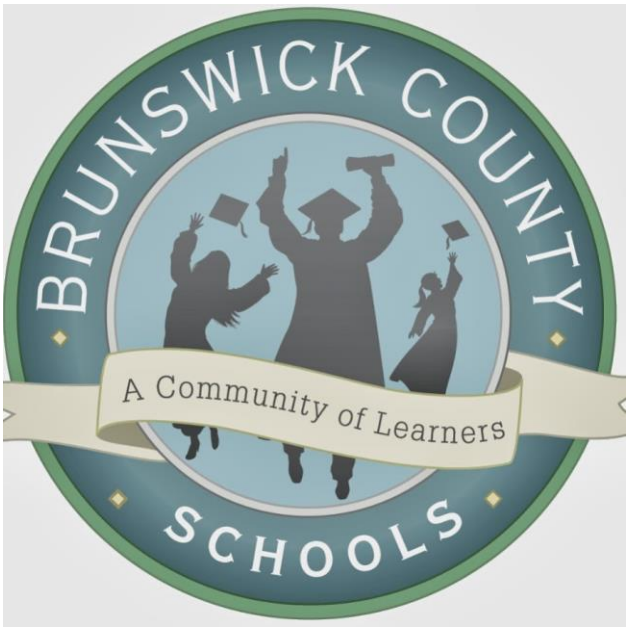
PROJECT MANUAL



WACCAMAW ELEMENTARY SCHOOL

5901 Waccamaw School Road, Ash, North Carolina

BID DOCUMENTS
APRIL 22, 2020

LS3P

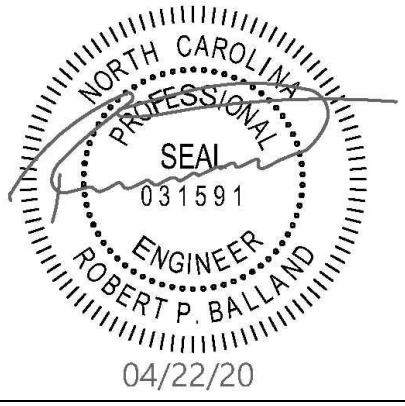
434 Fayetteville Street, Suite 1700
Raleigh, North Carolina 27601
Phone: 919-829-2700
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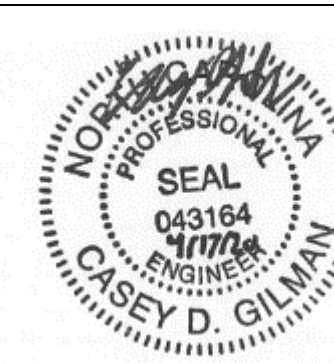
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SEALS PAGE

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ARCHITECT	Mary H. Brehler, AIA License No. 13105	
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CIVIL ENGINEER	Robert Balland, P.E. Engineer's License No. 031591 Paramounte Engineering, Inc	

FIRE SUPPRESSION ENGINEER	Casey D. Gilman, P.E. Engineer's License No. 043164 Cheatham and Associates, P.A. NC License No. C-1073	
PLUMBING ENGINEER	Casey D. Gilman, P.E. Engineer's License No. 043164 Cheatham and Associates, P.A. NC License No. C-1073	
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ELECTRICAL ENGINEER	Mark Ciarrocca, P.E. Engineer's License No. 17593 Cheatham and Associates, P.A. NC License No. C-1073	

END OF SEALS PAGE

TABLE OF CONTENTS

PROJECT INFORMATION

003100 Available Project Information
Geotechnical Exploration Report

DIVISION 1 - GENERAL REQUIREMENTS

011000 Summary
E-Verify Affidavit
012100 Allowances
012200 Unit Prices
012300 Alternates
012500 Substitution Procedures
Request for Substitution Form
012600 Contract Modification Procedures
Change Proposal Worksheet Summary
012900 Payment Procedures
013100 Project Management and Coordination
013200 Construction Progress Documentation
013233 Photographic Documentation
013300 Submittal Procedures
Digital Data Letter of Agreement
014000 Quality Requirements
014200 References
014533 Special Inspections
015000 Temporary Facilities and Controls
Project Sign Sample
016000 Product Requirements
017300 Execution
017419 Construction Waste Management and Disposal
017700 Closeout Procedures
017823 Operation and Maintenance Data
017836 Warranties
017839 Project Record Documents
017900 Demonstration and Training

DIVISION 02 - EXISTING CONDITIONS

024119 Selective Demolition

DIVISION 03 - CONCRETE

033000 Cast-In-Place Concrete

DIVISION 4 - MASONRY

042613 Masonry Veneer

DIVISION 5 - METALS

052100 Steel Joist Framing
053100 Steel Decking

054000 Cold-Formed Metal Framing
055000 Metal Fabrications
055213 Pipe and Tube Railings
057500 Custom Metal Canopy

DIVISION 6 - WOOD, PLASTICS AND COMPOSITES

061053 Miscellaneous Rough Carpentry
061600 Sheathing

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

071326 Self-Adhering Sheet Waterproofing
072100 Thermal Insulation
072726 Fluid-Applied Membrane Air Barriers
075423 Polyvinyl-Chloride (PVC) Roofing
076200 Sheet Metal Flashing and Trim
077100 Roof Specialties
077200 Roof Accessories
078413 Penetration Firestopping
078446 Fire-Resistive Joint Systems
079200 Joint Sealants

DIVISION 08 - OPENINGS

081113 Hollow Metal Frames
081416 Flush Wood Doors
082130 Fiberglass Reinforced Polyester (FRP) Doors
083113 Access Doors and Frames
084113 Aluminum-Framed Entrances and Storefronts
087100 Door Hardware
088000 Glazing

DIVISION 9 - FINISHES

092216 Non-Structural Metal Framing
092900 Gypsum Board
093000 Tiling
095113 Acoustical Panel Ceilings
096513 Resilient Base and Accessories
096520 Resilient Plank Flooring
099123 Interior Painting
099600 High-Performance Coatings

DIVISION 10 - SPECIALTIES

101100 Visual Display Surfaces
101423 Room-Identification Signage
102113 Plastic Toilet Compartments
102800 Toilet Accessories
104400 Fire-Protection Specialties
107326 Manufactured Canopy Systems

DIVISION 12 - FURNISHINGS

122413 Roller Window Shades
123216 Manufactured Plastic-Laminate-Faced Casework
123623 Plastic-Laminate-Clad Countertops
123661 Solid Surfacing Window Stools

DIVISION 21 - FIRE SUPPRESSION

210000 Fire Protection

DIVISION 22 - PLUMBING

220000 Plumbing

DIVISION 23 - MECHANICAL

230500 Heating and Air Conditioning
230900 Instrumentation and Control for HVAC

DIVISION 26 - ELECTRICAL

260000 Electrical, Basics
260500 Basic Electrical Materials and Methods
260519 Conductors and Cables
260526 Grounding and Bonding
260533 Raceways and Boxes
260538 Wire Mesh Cable Trays
260548 Seismic Controls for Electrical Systems
260553 Electrical Identification
260923 Lighting Control Devices
262200 Dry-Type Transformers (600 V and Less)
262416 Panelboards
262726 Wiring Devices
262816 Enclosed Switches and Circuit Breakers
264313 Surge Protective Devices
265119 LED Interior Lighting

DIVISION 27 - COMMUNICATIONS

271100 Communications Equipment Room Fittings
271300 Communications Backbone Cabling
271500 Communications Horizontal Cabling

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

283111 Digital, Addressable Fire-Alarm System
285000 Emergency Radio Communication Enhancement System
Appendix - Emergency Radio Communication Enhancement System

DIVISION 31 - EARTHWORK

31010.01 As-Built Drawings
31011.01 Dewatering
31012.01 Trench Boxes, Sheeting, and Shoring

31013.01 Excavating, Grading, Trenching and Backfilling
31018.01 Water Distribution System
31020.01 Gravity Sanitary Sewer System
31026.01 Concrete Reinforcement
311000 Site Clearing
312200 Grading
312216 Subgrade and Roadbed
312300 Excavation
312323 Fill and Backfill
312323.23 Proof Rolling
312333 Trenching for Site Utilities
312500 Temporary Erosion and Sedimentation Control
313116 Termite Control
313700 RipRap
316329 Earthquake Drains

DIVISION 32 - EXTERIOR IMPROVEMENTS

321123 Aggregate Base Course
321126 Bituminous Concrete Paving
321313 Concrete Paving for Sidewalks
321613 Concrete Curbing
321723 Pavement Markings
323113 Chain Link Fences and Gates
329113 Soil Preparation
329200 Plants
329219 Seeding
329223 Sodding
329700 Landscape Maintenance and Warranty

DIVISION 33 - UTILITIES

334000 Storm Drainage Piping
334600 Subdrainage
334913 Manholes and Covers

END OF TABLE OF CONTENTS

DOCUMENT 003100 - AVAILABLE PROJECT INFORMATION

PART 1 - GENERAL

1.1 DOCUMENT INCLUDES

A. Information that is made available to Bidders is for reference only, and is not intended to be part of the Contract.

1. Geotechnical Exploration Report

1.2 USE OF INFORMATION PROVIDED

A. Bidders are encouraged to review available Project information prior to submitting a Bid, and to obtain additional information if Bidder desires.

B. Owner-furnished information is provided only for information and convenience to Bidders. The Owner, Architect, or Architect's consultants do not warrant accuracy, adequacy, or applicability of information contained in available Project information. Owner and Architect disclaim responsibility for accuracy of information that has been prepared by others. Owner and Architect further disclaim responsibility for interpretation of that information by Bidders. The information and recommendations in available Project information are the sole responsibility of the preparer.

1.3 GEOTECHNICAL DATA

A. This Document with its referenced attachment is part of the Procurement and Contracting Requirements for Project. They provide information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' other investigations. They are made available for Bidders' convenience and information, but are not a warranty of existing conditions.

