches (150 mm) or less, place materials in a single layer.
5. When thickness of compacted subbase or base course exceeds 6 inches (150 mm), place materials in equal layers, with no layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick when compacted.

B. Pavement Shoulders: Place shoulders along edges of subbase and base course to prevent lateral movement. Construct shoulders, at least 12 inches (300 mm) wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

## 3.17 FIELD QUALITY CONTROL

A. Testing Agency: Contractor shall engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

C. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. (186 sq. m) or less of paved area, but in no case fewer than three tests.
2. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 150 feet (46 m) or less of trench length, but no fewer than two tests.

D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

## 3.18 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Engineer; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, back- fill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

## 3.19 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Transport surplus satisfactory soil offsite.

1. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dis- pose of it offsite.

END OF SECTION 312000

**PAGE INTENTIONALLY BLANK**

# PART 1 GENERAL

## 1.01 SUMMARY

A. This Section includes excavation and backfill as required for pipe installation or other construction in the trench, and removal and disposal of water, in accordance with the applicable provisions of Section 31 20 00 Earth Moving and Section 31 50 00 Excavation Support and Protection unless modified herein.

# PART 2 PRODUCTS

NOT USED

# PART 3 EXECUTION

## 3.01 EXCAVATION

A. The trench excavation shall be located as shown on the Drawings or as specified. Under ordinary conditions, excavation shall be by open cut from the ground surface. Where the depth of trench and soil conditions permit, tunneling may be required beneath cross walks, curbs, gutters, pavements, trees, driveways, railroad tracks and other surface structures. No additional compensation will be allowed for such tunneling over the price bid for open cut excavation of equivalent depths below the ground surface unless such tunnel excavation is specifically provided for in the Bidding Documents.

B. Trenches shall be excavated to maintain the depths as shown on the Drawings or as specified for the type of pipe to be installed.

C. The alignment and depth shall be determined and maintained by the use of a string line installed on batter boards above the trench, a double string line installed along side of the trench or a laser beam system.

D. The minimum width of trench excavation shall be 12 inches on each side of the pipe hub.

E. Trenches shall not be opened for more than 300 feet in advance of pipe installation nor left unfilled for more than 100 feet in the rear of the installed pipe when work is in progress without the consent of the Engineer. Open trenches shall be protected and barricaded as required. No trench shall be left open over night unless an adequate road plan is provided.

F. Bridging across open trenches shall be constructed and maintained where required. Provide shop drawing of bridging or road plate system designed and stamped by NYS Licensed Professional Engineer.

## 3.02 SUBGRADE PREPARATION FOR PIPE

A. Where pipe is to be laid on undisturbed bottom of excavated trench, mechanical excavation shall not extend lower than the finished subgrade elevation at any point.

B. Where pipe is to be laid on special granular material the excavation below subgrade shall be to the depth specified or directed. The excavation below subgrade shall be refilled with special granular material as specified or directed, shall be deposited in layers not to exceed 6 inches and shall be thoroughly compacted prior to the preparation of pipe subgrade.

C. The subgrade shall be prepared by shaping with hand tools to the contour of the pipe barrel to allow for uniform and continuous bearing and support on solid undisturbed ground or embedment for the entire length of the pipe.

D. Pipe subgrade preparation shall be performed immediately prior to installing the pipe in the trench. Where bell holes are required they shall be made after the subgrade preparation is complete and shall be only of sufficient length to prevent any part of the bell from becoming in contact with the trench bottom and allowing space for joint assembly.

## 3.03 STORAGE OF MATERIALS

A. Traffic shall be maintained at all times in accordance with the applicable Highway Permits, Division 01 General Requirements, and Drawings.

B. Where conditions do not permit storage of materials adjacent to the trench, the material excavated from a length as may be required, shall be removed by the Contractor, at his cost and expense, as soon as excavated. The material subsequently excavated shall be used to refill the trench where the pipe had been built, provided it be of suitable character. The excess material shall be removed to locations selected and obtained by the Contractor.

1. The contractor shall, at his cost and expense, bring back adequate amounts of satisfactory excavated materials as may be required to properly refill the trenches.

C. If directed by the Engineer, the Contractor shall refill trenches with satisfactory soil materials or other suitable materials and excess excavated materials shall be disposed of offsite by the contractor.

## 3.04 REMOVAL OF WATER AND DRAINAGE

A. The Contractor shall at all times provide and maintain proper and satisfactory means and devices for the removal of all water entering the trench, and shall remove all such water as fast as it may collect, in such manner as shall not interfere with the prosecution of the work.

B. The removal of water shall be in accordance Section 01 50 00 Temporary Facilities and Controls.

## 3.05 PIPE EMBEDMENT

A. All pipe shall be protected from lateral displacement and possible damage resulting from superimposed backfill loads, impact or unbalanced loading during backfilling operations by being adequately embedded in suitable pipe embedment material. To ensure adequate lateral and vertical stability of the installed pipe during pipe jointing and embedment operations, a sufficient amount of the pipe embedment material to hold the pipe in rigid alignment shall be uniformly deposited and thoroughly compacted on each side, and back of the bell, of each pipe as laid.

B. Concrete cradle and encasement of the class specified shall be installed where and as shown on the Contract Drawings or ordered by the Engineer. Before any concrete is placed, the pipe shall be securely blocked and braced to prevent movement or flotation. The concrete cradle or encasement shall extend the full width of the trench as excavated unless otherwise authorized by the Engineer. Where concrete is to be placed in a sheeted trench it shall be poured directly against sheeting to be left in place or against a bond-breaker if the sheeting is to be removed.

C. Embedment materials placed above the centerline of the pipe or above the concrete cradle to a depth of 12 inches above the top of the pipe barrel shall be deposited in such manner as to not damage the pipe. Compaction shall be as required for the type of embedment being installed.

## 3.06 BACKFILL ABOVE EMBEDMENT

A. The remaining portion of the pipe trench above the embedment shall be refilled with suitable materials compacted as specified.

1. The trench shall be refilled in horizontal layers not more than 8 inches in thickness, and compacted per Section 31 20 00 Earth Moving.

2. Hand tamping shall be required around buried utility lines or other subsurface features that could be damaged by mechanical compaction equipment.

B. Backfilling of trenches beneath, across or adjacent to drainage ditches and water courses shall be done in such a manner that water will not accumulate in unfilled or partially filled trenches and the backfill shall be protected from surface erosion by adequate means.

1. Where trenches cross waterways, the backfill surface exposed on the bottom of slopes thereof shall be protected from surface erosion by adequate means.

C. All settlement of the backfill shall be refilled and compacted as it occurs.

D. Temporary pavement shall be placed as required by the Highway Work Permits and all Laws and Regulations.

END OF SECTION 312333

**PAGE INTENTIONALLY BLANK**

# PART 1 - GENERAL

## 1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions apply to this Section.

B. New York State Department of Environmental Conservation SPDES General Permit for Stormwater Discharges from Construction Activity Permit No. GP-0-20-001.

## 1.02 SUMMARY

A. This section includes furnishing, installing, maintaining, and removing temporary erosion and sediment control measures as shown on the contract documents or as ordered by the Engineer throughout the life of the contract to control soil erosion, sediment and water pollution through the use of temporary swales, check dams, bales, sediment traps, and silt fences.

B. Related Sections include other Division 2 Sections.

## 1.03 REFERENCES

A. Materials installation, maintenance, inspection and removal shall be in accordance with the *New York Standards and Specifications for Erosion and Sediment Control*.

## 1.04 SUBMITTALS

A. Submittals shall be submitted in accordance with the provisions set forth in the General Specifications.

B. Submittal shall contain source and supplier of material showing its compliance with specifications and associated standards.

1. Samples of any kind shall be submitted upon Engineer’s request.

C. The Contractor shall submit schedules for the accomplishment of temporary sediment control work.

## PART 2 - PRODUCTS

### 2.01 GENERAL

A. Products shall be as specified on the contract drawings and as stated in *New York Standards and Specifications for Erosion and Sediment Control*.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

A. In the event of conflict between these specification requirements and pollution control laws, rules or regulations by other federal, state or local government agencies, the more restrictive rules and regulations shall apply.

B. Temporary erosion and sediment control measures shall be inspected by the Contractor and maintained during the life of the project, and such maintenance and inspection shall continue until permanent stabilization measures are in place and the temporary control measures are ordered to be removed by the Engineer, and the disturbed area returned to its intended stabilized condition.

C. The Engineer has the authority to limit the surface area of erodible earth material exposed by excavation, borrow and fill operations and to direct the Contractor to provide immediate permanent or temporary erosion and sediment control measures to minimize damage to adjacent property.

D. The Contractor shall submit schedules for the accomplishment of temporary and permanent erosion and sediment control work to the Engineer for acceptance. All work done under this section shall be included as part of the construction schedule submitted by the Contractor.

E. Maintenance shall be performed as directed by the Engineer. All sediment deposits shall be considered unsuitable material and properly disposed of.

F. The Contractor shall immediately repair or replace defective or damaged portions of the erosion and sediment control facilities.

G. Erosion and sediment control measures shall be installed where necessary and shall remain in place until the area is permanently stabilized or the Engineer directs that it be removed. Upon removal, the Contractor shall remove and dispose of any sediment accumulations and restore the area as directed by the Engineer. The removed facilities and materials shall become the property of the Contractor and be removed from the site.

END OF SECTION 312500

# PART 1 - GENERAL

## 1.01 RELATED DOCUMENTS

A. Drawings and Division 01 General Requirements, Section 31 20 00 Earth Moving, apply to this Section.

B. This Section applies to all asphalt paving.

## 1.02 SUMMARY

A. This Section includes the following:

1. Hot-mix asphalt paving.
2. Hot-mix asphalt patching.

B. Scheduling of Asphalt Paving:

1. The contractor shall have substantially completed site work in the vicinity of paving and obtain the Engineer's approval prior to placement of the binder course of asphalt.
2. The contractor shall have substantially completed construction and obtain the Engineer's approval prior to placement of the top course of asphalt.

## 1.03 SYSTEM DESCRIPTION

A. Provide hot-mix asphalt paving according to materials, workmanship, and other applicable requirements of the standard specifications of the state or authorities having jurisdiction.

1. Standard Specification: New York State Department of Transportation.
2. Measurement and payment provisions and safety program submittals included in NYSDOT Standard Specifications do not apply to this Section.

## 1.04 SUBMITTALS

A. Product Data: For each product specified. Include technical data and tested physical and performance properties.

B. Job-Mix Designs: For each job mix proposed for the Work.

C. Material Test Reports: Indicate and interpret test results for compliance of materials with requirements indicated.

D. Material Certificates: Certificates signed by manufacturers certifying that each material complies with requirements.

## 1.05 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Installer Qualifications: Engage and experienced installer who has completed hot-mix asphalt paving similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

C. Manufacturer Qualifications: Engage a firm experienced in manufacturing hot-mix asphalt similar to that indicated for this Project and with a record of successful in-service performance.

1. Firm shall be a registered with and approved paving mix manufacturer with authorities having jurisdiction or the DOT of the state in which Project is located.

D. Regulatory Requirements: Conform to applicable standards of authorities having jurisdiction for asphalt paving work on public property.

E. Asphalt-Paving Publication: Comply with AI's , "The Asphalt Handbook," except where more stringent requirements are indicated.

F. Pre-installation Conference: Conduct Pre-installation conference at the Site per Division 01 General Requirements. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:

1. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
2. Review condition of substrate and preparatory work performed by other trades.
3. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
4. Review and finalize construction schedule for paving and related work. Verify availability of materials, paving Installer's personnel, and equipment required to execute the Work without delays.
5. Review inspection and testing requirements, governing regulations, and proposed installation procedures.
6. Review forcasted weather conditions and procedures for coping with unfavorable conditions.

## 1.06 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if substrate is wet or excessively damp or if the following conditions are not met:

.

7. Asphalt Base Course: Minimum surface temperature of 40 deg F (4 deg C) and rising at time of placement.
8. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.5 deg C) at time of placement.

## PART 2 - PRODUCTS

### 2.01 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: Sound; angular crushed stone, crushed gravel, or properly cured, crushed blast-furnace slag; complying with ASTM D 692.

C. Fine Aggregate: Sharp-edged natural sand or sand prepared from stone, gravel, properly cured blast-furnace slag, or combinations thereof, complying with ASTM D 1073

1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

D. Mineral Filler: Rock or slag dust, hydraulic cement, or other inert material complying with ASTM D 242.

### 2.02 ASPHALT MATERIALS

A. Asphalt Cement: ASTM D 3381 for viscosity-graded material

B. Undersealing Asphalt: ASTM D 3141, pumping consistency.

C. Water: Potable.

### 2.03 AUXILIARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.

B. Sand: ASTM D 1073, Grade Nos. 2 or 3.

### 2.04 MIXES

A. Hot-Mix Asphalt: Provide dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction**;** designed according to procedures in AI MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types"; and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
2. Base Course: As indicated.
3. Surface Course: As indicated.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to support paving and imposed loads.

B. Proof-roll subbase using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction.

C. Notify Engineer in writing of any unsatisfactory conditions. Do not begin paving installation until these conditions have been corrected.

### 3.02 PATCHING AND REPAIRS

A. Patching: Saw cut perimeter of patch and excavate existing pavement section to sound base. Recompact new subgrade. Excavate rectangular or trapezoidal patches, extending 12 inches (300 mm) into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically.
   1. Tack coat faces of excavation and allow to cure before paving.
   2. Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

B. Leveling Course: Install and compact leveling course consisting of dense-graded, hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch (25 mm) in existing pavements.