1. This Document and its attachment are for information only and are not part of the Contract Documents.
2. Immediately on discovery of a difference between the Geotechnical Data and the Contract Documents, prepare and submit a detailed report to the Architect and Owner.

B. A geotechnical investigation report for this Project, prepared by the following, is bound directly behind this Document.

1. Testing Agency's Project Number: 1306-19-019
2. Date of Survey: September 24, 2019
3. Geotechnical Evaluation Report Prepared By: S&ME, Inc.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF DOCUMENT 003100

Geotechnical Exploration Report
Waccamaw Elementary Addition
Ash, North Carolina
S&ME Project No. 1306-19-019

PREPARED FOR:

LS3P Associates Limited
101 North Third Street Suite 500
Wilmington, North Carolina 28401

PREPARED BY:

S&ME, Inc.
3006 Hall Waters Drive, Suite 100
Wilmington, NC 28405

September 24, 2019

September 24, 2019

LS3P Associates Limited
101 North Third Street Suite 500
Wilmington, North Carolina 28401

Attention: Mr. Charles H. Boney Jr.

Reference: **Geotechnical Exploration Report**
Waccamaw Elementary School Addition
5901 Waccamaw School Road NW
Ash, North Carolina
S&ME Project No. 1306-19-019
NC PE Firm License No. F-0176

Dear Mr. Boney:

S&ME is pleased to submit this geotechnical exploration report for the referenced project site. The work was completed in general accordance with our proposal number 13-1900322 dated July 17, 2019. The purpose of the exploration was to evaluate subsurface conditions as they relate to site grading and building foundations. This report presents a summary of pertinent project information, results of field testing, and our geotechnical engineering conclusions and recommendations. A Site Vicinity Plan, Boring Location Plan, SPT boring logs, and Generalized Subsurface Profile are included in the appendix.

S&ME appreciates the opportunity to provide our services on this project. Please contact us if you have any questions regarding this report or if we may be of further assistance.

Sincerely,

S&ME, Inc.

J. Adam Browning, P.E.
Sep 24 2019 3:03 PM

DocuSign

Elliot Blonshine
Geotechnical Staff Professional

J. Adam Browning, P.E.
Senior Engineer
N.C. Registration No. 034984

Table of Contents

1.0 Project and Site Information 3

2.0 Methods of Exploration 3

3.0 Subsurface Conditions 4

3.1 Physiography 4

3.2 Subsurface Conditions 4

4.0 Conclusions and Recommendations 5

4.1 Earthwork 5

4.1.1 Site Preparation 5

4.1.2 Placement of Structural Fill 5

4.1.3 Excavations 6

4.1.4 Subgrade Repair and Improvement Methods 7

4.2 Building Foundation Recommendations 7

4.2.1 Bearing Pressure 7

4.2.2 Bearing Depth and Dimension 7

4.2.3 Settlement 8

4.3 Floor Slab 8

4.4 Seismic Site Classification 8

4.4.1 Liquefaction Triggering 8

4.4.2 Seismic Site Class and Ground Motion Parameters 9

4.4.3 Liquefaction Mitigation – Earthquake Drains 9

5.0 Qualifications of Report 10

1.0 Project and Site Information

This report is based on the following information:

- Email from Mr. Charles H. Boney, Jr with LS3P to Mr. Nate Buffum, P.E. with S&ME on July 11, 2019 which contained a request for a proposal with report requirements described by Mr. Don Woods, P.E. with Woods Engineering.
- Boring Location Plan with building addition location.

We understand that Brunswick County Schools (BCS) is making improvements to Waccamaw Elementary School on Waccamaw School Road NW in Ash, North Carolina. Improvements include demolishing an existing classroom building and construction of a roughly 14,000 square foot, nine-classroom building with a concrete slab-on-grade and masonry block walls. The new building will be roughly in the footprint of the existing building and adjacent bus parking lot area.

The structure will be relatively light with maximum column loads of 50 kips and wall loads of less than 3 kips per linear foot. A final floor elevation was not provided, but we have assumed it will match the existing building's FFE. Thus, we have assumed less than 1 to 2 feet of cut/fill will be required to reach design subgrade elevation.

2.0 Methods of Exploration

Our exploration included a site reconnaissance by a geotechnical professional and the performance of two standard penetration test (SPT) borings.

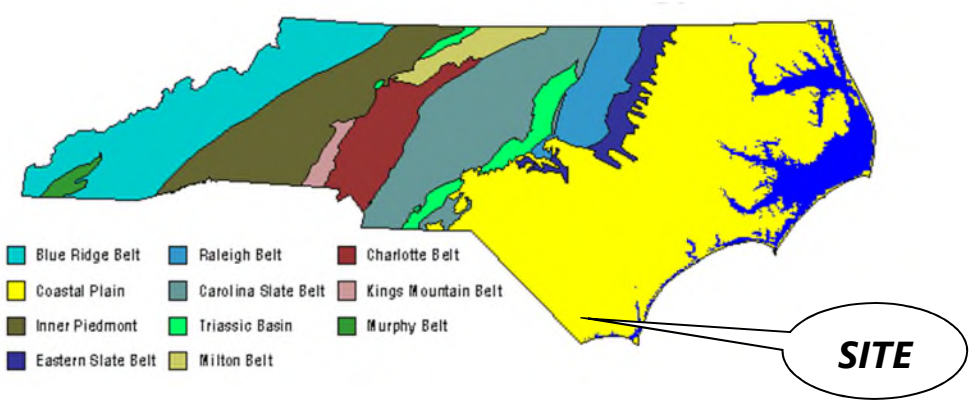
Boring locations were established in the field by our personnel by estimating distances and angles from existing site features. S&ME advanced two SPT borings (B-1 and B-2) as shown on the Boring Location Plan (Figure 1B) in the Appendix. The borings were drilled by Mid-Atlantic Drilling on August 22, 2019, using a CME 45 rig equipped with an automatic hammer. The borings were advanced to approximate depths of 30 and 50 feet below the existing ground surface using mud-rotary drilling techniques. Within the borings, samples of subsurface soils were taken at 2.5-foot intervals above a depth of 10 feet and at 5-foot intervals below 10 feet using a split-spoon sampler. Standard penetration tests (SPTs) were conducted in conjunction with split-spoon sampling in general accordance with ASTM D1586-11 using an automatic hammer. The ground surface elevations shown on the Boring Logs are from Google Earth and should be considered approximate.

Water levels were measured at termination of drilling; however water levels were likely impacted by the introduction of fluid during drilling. At the end of our exploration, the borings were backfilled with soil cuttings to the ground surface and patched with asphalt cold patch.

3.0 Subsurface Conditions

3.1 Physiography

Figure 1 - Physiography



The site is located within the Coastal Plain Physiographic Province of North Carolina as shown in Figure 1. The Coastal Plain Province is typically characterized by marine, alluvial, and aeolian sediments that were deposited during periods of fluctuating sea levels and moving shorelines. The soils and basal formations in the North Carolina Coastal Plain Physiographic Province are typical of those laid down in a shallow sloping sea bottom; interbedded sands and clays with irregular deposits of shells and layers of limestone and cemented sands. Alluvial sands, silts, and clays are typically present near rivers and creeks. Deposits of peat, organic silt, and organic clay are also typically present in or near current or former tidal marsh areas in the outer portion of the Coastal Plain.

According to the 1985 Geologic Map of North Carolina, the site is underlain by the Peedee Formation of Cretaceous age. This formation consists of fossiliferous and calcareous sand, clayey sand, and greenish gray to olive black clay. The top of the coastal formations on the geologic map are typically on the order of 30 to 100 feet below the ground surface. They represent basal, relatively hard formations with consistency over large areas.

3.2 Subsurface Conditions

The exploration typically encountered very loose to medium dense, silty, clayey and relatively clean sands to approximate depths of 47 feet below the existing ground surface. An approximately 10-feet thick zone of very soft clay was encountered from 12 to 22 feet below ground surface. Dense silty sand associated with the Peedee Formation was encountered at approximately 47 feet in boring B-2.

Water levels were measured upon completion of the borings. Water levels at the time of the exploration were encountered at depths of 3.5 feet below existing ground surface in each boring. These levels may have been affected by the introduction of fluid during drilling. Water levels will vary with seasonal conditions.

4.0 Conclusions and Recommendations

The exploration indicates the site is adaptable for the proposed construction. Building foundations may be designed as conventional shallow foundations bearing in suitable natural soils and well-compacted fill soils. The primary geotechnical consideration will be the potential for liquefaction during the design seismic event (see section 4.4).

The following presents out geotechnical recommendations regarding site grading and structural support. During the review of these recommendations, it should be kept in mind that demolition and replacement of an existing building is planned. With any previously-developed site, unexpected subsurface conditions will be encountered. Also, subsurface conditions will vary between the test locations and different subsurface conditions may be encountered beneath the existing building. These conditions could include such things as poorly-compacted fill deposits, buried debris, or remnants of previous development. The unexpected conditions can normally be handled during construction by on-site engineering evaluation.

4.1 Earthwork

4.1.1 Site Preparation

Site preparation should begin with demolition of the existing building and clearing and stripping the proposed construction areas of any topsoil, roots, organics, and other unsuitable foundation supporting material. Any voids created from stripping and removing construction materials should be cleaned and filled with well-compacted controlled fill. A sanitary sewer line was marked within the proposed building footprint. Any existing utilities should be removed/relocated, the excavation observed, and backfilled with compacted structural fill.

After the required initial site work has been completed, we recommend that the exposed subgrade soils be proofrolled with a 10-ton smooth-drum self-propelled roller operating in the static mode or a loaded dump truck to locate any areas of soft or otherwise unsuitable surface conditions. Any area that ruts or pumps should be disced, moisture conditioned to near the soil's optimum moisture content by drying or wetting, and recompacted. If water is drawn to the surface, the vibrator should be disengaged.

Each boring encountered very loose sands (N-value of 4 or less) at depths of about 3 to 8 feet below ground surface. Depending on the final subgrade elevation, and the conditions below the existing building, undercutting or densification may be required.