   1. Install leveling wedges in compacted lifts not exceeding 3 inches (75 mm) thick.

C. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch (6 mm). Refill with asphalt joint-filling material to restore watertight condition. Remove excess filler that has accumulated near cracks or joints.

D. Tack Coat: Apply uniformly to surfaces of existing pavement of previously constructed asphalt or portland cement concrete paving and to surfaces abutting or projecting into new, hot-mix asphalt pavement. Apply at a uniform rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m) of surface.

   1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
   2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

### 3.03 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

1. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

## 3.04 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
2. Place hot-mix asphalt surface course in single lift.
3. Spread mix at minimum temperature of 250 deg F (121 deg C).
4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes, unless otherwise indicated.
5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet (3 m) wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

## 3.05 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches (150 mm).
3. Offset transverse joints, in successive courses, a minimum of 24 inches (600 mm).
4. Construct transverse joints by bulkhead method or sawed vertical face method as described in AI’s, "The Asphalt Handbook”.
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

## 3.06 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F (85 deg C).

2. Use at minimum a 10-ton roller.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 96 percent of reference laboratory density according to ASTM D 1559, but not less than 94 percent nor greater than 100 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

## 3.07 INSTALLATION TOLERANCES

A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch (13 mm).
2. Surface Course: Plus 1/4 inch (6 mm), no minus.

B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch (6 mm).

2. Surface Course: 1/8 inch (3 mm).

3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch (6 mm).

## 3.08 FIELD QUALITY CONTROL

A. Testing Agency: Contractor shall engage a qualified independent testing agency to perform field quality-control testing.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. Revise methods of verifying field compaction if using the Superpave mix design system. Consult state or local DOT for methods that have been successfully used.

E. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

END OF SECTION 321216

**PAGE INTENTIONALLY BLANK**

# PART 1 - GENERAL

## 1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

## 1.02 SUMMARY

A. This Section includes exterior cement concrete pavement for the following:
   1. Curbs.
   2. Walkways.
   3. Exterior Steps.

B. Related Sections include other Division 2 Sections.

## 1.03 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.

## 1.04 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. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:

   1. Cementitious materials.
   2. Steel reinforcement and reinforcement accessories.
   3. Fiber reinforcement.
   4. Admixtures.
   5. Curing compounds.
   6. Applied finish materials.
   7. Bonding agent or epoxy adhesive.
   8. Joint fillers.
   9. Detectable warning strips.

D. Field quality-control test reports.

1.05 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.

C. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.

D. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

1.06 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. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.02 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; deformed.

C. Hook Bolts: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), internally and externally threaded. Design hook-bolt joint assembly to hold coupling against pavement form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

D. 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 CRSI'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 the following cementitious materials, of the same type, brand, and source throughout the Project:

1. Portland Cement: ASTM C 150, Type I or II gray.

B. Normal-Weight Aggregates: ASTM C 33, Class [4S] [4M] coarse aggregate, uniformly graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar pavement applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: 1 inch (25 mm) nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94/C 94M.

D. Air-Entraining Admixture: ASTM C 260.

E. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain not 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.

## 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. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

1. Available Products:

a. Axim Concrete Technologies; Cimfilm.
b. Burke by Edeco; BurkeFilm.
c. ChemMasters; Spray-Film.
d. Conspec Marketing & Manufacturing Co., Inc.; Aquafilm.
e. Dayton Superior Corporation; Sure Film.
f. Euclid Chemical Company (The); Eucobar.
g. Kaufman Products, Inc.; Vapor Aid.
h. Lambert Corporation; Lambco Skin.
i. L&M Construction Chemicals, Inc.; E-Con.
j. MBT Protection and Repair, ChemRex Inc.; Confilm.
k. Meadows, W. R., Inc.; Sealtight Evapre.
l. Metalcrete Industries; Waterhold.
m. Nox-Crete Products Group, Kinsman Corporation; Monofilm.
n. Sika Corporation, Inc.; SikaFilm.
o. Symons Corporation; Finishing Aid.
p. Vexcon Chemicals, Inc.; Certi-Vex EnvioAssist.

E. 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.
j. Meadows, W. R., Inc.; 1100 Clear.
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.
p. Tamms Industries, Inc.; Horncure 200-W.
q. Unitex; Hydro White.
r. Vexcon Chemicals, Inc.; Certi-Vex Enviocure White 100.

## 2.06 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

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 IV and V, 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.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs for the trial batch method.

B. Proportion mixtures to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 4,000 psi (20.7 MPa).
2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45
3. Slump Limit: 4” (100 mm) plus or minus 1 inch (25 mm).

C. 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: 6 percent plus or minus 1.5 percent for 3/4-inch (19-mm) nominal maximum aggregate size.

D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use plasticizing and retarding 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.

## 2.08 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 deg F (30 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For concrete mixes of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For concrete mixes larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

# PART 3 - EXECUTION

## 3.01 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph (5 km/h).
2. Subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch (13 mm) require correction according to requirements in Division 2 Section "Earthwork."

C. Proceed with concrete pavement operations only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

## 3.02 PREPARATION

A. Remove loose material from compacted subbase 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.

E. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch (50-mm) overlap of adjacent mats.

## 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.

2. Provide tie bars at sides of pavement strips where indicated.
3. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.

C. Isolation Joints: Form isolation 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 30 feet, unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. 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.

D. 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:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch (6-mm) radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 1/4-inch (6-mm) 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 formwork 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 subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase 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 Engineer.

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 for formed concrete. If results are not approved, remove and replace with formed concrete.

M. Slip-Form Pavers: When automatic machine placement is used for pavement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce pavement to required thickness, lines, grades, finish, and jointing as required for formed pavement.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of paver machine during operations.

N. When adjoining pavement sections are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.

O. 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 (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) 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.

P. 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 (32 deg C) 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.

## 3.07 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
2. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

## 3.08 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. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. 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:

    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) 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 (300 mm), 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.

## 3.09 PAVEMENT TOLERANCES

A. Comply with tolerances of ACI 117 and as follows:

1. Elevation: 1/4 inch (6 mm).
2. Thickness: Plus 3/8 inch (10 mm), minus 1/4 inch (6 mm).
3. Surface: Gap below 10-foot- (3-m-) long, unleveled straightedge not to exceed 1/4 inch (6 mm).
4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch (25 mm).
5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch (6 mm).
6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch (13 mm).
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches (6 mm per 300 mm).

8. Joint Spacing: 3 inches (75 mm).
9. Contraction Joint Depth: Plus 1/4 inch (6 mm), no minus.
10. Joint Width: Plus 1/8 inch (3 mm), no minus.

## 3.10 FIELD QUALITY CONTROL

A. Testing Agency: 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:

1. Testing Frequency: Obtain at least 1 composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mix placed each day.

    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete 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.
4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test 1 specimen at 7 days and 2 specimens at 28 days.

    a. A compressive-strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days.

C. 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 (3.4 MPa).

D. Test results shall be reported in writing to Engineer, 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.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.

F. 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 Engineer.

G. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.

H. 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 concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.

B. Drill test cores, where directed by Engineer, 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.

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 321313

**PAGE INTENTIONALLY BLANK**

# PART 1 GENERAL

## 1.01 SUMMARY

A. This Section includes fence framework, fabric, gates, steel posts and channels as shown on the Contract Drawings, complete with accessories.

## 1.02 REFERENCES

A. Materials and installation shall be in accordance with the latest revisions of the following codes, standards and specifications, except where more stringent requirements have been specified herein:

1. American Society for Testing and Materials (ASTM)

a. A90 Test Method for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles

b. A121 Specification for Zinc-Coated (Galvanized) Steel Barbed Wire

c. A392 Specification for Zinc-Coated Steel Chain-Link Fence Fabric

d. A428 Test Method for Weight of Coating on Aluminum-Coated Iron or Steel Articles

e. A491 Specification for Aluminum-Coated Steel Chain-Link Fence Fabric

f. A569 Specification for Steel, Sheet and Strip, Carbon (0.15 Maximum Percent). Hot-Rolled, Commercial Quality

g. A585 Specification for Aluminum-Coated Steel Barbed Wire

h. A817 Specification for Metallic-Coated Steel Wire for Chain-Link Fence Fabric

i. A824 Specification for Metallic-Coated Steel Marcelled Tension Wire for Use with Chain-Link Fence

j. B117 Method of Salt Spray (Fog) Testing

k. C94 Ready-Mixed Concrete

l. F567 Standard Practice for Installation of Chain-Link Fence

m. F626 Specification for Fence Fittings

n. F669 Standard Specification for Strength Requirements of Metal Posts and Rails

o. F083 Standard Specification for Pipe, Steel and Hot Dipped Zinc Coated, Welded, for Fence Structures

1.03 SUBMITTALS

A. In addition to those submittals identified in the General Provisions, the following items shall be submitted:

1. Manufacturers certification that all materials furnished are in compliance with the applicable requirements of the referenced standards and this specification.

B. Samples of any material shall be submitted at the Engineers request.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The following manufacturers are named to establish a standard of quality necessary for the Project.

1. Allied Tube & Conduit Corp.
2. Anchor Fence, Inc.
3. Page Aluminized Steel Corp.
4. Or equal

2.02 GENERAL

A. Framework: Type I or Type II Steel Pipe.

1. Type I - Schedule 40 steel pipe with 1.8 ounces of zinc coating per square foot of surface area conforming to Standard Specification ASTM F1083; or

2. Type II - pipe manufactured from steel conforming to ASTM A 569 or F 669, cold-formed, high frequency welded and having a minimum yield strength of 50,000 PSI. External surface triple coated with 1.0 ounce +- 0.1 ounce of zinc per square foot, 30 +- 15 micrograms of chromate per square inch and 0.5 +- 0.2 mils of clear, cross linked polyurethane. Internal surface coated, after welding, with a zinc-rich based organic coating having an 87% zinc powder loading capable of providing galvanic protection.

3. Pipe shall be straight, true to section and conform to the following weights:

| Pipe Size Outside Diameter | Type I Weight Lbs./Ft. | Type II Weight Lbs./Ft. |
|---|---|---|
| 1 5/8" | 2.27 | 1.84 |
| 2" | 2.72 | 2.28 |
| 2 1/2" | 3.65 | 3.12 |
| 3" | 5.79 | 4.64 |
| 3 1/2" | 7.58 | 5.71 |
| 4" | 9.11 | 6.56 |

4. Channel shall be Unistrut, model P1001A, 1 ⅝" x 3 ¼", 12 ga. galvanized steel channel, or approved equal.

B. Fittings:

1. Pressed steel or cast iron, galvanized with a minimum of 1.2 ounces of zinc per square foot of surface area, or cast aluminum alloy, all conforming to ASTM F 626.

2.03 CONCRETE MIX

A. ASTM C 94 Portland Cement concrete with maximum 3/4" aggregate having a minimum compressive strength of 2,500 PSI at 28 days.

2.04 MATERIALS AND CONSTRUCTION

A. Fence Posts

1. Fence posts shall be sized as follows:

| Fabric Height | Line Post O.D. | | Terminal Post O.D. | |
|---|---|---|---|---|
| | Type I | Type II | Type I | Type II |
| Under 6' | 2" | 2" | 3" | 2 1/2" |
| 6' to 9' | 2 1/2" | 2 1/2" | 3" | 3" |
| 9' to 12' | 3" | 3" | 4" | 3 1/2" |

B. Gate and Electric Equipment Mounting Posts

1. Gate and electric equipment mounting posts shall be sized as follows:

| Single Gate Width | Double Gate Width | Post O.D. Type I | Post O.D. Type II |
|---|---|---|---|
| Up to 6' | Up to 12’ | 4" | 3” |
| 7' to 12' | 13' to 25' | 4" | 3.5" |
| 13' to 18' | 25' to 36' | 6 5/8" | --- |
| Electrical Equipment Mounting Span | | | |
| Up to 5' | | 4" | 4" |

C. Rails and Braces

1. Rails and braces shall be 1 5/8" O.D., Type I or Type II.

D. Fabric

1. Fabric shall be black vinyl-coated steel wire, 9 gage, woven in a 2-inch diamond mesh with top knuckled selvage twisted and barbed and bottom selvage knuckled. Fence heights up to 12 feet shall be one-piece widths.

E. Gates

1. Gates shall have frame assembly of 2 inches O.D., Type I or Type II pipe with welded joints. Weld areas repaired with zinc-rich coating applied per manufacturer's directions. Fabric shall match fence. Gate accessories, hinges, latches, center stops, keepers and necessary hardware shall be of quality required for industrial and commercial application. Latches shall permit padlocking of gate.

F. Channels

1. Channel shall be Unistrut, model P1001A, 1 ⅝” x 3 ¼”, 12 ga. galvanized steel channel, or approved equal.

G. Fittings

1. Post caps shall be pressed steel, cast iron or cast aluminum alloy designed to fit snugly over posts to exclude moisture. Supply cone type caps for terminal posts and loop type for line posts.

2. Rail and brace ends shall be pressed steel, cast iron or cast aluminum alloy, cup-shaped to receive rail and brace ends.