4.1.2 Placement of Structural Fill

We anticipate minimal new structural fill will be required (i.e. less than 2 feet) at this site to reach finished grades. Where structural fill is required to reach finished grade and is placed above existing grade, we recommend that a clean sand, a slightly silty sand, a slightly clayey sand, or a silty sand with less than 20 percent fines and having a Unified Soil Classification of SP, SP-SM, SP-SC, or SM be used. The more clayey and silty sands (% passing No. 200 sieve greater than 12%) are moisture sensitive and will be difficult to work with during wet weather conditions. The fill should be free of organics and debris, be placed in 8 to 10-inch thick lifts and should be compacted to at least 98 percent of its standard Proctor maximum dry density (ASTM D 698). To confirm that the

specified degree of compaction is being obtained, field density testing should be performed in each fill lift by a soils technician.

4.1.3 Excavations

Installation of footings and new utilities may require excavations to depths of up to approximately 5 feet below the existing ground surface. The excavations may require temporary sloping in addition to construction dewatering. We anticipate internal sumps and pumps will provide adequate groundwater control. Borings indicate that excavations will extend through low to moderate consistency soils. Generally, these soils can be excavated using trackhoes, and other types of typical earthmoving equipment.

4.1.3.1 Temporary Sloping and Shoring

Temporary construction slopes and excavation shoring should be designed in strict compliance with the most recent local, state, and federal governing regulations, including OSHA (29 CFR Part 1926) excavation trench safety standards. Temporary excavations should be cut to a stable slope or the excavations should be temporarily braced, depending upon the excavation depth, nearby site features, and encountered subsurface conditions. Temporary slopes should be designed using analytical methods, as the standard OSHA temporary slope angles for different types of soils may not be applicable for this site.

Stockpiles should be placed well away from the edge of the excavations, and their heights should be controlled so they do not surcharge the sides of the excavations. The responsibility for excavation safety and stability of temporary construction slopes should lie solely with the constructor. This information is provided only as a service and under no circumstance should S&ME be assumed to be responsible for construction site safety.

4.1.3.2 Construction Dewatering

S&ME does not anticipate significant dewatering will be required provided excavations are less than 2 to 3 feet below existing grade. If deeper excavations are performed, potential groundwater control methods include open pumping, predrainage dewatering, and cutoff/exclusion. Open pumping utilizes submersible sump pumps in pits or trenches dug below the bottom of the excavation and backfilled with No. 57 stone. Submersible sump pumps placed in perforated or slotted plastic pipe installed in angled pits backfilled with No. 57 stone below the bottom of the excavation, called "stingers", are another type of open pumping. Pumping can be performed on an intermittent basis to remove water from the construction excavation, but should be continuous (24 hours a day) to maintain excavation bottom stability. Predrainage dewatering requires the installation of temporary wells and/or well points within or around the excavations, with continuous (24 hours a day) pumping both before excavation and while the excavations are in use to lower the groundwater adequately beneath the entire excavation areas. Groundwater should be maintained a minimum of 2 to 3 feet below the excavation bottom throughout construction to maintain bottom stability. The dewatering system designer should also consider the influence of dewatering on any nearby structures and roadways.

The responsibility for dewatering of construction excavations should lie solely with the contractor. This information is provided only as a service and under no circumstance should S&ME be assumed to be responsible for the effectiveness of the construction dewatering method(s) selected by the contractor.

4.1.4 Subgrade Repair and Improvement Methods

The exposed subgrade can deteriorate and lose support when exposed to construction traffic and adverse weather conditions. Deterioration can occur in the form or rutting, pumping, freezing, or erosion. We recommend that during construction, exposed subgrade surfaces be sealed at the end of each day or when wet weather is forecast. Water should not be allowed to pond on exposed subgrades. Heavy rubber-tired construction equipment should not be allowed to operate on exposed subgrades during wet conditions.

Immediately prior to floor slab construction, exposed subgrade soils should be evaluated by proofrolling to determine their stability. Soils which rut, pump, or deflect under proofrolling should be repaired prior to ABC stone placement. Repair measures may include scarifying/drying/recompacting, undercutting, placement of geotextiles, or some combination of these. Actual repair measures will be influenced by project schedule and weather conditions and can only be determined in the field by the geotechnical engineer.

4.2 Building Foundation Recommendations

Based on the borings and assumed structural loads, the building may be supported on shallow spread footings provided the site is prepared as recommended above. The following sections provide our geotechnical conclusions and recommendations regarding building foundation support.

4.2.1 Bearing Pressure

Shallow foundations for the building may be designed using a net allowable soil bearing pressure of 2,000 pounds per square foot. All foundation excavations should be evaluated by the geotechnical engineer or his representative prior to concrete placement to confirm the suitability of underlying materials. This evaluation will include probing and hand-augering and dynamic cone penetrometer testing. If loose, soft or otherwise unsuitable soils are encountered, these soils should be densified or overexcavated and backfilled with washed stone (NCDOT No. 57).

Based on the borings, loose sands were encountered in the upper 3 ft beneath the existing ground surface and very loose sands between 3 and 8 feet below ground surface. Overexcavation and replacement with washed stone will likely be required. The overexcavation depths should be determined by a representative of the geotechnical engineer based on the foundation subgrade evaluations.

If water collects in any excavations it should be removed promptly. Care should be exercised during construction of foundations in order not to disturb bearing soils and reduce their bearing strength. Concrete for the footings should be placed as soon as practical following excavation. If concrete placement is delayed, placement of a concrete "mud mat" on exposed bearing soils should be considered.

4.2.2 Bearing Depth and Dimension

Footings should bear at least 18 inches below exterior grade to avoid frost penetration and develop the design bearing capacity. Continuous wall footings should be at least 18 inches wide and isolated column footings should be at least 24 inches wide. This recommendation is made to prevent a localized or "punching" shear failure condition which can occur with very narrow footings.

4.2.3 Settlement

Based on conditions encountered by this exploration, our assumed structural loads, and provided the site is prepared as recommended above, we expect that maximum total settlements beneath footings will be less than 1 inch. Differential settlements are expected to be ½ inch or less for footings bearing on similar materials.

4.3 Floor Slab

The ground floor slab may be constructed above suitable compacted fill or stable natural soils provided that the recommendations described above are implemented. The slab should be separated from footings to allow for relative displacement.

We recommend that at least 6 inches of compacted select granular material be placed beneath all ground floor slabs to provide a capillary break, provide more uniform slab support, and reduce damage to subgrade soils during construction. The select granular fill should classify as SP, SP-SM, SW, or SW-SM in accordance with the Unified Soil Classification System, which requires that these soils have less than 12 percent passing the No. 200 sieve. Manufactured materials such as aggregate base course (ABC) or processed fill (i.e., screenings) meeting this specification can be used. A modulus of subgrade reaction value of 150 psi/in may be used to design floor slab on subgrades consisting of these soils compacted to at least 98 percent of the soil's standard Proctor maximum dry density.

Exposure to the environment and construction activities will weaken the floor slab subgrade soils. Therefore, we recommend that subgrade soils in slab areas be evaluated prior to placement of the select granular fill. If near surface deterioration of the soils has occurred, undercutting or reworking of the fill may be necessary.

Based on the results of our exploration and the assumed finish floor elevation, the floor slab will not be below the exterior grade and will not be subjected to hydrostatic pressure from groundwater. However, water vapor transmission through the slab is still a design consideration. Evaluating the need for and design of a vapor retarder or vapor barrier for moisture control is outside our scope of services and should be determined by the project architect/structural engineer based on the planned floor coverings and the corresponding design constraints, as outlined in ACI 302.1R-04 Guide for Concrete Floor and Slab Construction. Further, health and environmental considerations with respect to any potentially harmful vapor transmission are also outside of our scope.

4.4 Seismic Site Classification

The following sections pertain to seismic considerations.

4.4.1 Liquefaction Triggering

We performed a seismic liquefaction triggering evaluation using the methods presented by Youd et. al. (2001) and Boulanger and Idriss (2014) based on the design earthquake (M=7.3). The design earthquake has a 2 percent probability of exceedance in a 50-year period. This is equivalent to an earthquake that has the likelihood of occurring once every 2,475 years.

To help evaluate the consequences of liquefaction, the Liquefaction Potential Index (LPI) was computed. The LPI is an empirical tool used to evaluate the site liquefaction hazard and the potential for liquefaction-induced damages[1]. The LPI considers the factor of safety against liquefaction, the depth to the liquefiable soils, and the thickness of the liquefiable soils to compute an index that ranges from 0 to 100. An LPI of 0 means there is no risk of liquefaction; an LPI of 100 means the entire profile is expected to liquefy. The level of risk is generally defined as:

- LPI < 5 – surface manifestation and liquefaction-induced damage not expected.
- 5 ≤ LPI ≤ 15 – moderate liquefaction with some surface manifestation possible.
- LPI > 15 – severe liquefaction and foundation damage is likely.

Based on the results of our analyses, we conclude that the site has a severe potential for liquefaction for the design earthquake under the 2018 NCBC. LPI calculated at our test locations is about 45; therefore, liquefaction-induced damage is expected during the design seismic event.

4.4.2 *Seismic Site Class and Ground Motion Parameters*

Section 1613.3.2 of the IBC 2015, as referenced by the 2018 North Carolina Building Code, classifies sites with the potential for liquefaction as Seismic Site Class F. However, the IBC 2015 allows the design spectral response accelerations for a site to be determined without regard to liquefaction provided buildings have a fundamental period of less than or equal to 0.5 seconds and the risks of liquefaction are considered in design. The proposed building should meet this criteria; however, this must be confirmed by the Structural Engineer. **The site should be considered as Site Class F**. Provided the above criteria are met, the design accelerations may be calculated on the basis of a Site Class D assumption. The spectral response accelerations and site coefficients for the site are given below.