3. Top rail sleeves shall be tubular steel, 0.051 thickness by 7 inches long, expansion type.

4. Tension bars shall be steel strip, 5/8 inch wide by 3/16 inch thick.

5. Tension bands shall be pressed steel, 14 gage thickness by 2 inch wide.

6. Brace bands shall be pressed steel, 12 gage thickness by 2 inch wide.

7. Truss rods shall be steel rod, 3/8 inch diameter merchant quality with turnbuckle.

8. Channel mounting bolts shall be hot dip galvanized meeting ASTM F 1554, Grade 36, with nuts meeting ASTM A563 and flat washers.

G. Tension Wire

1. Tension wire shall be marcelled 7 gage steel wire with minimum coating of 0.80 ounces of zinc or 0.40 ounces of aluminum per square foot of wire surface and conforming to ASTM A 824.

H. Tie Wires

1. Tie wires shall be aluminum 9 gage, alloy 1100-H4, A58 self locking fabric bands or equal.

I. Hog Rings

1. Hog rings shall be steel wire, 11 gage with a minimum zinc coating of 0.80 ounces per square foot of wire surface.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Fence installation shall conform to requirements of ASTM F 567.

B. Provide fence heights as shown on Contract Drawings.

C. Space line posts at intervals not exceeding ten feet.

D. Set terminal, gate and line posts plumb in concrete footings as shown on Contract Drawings. Top of footing shall be 2 inches above grade and sloped to direct water away from posts.

E. Brace gate and terminal posts back to adjacent line posts with horizontal brace rails and diagonal truss rods.

F. Install top rail through line post loop caps connecting sections with sleeves to form a continuous rail between terminal posts. Fasten top rail to terminal posts.

G. Stretch bottom tension wire between terminal posts 6" above grade and fasten to outside of line posts with tie wires.

H. Pull fabric taut to provide a smooth uniform appearance, free from sag, with bottom selvage 2" above grade. Fasten to terminal posts with tension bars threaded through mesh and secured with tension bands at maximum 18" intervals. Tie to line posts and top rails with tie wires spaced at maximum 14" on posts and 24" on rails. Attach to bottom tension wire with hog rings at maximum 24" intervals.

I. Install gates plumb, level and secure for full opening without interference. Anchor center stops and keepers in concrete. Adjust and lubricate hardware for smooth operation.

J. Install nuts for fittings, bands and hardware bolts on inside of fence. Peen ends of bolts or score threads to prevent removal.

END OF SECTION 323113

# PART 1 - GENERAL

## 1.01 RELATED DOCUMENTS

A. Drawings, Division 01 General Requirements and Section 01 50 00 Temporary Facilities and Controls apply to this Section.

## 1.02 SUMMARY

A. This Section includes the following:

1. Seeding.

B. Related Sections include Section 01 50 00 Temporary Facilities and Controls for Temporary Seeding.

## 1.03 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.

C. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill immediately beneath planting soil.

## 1.04 SUBMITTALS

A. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name and percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

B. Product Certificates: For soil amendments and fertilizers, signed by product manufacturer.

C. Qualification Data: For landscape Installer.

D. Planting Schedule: Indicating anticipated planting dates for each type of planting.

## 1.06 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful lawn and meadow establishment.

1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when planting is in progress.

B. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; deleterious material; pH; and mineral and plant-nutrient content of topsoil.

1. Report suitability of topsoil for lawn growth. State recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce a satisfactory topsoil.

C. Pre-installation Conference: Conduct pre-installation conference at the Site per Division 01 General Requirements.

## 1.07 DELIVERY, STORAGE, AND HANDLING

A. Seed: Deliver seed in original sealed, labeled, and undamaged containers.

## 1.08 SCHEDULING

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. Planting: April 1 to September 15 or as approved by Engineer.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit.

## 1.09 LAWN MAINTENANCE

A. Begin maintenance immediately after each area is planted and continue until acceptable lawn is established, but for not less than the following periods:

1. Seeded Lawns: 60 days from date of Substantial Completion.

a. When full maintenance period has not elapsed before end of planting season, or if lawn is not fully established, continue maintenance during next planting season.

B. Maintain and establish lawn by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth lawn.

1. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch.

C. Watering: Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources and to keep lawn uniformly moist to a depth of 4 inches (100 mm).
   1. Water lawn at a minimum rate of 1 inch (25 mm) per week.

D. Mow lawn as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 40 percent of grass height. Remove no more than 40 percent of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

   1. Mow grass 1 to 2 inches (25 to 50 mm) high.

E. Lawn Post-fertilization: Apply fertilizer after initial mowing and when grass is dry.

   1. Use fertilizer that will provide actual nitrogen of at least 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) to lawn area.

## 1.10 SEED

A. Seed Species:

   1. Seed Mix #1 (Lawn Areas)
      a. Provide seed mix at a rate of 100 pounds per acre containing the following mixture:
         1) Kentucky Bluegrass (20%).
         2) Creeping Red Fescue (40%).
         3) Perennial Ryegrass (20%).
         4) Annual Ryegrass (20%).

## 1.11 TOPSOIL

A. Topsoil: ASTM D 5268, pH range of 5.5 to 7, a minimum of 4 percent organic material content; free of stones 1 inch (25 mm) or larger in any dimension and other extraneous materials harmful to plant growth.

   1. Topsoil Source: Reuse surface soil stockpiled on-site. Verify suitability of stockpiled surface soil to produce topsoil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.

      a. Supplement with imported or manufactured topsoil from off-site sources when quantities are insufficient. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches (100 mm) deep; do not obtain from agricultural land, bogs or marshes.

## 1.12 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent and as follows:

1. Class: Class T, with a minimum 99 percent passing through No. 8 (2.36-mm) sieve and a minimum 75 percent passing through No. 60 (0.25-mm) sieve.

B. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, with a minimum 99 percent passing through No. 6 (3.35-mm) sieve and a maximum 10 percent passing through No. 40 (0.425-mm) sieve.

C. Aluminum Sulfate: Commercial grade, unadulterated.

D. Perlite: Horticultural perlite, soil amendment grade.

E. Sand: Clean, washed, natural or manufactured, free of toxic materials.

## 1.13 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through [3/4-inch (19-mm)] sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.

B. Peat: Sphagnum peat moss, partially decomposed, finely divided or granular texture, with a pH range of 3.4 to 4.8.

C. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

## 1.14 PLANTING ACCESSORIES

A. Selective Herbicides: EPA registered and approved, of type recommended by manufacturer for application.

## 1.15 FERTILIZER

A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 4 percent nitrogen and 20 percent phosphoric acid.

B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
   1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

   1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

1.16 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

1.17 EROSION-CONTROL MATERIALS

A. Erosion-Control Blankets: per Section 01 50 00 Temporary Facilities and Controls.

1.18 PLANTING SOIL MIX

A. Planting Soil Mix: Mix topsoil with soil amendments and fertilizers recommended by the qualified soil testing laboratory.

PART 2 - EXECUTION

2.01 EXAMINATION

A. Examine areas to receive lawns and grass for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

2.02 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

   1. Protect adjacent and adjoining areas from hydroseeding overspray.

B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

## 2.03 LAWN PREPARATION

A. Limit lawn subgrade preparation to areas to be planted.

B. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 6 inches (150 mm). Remove stones larger than 1 inch (25 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Thoroughly blend planting soil mix off-site before spreading or spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil mix.

    a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.

2. Spread planting soil mix to a depth of 4 inches but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

C. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch (13 mm) of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future.

D. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

E. Restore areas if eroded or otherwise disturbed after finish grading and before planting.

## 2.04 SEEDING

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph (8 km/h). Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.

1. Do not use wet seed or seed that is moldy or otherwise damaged.

B. Sow seed at the rate of 3 to 4 lb/1000 sq. ft. (1.4 to 1.8 kg/92.9 sq. m).

C. Rake seed lightly into top 1/8 inch (3 mm) of topsoil, roll lightly, and water with fine spray.

D. Protect seeded areas with slopes by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre (42 kg/92.9 sq. m) to form a continuous blanket 1-1/2 inches (38 mm) in loose depth over seeded areas. Spread by hand, blower, or other suitable equipment.

## 2.05 HYDROSEEDING

A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.

1. Mix slurry with nonasphaltic tackifier.
2. Apply slurry uniformly to all areas to be seeded in a one-step process. Apply mulch at a minimum rate of 1500-lb/acre (15.3-kg/92.9 sq. m) dry weight but not less than the rate required to obtain specified seed-sowing rate.

## 2.06 SATISFACTORY LAWNS

A. Satisfactory Seeded Lawn: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. (0.92 sq. m) and bare spots not exceeding 5 by 5 inches (125 by 125 mm).

B. Reestablish lawns that do not comply with requirements and continue maintenance until lawns are satisfactory.

## 2.07 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by lawn work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Erect barricades and warning signs as required to protect newly planted areas from traffic. Maintain barricades throughout maintenance period and remove after lawn is established.

C. Remove erosion-control measures after grass establishment period.

END OF SECTION 329200

**PAGE INTENTIONALLY BLANK**

# PART 1 - GENERAL

## 1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this section.

## 1.02 SUMMARY

A. This Section includes sanitary sewerage outside the building.

## 1.03 DEFINITIONS

A. PE: Polyethylene plastic.

B. PVC: Polyvinyl chloride plastic.

## 1.04 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure-Piping Pressure Ratings: At least equal to system test pressure.

B. Pressure rated pipe and fittings, 200 psi pressure rating.

## 1.05 SUBMITTALS

A. Shop Drawings: Include plans, elevations, details, and attachments for the following:

1. Precast concrete tanks and manholes, including cast iron frames and covers.

2. Pipe and fittings.

## 1.06 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic structures, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle precast concrete manholes and other structures according to manufacturer's written rig- ging instructions.

## 1.07 PROJECT CONDITIONS

A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.

B. Locate existing structures and piping to be closed and abandoned.

C. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Engineer not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Engineer's written permission.

# PART 2 - PRODUCTS

## 2.01 PIPES AND FITTINGS

A. PVC Sewer Pipe and Fittings: According to the following:

1. PVC Sewer Pipe and Fittings, NPS 12 (DN375) and Smaller: ASTM D 3034, SDR-35, for solvent-cemented joints or gasketed joints.

   a. Gaskets: ASTM F 477, elastomeric seals.

2. PVC Sewer Pipe and Fittings, NPS 15 and Smaller: ASTM D 2241, SDR 21, for solvent- cemented or gasketed joints.

   a. Gaskets: ASTM F 477, elastomeric seals.

B. Ductile-Iron Pipe and Fittings:

1. Restrained joint pipe shall be ductile iron manufactured in accordance with the require- ments of ANSI/AWWA C151/A21.51. Push-on joints for such pipe shall be in accor- dance with ANSI/AWWA C111/A21.11 "Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings". Pipe thickness shall be designed in accordance with ANSI/AWWA C150/A21.50 "Thickness Design of Ductile-Iron Pipe" Class 52.

2. Restrained joint fittings and the restraining components shall be ductile iron in accor- dance with applicable requirements of ANSI/AWWA C110/A21.10 and/or C153/A21.53. Push-on joints for such fittings shall be in accordance with ANSI/AWWA C111/A21.11.

3. Restrained joint pipe and fittings shall be U.S. Pipe's Tyton Joint Pipe with Field Lok 350 gaskets or approved equal.

4. Cement mortar lining and seal coating for pipe and fittings shall be in accordance with ANSI/AWWA C104/A21.4 Asphaltic outside coating shall be in accordance with

ANSI/AWWA C151/A21.51 for pipe and ANSI/AWWA C110/A21.10 or ANSI/AWWA
C153/A21.53 for fittings.

5. Restrained push-on joints for pipe and fittings shall be designed for a water working pres- sure of 350 psi for sizes 4-inch through 24-inch.

6. Restrained push-on joint pipe and fittings shall be capable of being deflected after assem- bly.

## 2.02 SPECIAL PIPE COUPLINGS AND FITTINGS

A. Sleeve-Type Pipe Couplings: ASTM C 1173, rubber or elastomeric sleeve and band assembly fabricated to mate with OD of pipes to be joined, for nonpressure joints.

1. Sleeve Material for Plastic Pipe: ASTM F 477, elastomeric seal.
2. Sleeve Material for Dissimilar Pipe: Compatible with pipe materials being joined.
3. Bands: Stainless steel, at least one at each pipe insert.

B. Pipe and Tube Fittings:

1. Ductile-Iron, Flexible Expansion Joints: Compound fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Units have 2 gasketed ball-joint sections and 1 or more gasketed sleeve sections. Include 250-psig (1725-kPa) minimum working-pressure rating; epoxy, interior coating according to AWWA C550; length for offset and expansion indicated; and glands, rubber gaskets, and bolts and nuts according to AWWA C111.
2. Ductile-Iron, Deflection Fittings: Compound coupling fitting with sleeve and flexing sections, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include 250-psig (1725-kPa) minimum working-pressure rating; cement- mortar lining or epoxy, interior coating according to AWWA C550; deflection of at least 20 degrees (0.34 radians); and glands, rubber gaskets, and bolts and nuts according to AWWA C111.
3. Ductile-Iron Fittings for PVC Pipe: AWWA C110, ductile-iron or cast-iron; or AWWA C153, ductile-iron, compact type; push-on- or mechanical-joint type. Include dimensions matching PVC pipe, cement-mortar lining and seal coat according to AWWA C104, and rubber compression gaskets according to AWWA C111.
4. Mechanical joint restraining glands shall be "megalug 2000 PV" as manufactured by Ebaa Iron Sales, Inc. or approved equal.

## 2.03 MANHOLES

A. Normal-Traffic Precast Concrete Manholes: ASTM C 478 (ASTM C 478M), precast, rein- forced concrete, of depth indicated, with provision for rubber gasketed joints.