Table 1 – Ground Motion Parameters

Method	Site Class	S_S	S_1	S_{DS}	S_{D1}	PGA_M	Seismic Design Category (S_{DS} / S_{D1})
ASCE 7-10	F	0..311g	0.121g	0.321g	0.187g	0.241g	C / D

4.4.3 *Liquefaction Mitigation – Earthquake Drains*

The project owner may elect to mitigate the liquefaction potential discussed above. Earthquake drain installation can mitigate liquefaction potential and reduce seismic settlement to acceptable levels (less than 2 inches); however, the drains cannot totally eliminate seismic settlement. The drains allow for the rapid dissipation of excess soil porewater pressures generated during a seismic event thus reducing liquefaction. The drains are

[1] Iwasaki et al. 1982, Toprak & Holzer (2003).

composed of corrugated, perforated plastic pipe encased in a filter fabric which prevents migration of fines into the pipe. Pipe diameters and spacing's vary according to the anticipated liquefaction risk and may be supplemented with man-made gravel reservoirs for additional water storage. The drains are installed by vibrating a steel casing into the ground which helps densify the surrounding loose sands and allows insertion of the drain pipe.

Earthquake drains are typically provided in a design-build contract by a specialty contractor experienced with the design and installation of the system. If the owner decides to take measures to mitigate liquefaction potential, requests be submitted to qualified contractors to prepare a proposal to furnish all necessary labor, equipment, and materials to design and install EQ drains to reduce liquefaction-induced deformations for the IBC 2015 design earthquake in building areas to a magnitude acceptable to the structural engineer. The IBC 2015 design event comprises a 7.3 magnitude earthquake with a peak ground acceleration (PGA_M) of 0.241. A copy of this report should be submitted with the request to provide the necessary subsurface data to perform the design. The proposals should be evaluated by the project Geotechnical and Structural Engineers, and then a contractor should be selected based on technical approach, past experience, and cost.

If performed, EQ drain installation should be observed by a representative of the Geotechnical Engineer to confirm that 1) earthquake drains are installed in all locations, 2) earthquake drains are installed to the design depth, and 3) note any non-conformance with the EQ drain design.

5.0 Qualifications of Report

This report has been prepared in accordance with generally accepted engineering practice for specific application to this project. Any wetland, environmental, or contaminant assessment efforts are beyond the scope of this geotechnical exploration; and therefore, those issues are not addressed in this report. The conclusions and recommendations contained in this report are based on the applicable standards of our profession at the time this report was prepared. No other warranty, express or implied, is made.

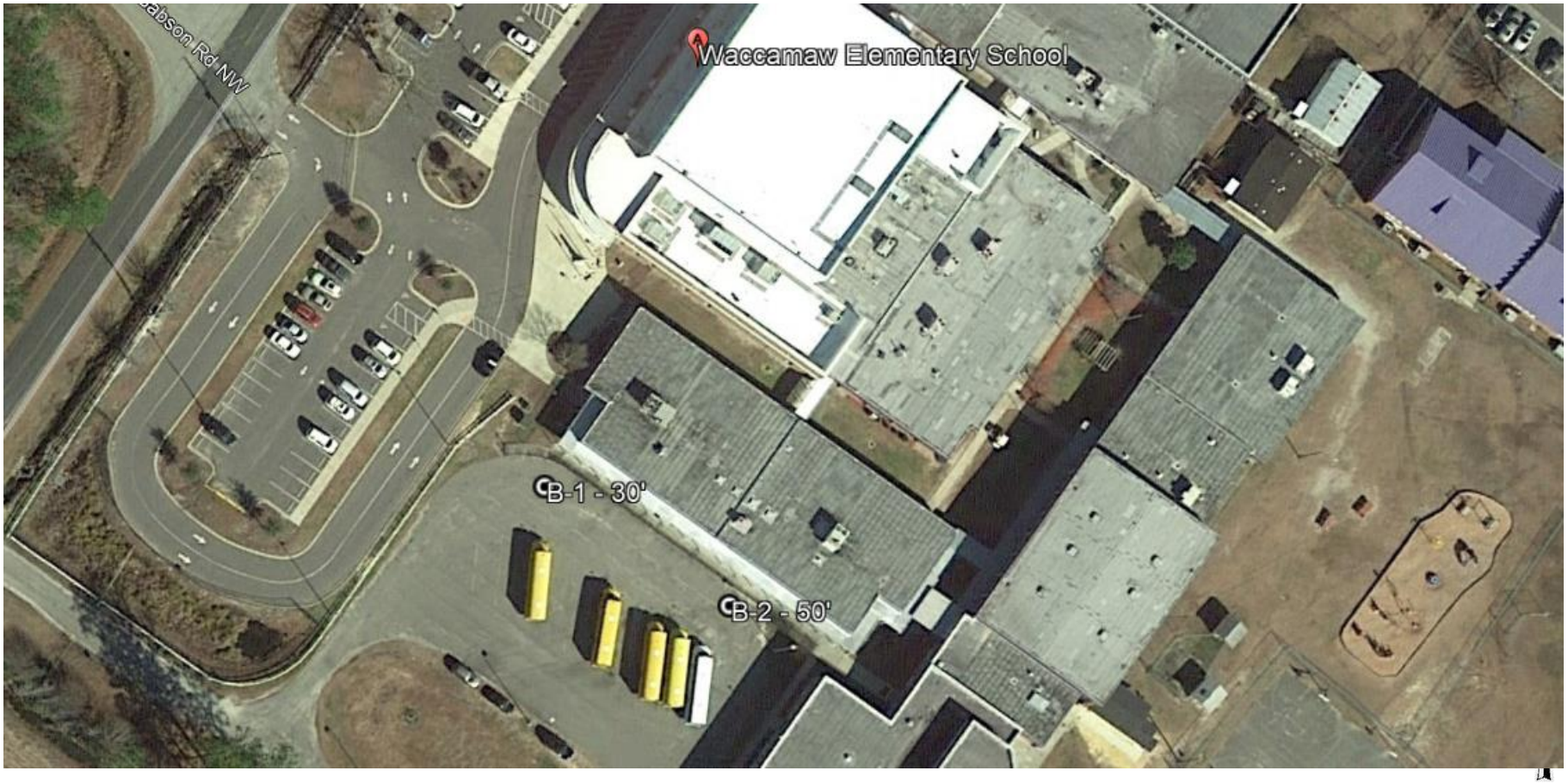
The nature and extent of variations between and beyond the specific sounding locations may not become evident until discovered during construction. If variations appear evident, then it will be necessary to re-evaluate the recommendations of this report. In the event that any changes in the nature or design of the proposed facility are planned, the conclusions and recommendations contained in this report should be reviewed and conclusions of this report modified or verified in writing.

Appendices



REFERENCE: GOOGLE EARTH

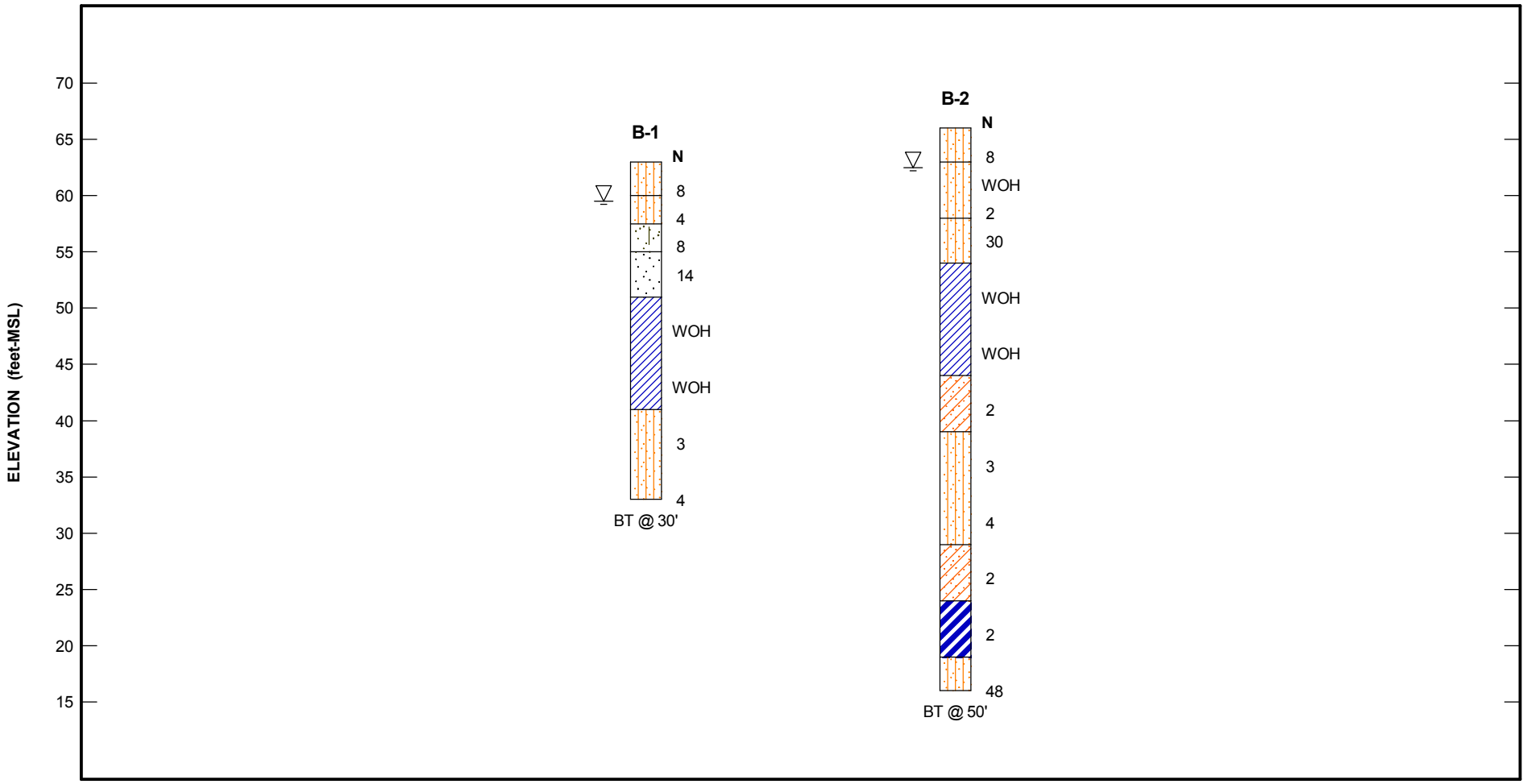
	SITE VICINITY PLAN	SCALE: NOT TO SCALE	FIGURE NO.
	WACCAMAW ELEMENTARY ADDITION ASH, NORTH CAROLINA	DATE: 9/5/2019 PROJECT NUMBER 1306-19-019	**1A**



B-1 - 30' Proposed Boring Locations

REFERENCE: GOOGLE EARTH

	BORING LOCATION PLAN	SCALE: NOT TO SCALE	FIGURE NO.
	WACCAMAW ELEMENTARY ADDITION ASH, NORTH CAROLINA	DATE: 9/5/2019 PROJECT NUMBER 1306-19-019	**1B**



N = Standard Penetration Test resistance value (blows per foot). The depicted stratigraphy is shown for illustrative purposes only. The actual subsurface conditions will vary between boring locations. Elevations are approximate.