1. Diameter: 48 inches (1200 mm) minimum, unless otherwise indicated

2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
3. Base Section: 6-inch (150-mm) minimum thickness for floor slab and 5-inch (125-mm) minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
4. Riser Sections: 5-inch (125-mm) minimum thickness, and lengths to provide depth indi- cated.
5. Top Section: Eccentric-cone type, unless concentric-cone or flat-slab-top type is indi- cated. Top of cone of size that matches grade rings.
6. Gaskets: ASTM C 443 (ASTM C 443M), rubber.
7. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch (150- to 229- mm) total thickness, that match 24-inch- (610-mm-) diameter frame and cover.
8. Steps: Fiberglass individual steps. Include width that allows worker to place both feet on one step and is designed to prevent lateral slippage off step. Cast or anchor into base, riser, and top section sidewalls with steps at 12-inch (300-mm) intervals.
9. Pipe Connectors: ASTM C 923 (ASTM C 923M), resilient, of size required, for each pipe connecting to base section.
10. Shall be designed for H-20 loading.

B. Manhole Frames and Covers: ASTM A -48, Class 35B, gray iron castings designed for heavy- duty service. Include 22⅜-inch ID by 6-inch (150-mm) riser with 4-inch (100-mm) minimum width flange, and 24-inch- diameter cover. Include indented top design with lettering "SEWER" cast into cover.

## 2.04 CONCRETE

A. Portland Cement Design Mix: 4000 psi (27.6 MPa) minimum, with 0.45 maximum water- cementitious materials ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60 (Grade 400), deformed steel.

B. Structure Channels and Benches: Factory or field formed from concrete. Portland cement de- sign mix, 4000 psi (27.6 MPa) minimum, with 0.45 maximum water-cementitious materials ra- tio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with

height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uni- form radius and slope.

a. Invert Slope: 2 percent through manhole.

2. Benches: Concrete, sloped to drain into channel.

b. Slope: 4 percent.

C. Ballast and Pipe Supports: Portland cement design mix, 3000 psi (20.7 MPa) minimum, with 0.58 maximum water-cementitious materials ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain. Reinforcement Bars: ASTM A 615/A 615M, Grade 60 (Grade 400), deformed steel.

2.05 PROTECTIVE COATINGS

A. Description: One-coat, coal-tar epoxy; 15-mil (0.38-mm) minimum thickness, unless otherwise indicated; factory or field applied to the following surfaces:

1. Concrete Manholes: On exterior surface.

2.06 CLEANOUTS

A. PVC Cleanouts: PVC body with PVC threaded cap. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping. Cleanout to be encased in minimum 6” I.D. Valve box cover with “sewer” stamped on cover.

PART 3 - EXECUTION

3.01 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Sections entitled "Earth Moving" and “Trenching and Backfilling”

3.02 IDENTIFICATION

A. Materials and their installation are specified in Section entitled "Earth Moving." Arrange for installing green warning tapes directly over piping buried 18” from finished grade.

3.03 PIPING APPLICATIONS

A. General: Include watertight joints.

B. Gravity-Flow Piping: Use the following:

1. NPS 4, NPS 6 and NPS 8 (DN100 and DN200): PVC, SDR 35, sewer pipe and fittings; solvent- cemented joints; or gaskets and gasketed joints.

## 3.04 SPECIAL PIPE COUPLING AND FITTING APPLICATIONS

A. Special Pipe Couplings: Use where required to join piping and no other appropriate method is specified. Do not use instead of specified joining methods.

1. Use the following pipe couplings for nonpressure applications:

   a. Sleeve type to join piping, of same size, or with small difference in OD.
   b. Increaser/reducer-pattern, sleeve type to join piping of different sizes.

2. Use the following pipe couplings for pressure applications:

   a. Sleeve type solvent cement of same size.

3. Special Pipe Fittings: Use where indicated.

## 3.05 INSTALLATION, GENERAL

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken con- tinuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

C. Use manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.

D. Use proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.

## 3.06 PIPE JOINT CONSTRUCTION AND INSTALLATION

A. General: Join and install pipe and fittings according to installations indicated.

B. Hub-and-Spigot, Cast-Iron Soil Pipe and Fittings: With rubber gaskets according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook." Use gaskets that match class of pipe and fittings.

C. DIP Piping, Gasketed Joints: Use joining materials according to ANSI/AWWA

C111/A21.11. Construct joints with elastomeric seals and lubricant according to AWWA C600 or AWWA M41 and pipe manufacturer's written instructions.

D. PVC Pressure Pipe and Fittings: Join and install according to AWWA M23.

E. PVC Sewer Pipe and Fittings: As follows:

1. Join pipe and gasketed fittings with gaskets according to ASTM D 2321. Join profile sewer pipe fittings with gaskets according to ASTM D 2321 and manufacturer's written instructions.
2. Install according to ASTM D 2321.
3. Join pipe with solvent cement fittings according to ASTMD 2855.

F. System Piping Joints: Make joints using system manufacturer's couplings, unless otherwise indicated.

1. Join piping made of different materials or dimensions with couplings made for this application. Use couplings that are compatible with and that fit both systems' materials and dimensions.

## 3.07 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Form continuous concrete channels and benches between inlets and outlet. Channels shall be Trowel finished with smooth surface, benches shall have a broom finish.

C. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3" above finished surface elsewhere, unless otherwise indicated.

D. Install precast concrete manhole sections with gaskets according to ASTM C 891.

## 3.08 CLEANOUT INSTALLATION

A. Set cleanout frames and covers flush with surrounding grade or as indicated on plans.

B. Set cleanout frames and covers in pavement areas with tops flush with pavement surface.

## 3.09 TAP CONNECTIONS

A. Make connections to existing piping and underground structures so finished Work complies as nearly as practical with requirements specified for new Work.

B. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch (150-mm) overlap, with not less than 6 inches (150 mm) of

concrete with 28-day compressive strength of 3000 psi (20.7 MPa).

C. Make branch connections from side into existing piping, NPS 4 to NPS 20 (DN100 to DN500). Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).

D. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

## FIELD QUALITY CONTROL

A. Clear interior of piping and structures of dirt and superfluous material as work progresses.

1. Place plug in end of incomplete piping at end of day and when work stops.
2. Flush piping between manholes and other structures to remove collected debris, if re- quired by authorities having jurisdiction.
    i. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (600 mm) of backfill is in place, and again at completion of Project.
3. Submit separate reports for each system inspection.
4. Defects requiring correction include the following:
    a. Alignment: Less than diameter of inside of pipe is visible between structures.
    b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 95 percent of piping diameter.
    c. Crushed, broken, cracked, or otherwise damaged piping.
    d. Infiltration: Water leakage into piping.
    e. Exfiltration: Water leakage from or around piping.
5. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
6. Re-inspect and repeat procedure until results are satisfactory.
    i. Test new piping systems, and parts of existing systems that have been altered, extended, or re- paired, for leaks and defects.
7. Do not put into service before inspection and approval.
8. Test completed piping systems according to authorities having jurisdiction.
9. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
10. Submit separate reports for each test.
11. Manholes and Sanitary Sewerage: Perform manhole vacuum testing in accordance with the latest revision of ASTM C1244-02. Perform low-pressure air testing of piping in accordance with the latest revision of ASTM F1417-92, Section 8.2.2, Time-Pressure Drop Method for a 0.5 psi drop.