JOB NO: 1306-19-019		Diagram: Generalized Subsurface Conditions	Figure 2
DATE: 9/3/19		Project: Waccamaw Elementary School Additions Location: Ash, North Carolina	

PROJECT: **Waccamaw Elementary School Additions**
Ash, North Carolina
S&ME Project No. 1306-19-019

BORING LOG **B-1**

DATE DRILLED: **8/22/19**	ELEVATION: **63.0 ft**
DRILL RIG: **CME 45**	BORING DEPTH: **30.0 ft**
DRILLER: **Mid Atlantic Drilling**	WATER LEVEL: **3.5' ATD**
HAMMER TYPE: **Automatic**	LOGGED BY: **E. Blonshine**
SAMPLING METHOD: **Split spoon**	
DRILLING METHOD: **Mud Rotary**	

NOTES: **Boring location and elevation are approximate.**

DEPTH (feet)	MATERIAL DESCRIPTION	ELEVATION (feet)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT / CORE DATA 1st 6in / RUN #	2nd 6in / REC	3rd 6in / RQD	STANDARD PENETRATION TEST DATA (blows/ft) / REMARKS	N VALUE
0	**COASTAL PLAIN: SILTY SAND (SM)** loose, black, fine, moist				4	4	4		8
	SILTY SAND (SM) very loose, tan, fine, moist				3	2	2		4
5	**SAND (SP-SM)** loose, dark brown, with silt, fine, wet	58.0			3	3	5		8
	SAND (SP) medium dense, brown, trace silt, trace mica, fine, wet	53.0			3	5	9		14
10									
	SILTY CLAY (CL) very soft, gray, some sand, wet	48.0			WOH	WOH	WOH		WOH
15									
		43.0			WOH	WOH	WOH		WOH
20									
	SILTY SAND (SM) very loose, gray, fine, wet	38.0			1	1	2		3
25									
		33.0			2	2	2		4
30	Boring terminated at 30 ft								

STANDARD PENETRATION TEST DATA (blows/ft) / REMARKS: 10 20 30 60 80

S&ME BORING LOG NO NORTHING AND EASTING WACCAMAW K-8 ADDITION.GPJ S&ME.GDT 9/3/19

NOTES:

1. *THIS LOG IS ONLY A PORTION OF A REPORT PREPARED FOR THE NAMED PROJECT AND MUST ONLY BE USED TOGETHER WITH THAT REPORT.*
2. *BORING, SAMPLING AND PENETRATION TEST DATA IN GENERAL ACCORDANCE WITH ASTM D-1586.*
3. *STRATIFICATION AND GROUNDWATER DEPTHS ARE NOT EXACT.*
4. *WATER LEVEL IS AT TIME OF EXPLORATION AND WILL VARY.*

PROJECT: **Waccamaw Elementary School Additions**
Ash, North Carolina
S&ME Project No. 1306-19-019

BORING LOG **B-2**

DATE DRILLED: **8/22/19**	ELEVATION: **66.0 ft**
DRILL RIG: **CME 45**	BORING DEPTH: **50.0 ft**
DRILLER: **Mid Atlantic Drilling**	WATER LEVEL: **3.5' ATD**
HAMMER TYPE: **Automatic**	LOGGED BY: **E. Blonshine**
SAMPLING METHOD: **Split spoon**	
DRILLING METHOD: **Mud Rotary**	

NOTES: **Boring location and elevation are approximate.**

DEPTH (feet)	MATERIAL DESCRIPTION	ELEVATION (feet)	SAMPLE NO.	SAMPLE TYPE	1st 6in / RUN #	2nd 6in / REC	3rd 6in / RQD	N VALUE
	COASTAL PLAIN: SILTY SAND (SM) loose, black, fine, moist				5	5	3	8
5	**SILTY SAND (SM)** very loose, dark brown, fine, wet	61.0			WOH	WOH	WOH	WOH
					3	1	1	2
10	**SILTY SAND (SM)** medium dense, brown, fine, wet	56.0			8	13	17	30
15	**SILTY CLAY (CL)** very soft, gray, some sand, wet	51.0			WOH	WOH	WOH	WOH
20		46.0			WOH	WOH	WOH	WOH
25	**CLAYEY SAND (SC)** very loose, gray, fine, wet	41.0			1	1	1	2
30	**SILTY SAND (SM)** very loose, gray, fine, wet	36.0			2	1	2	3
					2	2	2	4

STANDARD PENETRATION TEST DATA (blows/ft) / REMARKS — 10 20 30 60 80

S&ME BORING LOG NO NORTHING AND EASTING WACCAMAW K-8 ADDITION.GPJ S&ME.GDT 9/3/19

NOTES:

1. ***THIS LOG IS ONLY A PORTION OF A REPORT PREPARED FOR THE NAMED PROJECT AND MUST ONLY BE USED TOGETHER WITH THAT REPORT.***
2. ***BORING, SAMPLING AND PENETRATION TEST DATA IN GENERAL ACCORDANCE WITH ASTM D-1586.***
3. ***STRATIFICATION AND GROUNDWATER DEPTHS ARE NOT EXACT.***
4. ***WATER LEVEL IS AT TIME OF EXPLORATION AND WILL VARY.***

PROJECT: **Waccamaw Elementary School Additions**
Ash, North Carolina
S&ME Project No. 1306-19-019

BORING LOG **B-2**

DATE DRILLED: **8/22/19**	ELEVATION: **66.0 ft**
DRILL RIG: **CME 45**	BORING DEPTH: **50.0 ft**
DRILLER: **Mid Atlantic Drilling**	WATER LEVEL: **3.5' ATD**
HAMMER TYPE: **Automatic**	LOGGED BY: **E. Blonshine**
SAMPLING METHOD: **Split spoon**	
DRILLING METHOD: **Mud Rotary**	

NOTES: **Boring location and elevation are approximate.**

DEPTH (feet)	MATERIAL DESCRIPTION	ELEVATION (feet)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT / CORE DATA 1st 6in / RUN #	2nd 6in / REC	3rd 6in / RQD	STANDARD PENETRATION TEST DATA (blows/ft) / REMARKS	N VALUE
	SILTY SAND (SM) very loose, gray, fine, wet *(continued)*								
40	**CLAYEY SAND (SC)** very loose, gray, trace shell hash, fine, wet	26.0			1	1	1		2
45	**SILTY CLAY (CH)** very soft, gray, wet	21.0			1	1	1		2
50	**SILTY SAND (SM)** dense, gray, fine, wet	16.0			15	23	25		48
	Boring terminated at 50 ft								

STANDARD PENETRATION TEST DATA (blows/ft) / REMARKS: 10 20 30 60 80

S&ME BORING LOG NO NORTHING AND EASTING WACCAMAW K-8 ADDITION.GPJ S&ME.GDT 9/3/19

NOTES:

1. ***THIS LOG IS ONLY A PORTION OF A REPORT PREPARED FOR THE NAMED PROJECT AND MUST ONLY BE USED TOGETHER WITH THAT REPORT.***
2. ***BORING, SAMPLING AND PENETRATION TEST DATA IN GENERAL ACCORDANCE WITH ASTM D-1586.***
3. ***STRATIFICATION AND GROUNDWATER DEPTHS ARE NOT EXACT.***
4. ***WATER LEVEL IS AT TIME OF EXPLORATION AND WILL VARY.***

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Work under separate contracts.
4. Owner-furnished, Contractor-installed products.
5. Access to site.
6. Coordination with occupants.
7. Work restrictions.
8. Specification and drawing conventions.

1.2 PROJECT INFORMATION

A. Project Identification: Waccamaw Elementary School

B. Owner: County of Brunswick North Carolina, 35 Referendum Drive NE, Bolivia, North Carolina 28422

1. Owner's Representative: Craig Eckert, Program Director

C. Architect Identification: The Contract Documents were prepared for Project by LS3P, 434 Fayetteville Street, Suite 1700, Raleigh, North Carolina 27601.

1. Architect's Representative: Mary Brehler, AIA

D. Architect's Consultants:

1. Civil Engineer: Paramounte Engineering, Inc.
2. Structural Engineer: Woods Engineering, PA
3. Plumbing, Mechanical, and Electrical: Cheatham and Associates, PA

E. Construction Manager: Bordeaux Construction Company

1. Construction Manager has been engaged for this Project to serve as an advisor to Owner and to provide assistance in administering the Contract for construction between Owner and Contractor, according to a separate contract between Owner and Construction Manager.

F. A web-based Project Information Management System administered by Architect will be used for purposes of managing communication and documents during the construction stage.

1. See Section 013100 "Project Management and Coordination" for requirements for using the Project Information Management System.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

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

1. A nine-classroom addition (detached) to replace the existing 9 school classroom building located on the site. New construction shall be load-bearing metal studs with brick veneer.

B. Type of Contract: Construction manager at risk.

1.4 WORK UNDER SEPARATE CONTRACTS

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

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

1. The Owner's subcontractor will provide equipment as indicated on Drawings, including making the final utility connections.
2. Work of this Contract shall include coordinating and providing utilities for equipment provided under separate contract.
3. Coordination: Coordinate construction and operations of the Work with work performed under separate contracts.

a. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for portions of the Work performed under separate contracts. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
b. Preinstallation Conferences: Include construction personnel under separate contract at preinstallation conferences covering portions of the Work that are to receive work under separate contract.

1.5 OWNER-FURNISHED, CONTRACTOR-INSTALLED PRODUCTS

A. Owner will furnish products indicated. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner-furnished products.

B. Owner-Furnished, Contractor-Installed Products:

1. SMART board displays.
2. Toilet accessories as indicated in Section 102800 "Toilet Accessories."
3. Residential appliances.

1.6 ACCESS TO SITE

A. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

1. Limits: Contractor's use of Project site is limited by:

a. Owner's right to perform work,
b. Owner's right to retain other Contractors on portions of Project,
c. Owner's on-going business.

2. Driveways, Walkways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

1.7 COORDINATION WITH OCCUPANTS

A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.

1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

1.8 WORK RESTRICTIONS

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

1. Comply with Owner's "Minimum Operating Requirements" included at the end of this Section.
2. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

B. E-Verify Compliance: Contractor shall provide an affidavit, included at the end of this Section, attesting to compliance with E-Verify requirements for itself and all its subcontractors. Contractor shall provide affidavit prior to executing contract.

1. E-verify affidavit is not required to be submitted with bid form.

C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner.

1. Work requiring utility interruptions shall be performed outside of normal business working hours.
2. Notify Owner not less than two days in advance of proposed utility interruptions.
3. Obtain Owner's written permission before proceeding with utility interruptions.

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

1. Work activities that may be disruptive to Owner's on-going activities shall be performed outside of normal business working hours.
2. Notify Owner not less than two days in advance of proposed disruptive operations.
3. Obtain Owner's written permission before proceeding with disruptive operations.
4. Comply with requirements of authorities having jurisdiction.

E. Restricted Substances: Use of tobacco products and other controlled substances on school property is not permitted.

1. Use or display of tobacco or nicotine-containing products, including but not limited to electronic cigarettes (e-cigarettes), on school premises, both indoor and outdoor, is prohibited.

F. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

G. Background Checks: Comply with Owner's requirements.

H. Employee Conduct: Workers shall conduct themselves in a business-like manner at all times.

1. No loud radios will be allowed.
2. No guns or weapons will be allowed.
3. No drugs or alcohol will be allowed.

4. No harassment of any kind, including catcalls, foul language or other offensive language, gestures or other objectionable behavior will be permitted on the site.
5. All employees must wear proper attire at all times. Shirts and shoes are required. T-shirts are acceptable provided they contain no objectionable graphics or text.

1.9 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

E-VERIFY AFFIDAVIT

STATE OF _____

COUNTY OF _____

I, _____ (the individual attesting below), being duly authorized by

and on behalf of _____ (hereinafter "Employer") after first

being duly sworn hereby swears or affirms as follows:

1. Employer understands that E-Verify is the federal E-Verify program operated by the United States Department of Homeland Security and other federal agencies, or any successor or equivalent program used to verify the work authorization of newly hired employees pursuant to federal law in accordance with NCGS §64-25(5).
2. Employer understands that Employers Must Use E-Verify. Each employer, after hiring an employee to work in the United States, shall verify the work authorization of the employee through E-Verify in accordance with NCGS §64-26(a).
3. Employer is a person, business entity, or other organization that transacts business in this State and that employs 25 or more employees in this State. (Mark "Yes" or "No")
   a. YES _____
   b. NO _____
4. Employer's subcontractors will comply with E-Verify, and Employer will ensure compliance with E-Verify by any and all subcontractors subsequently hired by Employer.

This _____ day of _____, 20_____.

_____

Signature of Affiant

Print or Type Name: _____

State of _____

County of _____

Signed and sworn to (or affirmed) before me, this

the _____ day of _____, 20_____.

My Commission Expires: _____

_____

Seal

Notary Public

SECTION 012100 - ALLOWANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements governing allowances.

1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation. If necessary, additional requirements will be issued by Change Order.
2. Include defined costs associated with allowances in base bid.

B. Related Requirements:

1. Section 012200 "Unit Prices" for procedures for using unit prices.

1.2 INFORMATIONAL SUBMITTALS

A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.

C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.3 COORDINATION

A. Coordinate allowance items with other portions of the Work.

1.4 LUMP-SUM ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials selected by Owner under allowance and shall include taxes, freight, and delivery to Project site.

B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials selected by Owner under allowance shall be included as part of the Contract Sum and not part of the allowance.

1.5 QUANTITY ALLOWANCES

A. Quantity Allowance: An estimated quantity or extent of a product, assembly, or portion of the Work that cannot be measured prior to construction, but is reasonably anticipated.

B. All costs for performing the work described under the quantity allowance are included in the allowance. These costs include materials, delivery, installation, taxes, insurance, equipment rental, and similar costs, and Contractor's overhead and profit.

C. When work is performed and actual quantity or extent is measured, the Contract Sum will be adjusted by Change Order based on Unit Cost indicated in the Agreement.

1.6 ADJUSTMENT OF ALLOWANCES

A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable.

1. Include installation costs in purchase amount only where indicated as part of the allowance.
2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
3. Submit substantiation of a change in scope of work, if any, claimed in Change Orders related to unit-cost allowances.
4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.

B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.

1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of work has changed from what could have been foreseen from information in the Contract Documents.
2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

C. Unused amounts of moneys that define the value of the allowances, included integrally in the work and materials allowances, shall be credited to the Owner by deduct change order prior to approval of Final Application for Payment.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

B. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.2 UNSUITABLE SOIL ALLOWANCE

A. Work shall include in the Base Bid Proposal sufficient funds to replace the quantity of Unsuitable Soil listed under the Schedule of Allowances below.

1. The term "cubic yards" used in relation to the Unsuitable Soil Allowance shall be defined as cubic yards of undisturbed material in-place. Under no conditions will the term "cubic yard" refer to "loose", "truck" or "disturbed" material.

B. Soil removal, soil replacement, and other earthwork indicated on the Drawings shall be included in the Base Bid and are not to be included in this allowance. The allowance shall provide for unanticipated soil replacement in excess of the Scope of Work indicated on Drawings.

1. All soil replacement is unclassified.

C. Replacement of unsuitable soil is defined as including:

1. Excavation of unsuitable material, mechanical or manual means as indicated.
2. Disposal of unsuitable material on-site or off-site as indicated.
3. Supply of new satisfactory material acceptable to the Engineer from on-site or off site as indicated. Refer to Earthwork specifications for description of satisfactory backfill material.
4. Installation of new material including compaction as required by Division 31.

D. Final Payment for unsuitable soil replacement performed as work of this Section shall be made as follows:

1. The total quantity of unsuitable soil replacement shall be determined by an independent surveyor or testing agency paid by the Owner and acceptable to the Contractor. The Unit Price per the Contract/Agreement for unsuitable soil replacement shall be multiplied by the actual unsuitable soil replacement quantity. This product shall be defined as the "Actual Cost."
2. The unit price listed on the Contract/Agreement for Unsuitable Soil Replacement shall be multiplied by the Unsuitable Soil Allowance quantity listed under the Schedule of Allowances below. This product shall be defined as the "Allowance Amount."
3. The Contractor shall be paid that portion of the Actual Cost which exceeds the Allowance Amount. The Contract Sum shall be reduced by that portion (if any) of the Allowance Amount which exceeds the Actual Cost.

E. Coordinate quantity allowance adjustment with unit-price requirements in Section 012200 "Unit Prices."

3.3 SCHEDULE OF ALLOWANCES

A. General:

1. Allowance No. 1: Include **50 hours** for additional general labor.
2. Allowance No. 2: Include **25 hours** for additional final cleaning.
3. Allowance No. 3: Include **25 hours** for additional drywall patching after painting.
4. Allowance No. 4: Include labor and materials to provide **5 additional access doors**, 24 by 24 inches, in gypsum ceilings not indicated on Drawings.
5. Allowance No. 5: Include **25 hours** to rework ceilings.
6. Allowance No. 6: Include **50 hours** for additional touch-up painting.
7. Allowance No. 7: Include labor and materials to provide **2 additional fire extinguishers and cabinets** not indicated on Drawings.
8. Allowance No. 8: Include labor and materials to provide **2 additional fire extinguishers and brackets** not indicated on Drawings.
9. Allowance No. 9: Include the sum of **$1,500.00** for additional signage not indicated on Drawings.

B. Sprinkler:

1. Allowance No. 10: Include labor and materials to provide **3 additional sprinkler heads** not indicated on Drawings.

C. Plumbing:

1. Allowance No. 11: Include **25 cu. yd.** of unsuitable soils (trench) removal and disposal off site.
2. Allowance No. 12: Include **25 cu. yd.** of replacement of unsuitable soils (trench) with import select fill.
3. Allowance No. 13: Include **20 tons** of replacement of unsuitable soils (trench) with #78 stone.