12. Sewer Forcemain: Perform pressure and leakage test hydrostatically. Each forcemain test shall be for a minimum of 2 hours and at a minimum test pressure of 1.5 times operation pressure or 50 psi, whichever is greater. Allowable leakage for each forcemain is 0.5 gallons per 1,000 feet for 30 minutes.

END OF SECTION 333000

**PAGE INTENTIONALLY BLANK**

# PART 1 - GENERAL

## 1.01 RELATED DOCUMENTS

A. Drawings, Division 01 General Requirements, Section 31 20 00 Earth Moving, Section 31 23 33 Trenching and Backfilling, and Section 31 50 00 Excavation Support and Protection.

## 1.02 SUMMARY

A. This Section includes storm drainage as shown on the project drawings.

## 1.03 DEFINITIONS

A. HDPE: High-Density Polyethylene plastic.

B. PVC: Polyvinyl chloride plastic.

## 1.04 SUBMITTALS

A. Shop Drawings: Include plans, elevations, details, and attachments for the following:

1. Precast concrete inlets, catch basins, and other structures, including frames, covers, and grates.

2. Drainage Piping.

## 1.05 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 Requirements.

B. Do not store plastic structures, pipe, and fittings in direct sunlight.

C. Protect pipe, pipe fittings, and seals from dirt and damage.

D. Handle precast concrete inlets and other structures according to manufacturer's written rigging instructions.

## 1.06 PROJECT CONDITIONS

A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.

B. Locate existing structures and piping to be closed and abandoned.

# PART 2 - PRODUCTS

## 2.01 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe and fitting materials.

## 2.02 PIPES AND FITTINGS

A. Corrugated PE Drainage Tubing and Fittings: AASHTO M 252, Type S, with smooth waterway for coupling joints.

1. Soiltight Couplings: AASHTO M 252, corrugated, matching tube and fittings to form soiltight joints.

B. Corrugated PE Pipe and Fittings: AASHTO M 294, Type S, with smooth waterway for coupling joints.

1. Soiltight Couplings: AASHTO M 294, corrugated, matching pipe and fittings to form soiltight joints.

C. PVC Type PSM Solid and Perforated Piping:

1. Pipe: ASTM D 3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends
3. Gaskets: ASTM F 477, elastomeric seals
4. Perforations: ASTM F758 / AASHTO M278 Hole Pattern

## 2.03 STORMWATER INLETS

A. Yard Drain Inlets: Made with horizontal gutter opening, of materials and dimensions according to the project drawings. Include heavy-duty frames and grates.

B. Catch Basins: Made with vertical curb and horizontal gutter openings, of materials and dimensions according to project drawings. Include heavy-duty frames and grates.

C. Drain Inlets: Made with horizontal gutter opening, of materials and dimensions according to the project drawings. Include heavy-duty frames and grates.

D. Frames and Grates: Dimensions, opening pattern, free area, and other attributes as indicated on the project drawings.

1. Material: ASTM A 536, Grade 60-40-18 minimum, ductile-iron casting.

## 2.04 CONCRETE

A. Portland Cement Design Mix: 4000 psi (27.6 MPa) minimum, with 0.45 maximum water-cementitious ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.

2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, (Grade 420) deformed steel.

# PART 3 - EXECUTION

## 3.01 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 31 20 00 Earth Moving and Section 31 23 33 Trenching and Backfilling.

## 3.02 PIPING APPLICATIONS

A. General: Include watertight, silttight, or soiltight joints.

B. Refer to Part 2 of this Section for detailed specifications for pipe and fitting products listed below. Use pipe, fittings, and joining methods according to applications indicated.

C. Gravity-Flow Piping: Use the following:

1. NPS 4 and NPS 6 (DN100 and DN150): Corrugated PE drainage tubing and fittings, silttight couplings, and coupled joints.
2. NPS 8 to NPS 15 (DN200 to DN375): Corrugated PE drainage tubing and fittings, soiltight couplings, and coupled joints in NPS 8 and NPS 10 (DN200 and DN250). Use corrugated PE pipe and fittings, soiltight couplings, and coupled joints in NPS 12 and NPS 15 (DN300 and DN375).

## 3.03 SPECIAL PIPE COUPLING AND FITTING APPLICATIONS

A. Special Pipe Couplings: Use where required to join piping and no other appropriate method is specified. Do not use instead of specified joining methods.

1. Use the following pipe couplings for nonpressure applications:

   a. Sleeve type to join piping, of same size, or with small difference in OD.
   b. Increaser/reducer-pattern, sleeve type to join piping of different sizes.

## 3.04 INSTALLATION, GENERAL

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Use manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.

D. Use proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Extend storm drainage piping and connect to building's storm drains, of sizes and in locations indicated. Terminate piping as indicated.

F. PE Pipe and Fittings: As follows:
   1. Join Pipe, tubing, and fittings with couplings for soiltight joints according to manufacturer’s written instructions.
   2. Install according to ASTM D 2321 and manufacturer’s written instructions.
   3. Install corrugated piping according to the Corrugated Polyethylene Pipe Association’s “Recommended Installation Practices for Corrugated Polyethylene Pipe and Fittings”.

G. System Piping Joints: Make joints using system manufacturer’s couplings, unless otherwise indicated.

H. Join piping made of different materials or dimensions with couplings made for this application. Use couplings that are compatible with and that fit both systems’ materials and dimensions.

## 3.05 STORMWATER INLET INSTALLATION

A. Construct inlets to sizes and shapes indicated.

B. Set frames and grates to elevations indicated.

## 3.06 FIELD QUALITY CONTROL

A. Clear interior of piping and structures of dirt and superfluous material as work progresses.

1. Place plug in end of incomplete piping at end of day and when work stops.
2. Flush piping between inlets and other structures to remove collected debris, if required by authorities having jurisdiction.

B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (600 mm) of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:

    a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    c. Crushed, broken, cracked, or otherwise damaged piping.
    d. Infiltration: Water leakage into piping.
    e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

C. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

5. Do not enclose, cover, or put into service before inspection and approval.
6. Test completed piping systems according to authorities having jurisdiction.
7. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
8. Submit separate reports for each test.

END OF SECTION 334100

**PAGE INTENTIONALLY BLANK**