D. Mechanical:

1. Allowance No. 14: Include **5 hours** for additional BAS training.

E. Electrical:

1. Allowance No. 15: Include **25 cu. yd.** of unsuitable soils (trench) removal and disposal off site.
2. Allowance No. 16: Include **25 cu. yd.** of replacement of unsuitable soils (trench) with import select fill.
3. Allowance No. 17: Include **20 tons** of replacement of unsuitable soils (trench) with #78 stone.
4. Allowance No. 18: Include labor and materials to provide **3 additional horn strobes** not indicated on Drawings.
5. Allowance No. 19: Include labor and materials to provide **3 additional exit lights** not indicated on Drawings.
6. Allowance No. 20: Include labor and materials to provide **3 additional smoke detectors** not indicated on Drawings.
7. Allowance No. 21: Include labor and materials to provide **3 additional duplex outlets** not indicated on Drawings.
8. Allowance No. 22: Include labor and materials to provide **3 additional data outlets** not indicated on Drawings.
9. Allowance No. 23: Include labor and materials to provide **3 additional duct detectors** not indicated on Drawings.

F. Earthwork:

1. Allowance No. 24: Include **50 tons** of aggregate base course stone (NCDOT CABC).
2. Allowance No. 25: Include **250 sq. yds.** of geotechnical fabric.
3. Allowance No. 26: Include **100 lin. ft.** of subsurface drains (trench, install and backfill).
4. Allowance No. 27: Include **100 cu. yd.** of unsuitable soils (mass) removal and disposal off site.
5. Allowance No. 28: Include **100 cu. yd.** of unsuitable soils (trench) removal and disposal off site.
6. Allowance No. 29: Include **100 cu. yd.** of replacement of unsuitable soils (mass) with import select fill.
7. Allowance No. 30: Include **50 tons** of replacement of unsuitable soils (mass) with CABC.
8. Allowance No. 31: Include **100 cu. yd.** of replacement of unsuitable soils (trench) with import select fill.
9. Allowance No. 32: Include **50 tons** of replacement of unsuitable soils (trench) with #57 stone.
10. Allowance No. 33: Include **250 sq. yds.** of geogrid (BX-1100 or equal).
11. Allowance No. 34: Include **100 sq. ft.** to remove and replace existing concrete sidewalk.

G. Landscape:

1. Allowance No. 35: Include **200 sq. yds.** of reseeding.
2. Allowance No. 36: Include **50 sq. yds.** of additional sod.

END OF SECTION 012100

SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for unit prices.

1.2 DEFINITIONS

A. Unit price is an amount incorporated in the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.3 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.

B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.

C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

A. General:

1. Unit Price No. 1:
    a. Description: General labor.
    b. Unit of Measurement: Hour.
2. Unit Price No. 2:
    a. Description: Final cleaning.
    b. Unit of Measurement: Hour.
3. Unit Price No. 3:
    a. Description: Drywall patching after painting.
    b. Unit of Measurement: Hour.
4. Unit Price No. 4:
    a. Description: Furnish and install access door, 24 by 24 inches.
    b. Unit of Measurement: Each.

5. Unit Price No. 5:

   a. Description: Rework ceilings.
   b. Unit of Measurement: Hour.

6. Unit Price No. 6:

   a. Description: Touch-up painting.
   b. Unit of Measurement: Hour.

7. Unit Price No. 7:

   a. Description: Furnish and install fire extinguisher and cabinet.
   b. Unit of Measurement: Each.

8. Unit Price No. 8:

   a. Description: Furnish and install fire extinguisher and bracket.
   b. Unit of Measurement: Each.

B. Sprinkler:

1. Unit Price No. 9:

   a. Description: Furnish and install sprinkler head.
   b. Unit of Measurement: Each.

C. Plumbing:

1. Unit Price No. 10:

   a. Description: Unsuitable soils (trench) removal and disposal off site.
   b. Unit of Measurement: Cu. yd.

2. Unit Price No. 11:

   a. Description: Replacement of unsuitable soils (trench) with import select fill.
   b. Unit of Measurement: Cu. yd.

3. Unit Price No. 12:

   a. Description: Replacement of unsuitable soils (trench) with #78 stone.
   b. Unit of Measurement: Ton.

D. Mechanical:

1. Unit Price No. 13:

   a. Description: BAS training.
   b. Unit of Measurement: Hour.

E. Electrical:

1. Unit Price No. 14:

   a. Description: Unsuitable soils (trench) removal and disposal off site.
   b. Unit of Measurement: Cu. yd.

2. Unit Price No. 15:

   a. Description: Replacement of unsuitable soils (trench) with import select fill.
   b. Unit of Measurement: Cu. yd.

3. Unit Price No. 16:

   a. Description: Replacement of unsuitable soils (trench) with #78 stone.
   b. Unit of Measurement: Ton.

4. Unit Price No. 17:

   a. Description: Furnish and install horn strobe.
   b. Unit of Measurement: Each.

5. Unit Price No. 18:

   a. Description: Furnish and install exit light.
   b. Unit of Measurement: Each.

6. Unit Price No. 19:

   a. Description: Furnish and install smoke detector.
   b. Unit of Measurement: Each.

7. Unit Price No. 20:

   a. Description: Furnish and install duplex outlet.
   b. Unit of Measurement: Each.

8. Unit Price No. 21:

   a. Description: Furnish and install data outlet.
   b. Unit of Measurement: Each.

9. Unit Price No. 22:

   a. Description: Furnish and install duct detectors.
   b. Unit of Measurement: Each.

F. Earthwork:

1. Unit Price No. 23:

   a. Description: Aggregate base course stone (NCDOT CABC).
   b. Unit of Measurement: Ton.

2. Unit Price No. 24:

   a. Description: Geotechnical fabric.
   b. Unit of Measurement: Sq. yd.

3. Unit Price No. 25:

   a. Description: Subsurface drains (trench, install and backfill).
   b. Unit of Measurement: Lin. ft.

4. Unit Price No. 26:

   a. Description: Unsuitable soils (mass) removal and disposal off site.
   b. Unit of Measurement: Cu. yd.

5. Unit Price No. 27:

   a. Description: Unsuitable soils (trench) removal and disposal off site.
   b. Unit of Measurement: Cu. yd.

6. Unit Price No. 28:

   a. Description: Replacement of unsuitable soils (mass) with import select fill.
   b. Unit of Measurement: Cu. yd.

7. Unit Price No. 29:

   a. Description: Replacement of unsuitable soils (mass) with CABC.
   b. Unit of Measurement: Ton.

8. Unit Price No. 30:

   a. Description: Replacement of unsuitable soils (trench) with import select fill.
   b. Unit of Measurement: Cu. yd.

9. Unit Price No. 31:

   a. Description: Replacement of unsuitable soils (trench) with #57 stone.
   b. Unit of Measurement: Ton.

10. Unit Price No. 32:

    a. Description: Geogrid (BX-1100 or equal).
    b. Unit of Measurement: Sq. yd.

11. Unit Price No. 33:

    a. Description: Remove and replace existing concrete sidewalk.
    b. Unit of Measurement: Sq. yd.

G. Landscape:

1. Unit Price No. 34:

   a. Description: Reseeding.
   b. Unit of Measurement: Sq. yd.

2. Unit Price No. 35:

   a. Description: Sod.
   b. Unit of Measurement: Sq. yd.

END OF SECTION 012200

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.2 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.3 PROCEDURES

A. General: The Drawings generally indicate the work which will be included if the alternate bids are accepted. The portions of the work described in the alternates will not be included in the base bid.

B. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

C. Execute accepted alternates under the same conditions as other work of the Contract.

D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: In lieu of manufacturers specified as base bid, state the amount (cost difference) to be added to the base bid to provide Schneider Electric BAS StruxureWare system provided by Schneider-Electric (no substitutions), as indicated on Drawings and described in Specifications.

B. Alternate No. 2: In lieu of providing all custom metal canopies, state the amount (cost difference) to be deducted from the base bid to provide pre-engineered metal canopies on the east and west side of the building and a custom canopy on the north portion of the Main Entry canopy.

C. Alternate No. 3: In lieu of manufacturers specified as base bid, state the amount (cost difference) to be added to the base bid to provide Locks and Keyways by Schlage (no substitutions), as indicated on Drawings and described in Specifications.

D. Alternate No. 4: In lieu of manufacturers specified as base bid, state the amount (cost difference) to be added to the base bid to provide Door Closers by LCN (no substitutions), as indicated on Drawings and described in Specifications.

E. Alternate No. 5: In lieu of manufacturers specified as base bid, state the amount (cost difference) to be added to the base bid to provide Panic Hardware by Von Duprin (no substitutions), as indicated on Drawings and described in Specifications.

F. Alternate No. 6: In lieu of manufacturers specified as base bid, state the amount (cost difference) to be added to the base bid to provide Electronic Locks by Open Options (no substitutions), as indicated on Drawings and described in Specifications.

G. Alternate No. 7: In lieu of manufacturers specified as base bid, state the amount (cost difference) to be added to the base bid to provide Video Insight CCTV System (no substitutions), as indicated on Drawings and described in Specifications.

H. Alternate No. 8: In lieu of manufacturers specified as base bid, state the amount (cost difference) to be added to the base bid to provide GE Networx NX-8 System (no substitutions), as indicated on Drawings and described in Specifications.

I. Alternate No. 9: In lieu of manufacturers specified as base bid, state the amount (cost difference) to be added to the base bid to provide Notifier Fire Alarm System (no substitutions), as indicated on Drawings and described in Specifications.

END OF SECTION 012300

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

1.2 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
2. Substitutions for Convenience: Changes proposed by Contractor that are not required in order to meet other Project requirements but may offer advantage to Owner.

1.3 ACTION SUBMITTALS

A. Substitution Requests: Submit one copy of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use form included in Project Manual.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
c. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
d. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.

1) Contractor shall provide a marked-up specification section to provide a point-by-point comparison between the specified product and the proposed substitution. The point-by-point comparison shall indicate each point of compliance, non-compliance, and variance between the specified and proposed product.

e. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
f. Evidence that proposed product provides specified warranty.
g. Samples, where applicable or requested.
h. Certificates and qualification data, where applicable or requested.
i. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.

j. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
k. Research reports evidencing compliance with building code in effect for Project.
l. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
m. Cost information, including a proposal of change, if any, in the Contract Sum.
n. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
o. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor through Construction Manager of acceptance or rejection of proposed substitution within 14 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.5 COORDINATION

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied:

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
b. Requested substitution will not adversely affect Contractor's construction schedule.
c. Requested substitution has received necessary approvals of authorities having jurisdiction.
d. Requested substitution is compatible with other portions of the Work.
e. Requested substitution has been coordinated with other portions of the Work.
f. Requested substitution provides specified warranty.

g. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Not allowed.

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

REQUEST FOR SUBSTITUTION FORM

Project:	Waccamaw Elementary School	Project No.:	8201-191240
To:	LS3P ASSOCIATES LTD.	Specification Section #:	
	434 Fayetteville Street, Suite 1700 Raleigh, NC 27601	Contractor:	
Attn.:	Mary Brehler	Requested by:	
Phone:	919-829-2706	Phone:	
Fax:	919-829-2730	Fax:	
Email:	marybrehler@ls3p.com	Email:	

Reason for not providing specified item:

Savings to Owner for accepting substitution:

Specified Product/Fabrication Method
(List name/description; model no.; manufacturer):

Required Information for *Specified* Product:	Attached:
Point by Point Comparative Product Data	☐
Tests	☐
Reports	☐
Fabrication Drawings	☐
Samples (Where Applicable)	☐

Proposed Product/Fabrication Method
(List trade name/description; model no.;
manufacturer) :

Required Information for *Proposed* Product:	Attached:
Point by Point Comparative Product Data	☐ (Required)
Tests	☐
Reports	☐
Fabrication Drawings	☐
Samples (Where Applicable)	☐

List of Related Changes/Modifications:

Differences between proposed substitution
and specified product:

Does proposed product/fabrication method affects other parts of the Work? ☐ No ☐ Yes: Explain _____

_____

_____

Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product as utilized for this project, except as noted herein.
- Qualifications of manufacturer, installer, and other specified parties meet the specified qualifications.
- Same special warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source for replacement parts, as applicable, is available as that specified.
- Proposed substitution does not affect dimensions and functional clearances, except as noted herein.
- Proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
- Failure of proposed substitution to produce indicated results will not be considered grounds for additional payment or time.

For the Bidder: _____

Submitted by: _____

Signed: _____

Firm: _____

Telephone: _____

Fax: _____

Email: _____

For the Manufacturer:

Submitted by: _____

Signed: _____

Firm: _____

Telephone: _____

Fax: _____

Email: _____

END OF CONTRACTOR'S REQUEST FOR SUBSTITUTION FORM

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

1.2 MINOR CHANGES IN THE WORK

A. Architect will issue through Construction Manager supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

1.3 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Construction Manager will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Work Change Proposal Requests issued by Construction Manager are not instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
    a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
        1) Excavation Related Changes: Contractor shall coordinate with Owner's testing agency to determine in-place quantities of undisturbed material for changes in the Work relating to soil removal, hauling, disposal and/or placement. Loose, truck, or disturbed material measurements are not acceptable. Claims for quantities not verified by the testing agency are subject to rejection by the Owner.
    b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    c. Include costs of labor and supervision directly attributable to the change.
    d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

B. Contractor-Initiated Work Change Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Construction Manager.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    a. Excavation Related Changes: Contractor shall coordinate with Owner's testing agency to determine in-place quantities of undisturbed material for changes in the Work relating to

soil removal, hauling, disposal and/or placement. Loose, truck, or disturbed material measurements are not acceptable. Claims for quantities not verified by the testing agency are subject to rejection by the Owner.

3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.

C. Change Proposal Form: Use form included in Project Manual.

1.4 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Proposal Request, Construction Manager will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

B. In order to facilitate checking of quotations for extras or credits, proposals, except those so minor that their propriety can be seen by inspection, shall be accompanied by a complete itemization of costs including labor, materials, and Subcontracts. Labor and materials shall be itemized in the manner prescribed above. Where major cost items are Subcontracts, they shall be itemized also. In no case will a change be approved without such itemization.

1.5 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Construction Manager may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

1.6 EXTENSION OF TIME DUE TO WEATHER

A. General: The intention of this article is to establish the procedure for amending the Contract Time when excess adverse weather conditions have repeatedly caused cancellation of scheduled critical activities, resulting in delay to the Project.

B. Definitions:

1. Adverse Weather: Job site environmental conditions in which precipitation, or soil conditions resulting from precipitation, or ambient temperature conditions during working hours preclude carrying out a Scheduled Critical Activity. The following conditions may be considered by the Architect in determining the extent of excess adverse weather conditions, depending upon the nature of the delayed project tasks:

a. Precipitation greater than 0.1 inch of water equivalent per day.
b. Days on which the average air temperature does not exceed 32 degrees F.

c. Other weather conditions deemed hazardous by the Contractor.

2. Scheduled Critical Activity: Project tasks, the delay of which will directly result in a delay in the completion of the project.
3. Excess Adverse Weather: Adverse weather occurring in excess of the normal, cumulative number of calendar days of adverse weather as listed in Section V - General Conditions.

C. Claim for Extension of Time Due to Weather:

1. Contractor shall file claim utilizing the form provided at the end of this Section for each month during which adverse weather occurs.
   a. Attach copies of Contractor's Daily Reports for each day of adverse weather, describing fully the weather conditions, scheduled activities delayed, and reasons for the delay.
   b. Include photographs where applicable for documenting soil conditions.
   c. Attach copy of NCDC/NOAA Local Climatological Data report for given month, or other published U.S. or state monthly weather data acceptable to Architect.
2. Claim shall be filed for a calendar month by attaching the completed form to the Application for Payment submitted the following month.
3. Architect shall review and approve or take other action upon Contractor's Claim for Extension of Time. Adjustment of Contract Time shall be made by a single Change Order prepared at project closeout.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

CHANGE PROPOSAL WORKSHEET SUMMARY

Waccamaw Elementary School — Brunswick County Schools, Owner
LS3P Project No.: 8201-191240 — Contract Document Date: _____, 20___
Bulletin No. ____, Date: _____, 20___

A. NOTICE TO CONTRACTOR

1. Use this form as a cover sheet and summary for costs associated with Construction Change Directives, Requests for Proposal, and Change Orders. Use one form for Contractor, and a form for each subcontractor. Indicate allowable overhead and profit for Contractor, subcontractors, and sub-subcontractors in accordance with the Conditions of the Contract.

B. MATERIALS

1. Direct Cost of Materials $_____
   a) Attach list with quantity, item, unit cost, unit manhours, total manhours, OT manhours, total cost.
2. Overhead and Profit on Item B.1. $_____
   a) Include __% max. for small tools & consumables
3. Sales Tax $_____
4. Shipping and Transportation $_____
5. Materials Subtotal $_____

C. LABOR

1. Direct Cost of Labor: Hours: _____ @ _____ /hr. $_____
   a) Include time sheets if requested.
2. Overhead and Profit on Item C.1. $_____
   a) Show O & P percentage on straight labor cost, not on premium portion.
   b) O & P includes supervisor's time.
3. Payroll Taxes and Insurance @ _____ % $_____
4. Labor Subtotal $_____

D. EQUIPMENT RENTAL

1. Equipment Rental $_____
   a) Include quotes and pick-up/delivery tickets.
2. Overhead and Profit on Item D.1. (__% maximum) $_____
3. Equipment Rental Subtotal $_____

E. SUBCONTRACTORS

1. Subcontractors $_____
   a) Include quotes with material and equipment back up
2. Overhead and Profit on Item E.1. (__% maximum) $_____
3. Subcontractor Subtotal $_____

F. SUBTOTAL OF PROPOSAL $_____

1. Bonds (___% of Subtotal of Proposal) $_____

G. TOTAL OF CHANGE PROPOSAL $_____

CHANGE PROPOSAL WORKSHEET SUMMARY

H. TIME EXTENSION REQUEST:

1. Number of Days: _____ Schedule Activity # Affected: _____
2. Number of Days: _____ Schedule Activity # Affected: _____
3. Number of Days: _____ Schedule Activity # Affected: _____
4. Total Number of Days, this Proposal: _____

I. CONTRACTOR'S SIGNATURE:

1. Contractor: _____
   Company Name
2. Prepared By: _____
   Name
3. Date: _____

J. ATTACHMENTS:

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.2 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.

1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:

    a. Application for Payment forms with continuation sheets.
    b. Submittal schedule.
    c. Items required to be indicated as separate activities in Contractor's construction schedule.

2. Submit the schedule of values to Architect through Construction Manager at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.

B. Format and Content: Use Project Manual Table of Contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the schedule of values:

    a. Project name and location.
    b. Name of Architect.
    c. Architect's project number.
    d. Contractor's name and address.
    e. Date of submittal.

2. Arrange schedule of values consistent with format of AIA Document G703 with each item listing value of labor and material.
3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.

    a. Include separate line items under Contractor and principal subcontracts for Project closeout requirements.

4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
6. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

    a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.

1.3 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and Construction Manager and paid for by Owner.

1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

1. Submit draft copy of Application for Payment prior to due date for review by Architect.
2. Pay applications not submitted on time will not be paid until the following month.

C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Construction Manager will return incomplete applications without action.

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of approved Change Orders after all signatures are executed.
4. Provide Sales and Use Tax Report with each Application for Payment.

E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

1. Provide documentation as required by Owner and Architect.

F. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Construction Manager by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

G. Waivers of Mechanic's Lien: Owner reserves the right to require waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.

1. Owner reserves the right to designate which entities involved in the Work must submit waivers.
2. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.

H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of values.
3. Contractor's construction schedule (preliminary if not final).
4. Submittal schedule (preliminary if not final).
5. List of Contractor's staff assignments.

6. List of Contractor's principal consultants.
7. Copies of building permits.
8. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
9. Initial progress report.
10. Report of preconstruction conference.
11. Certificates of insurance and insurance policies.

I. Retainage Reduction: Until the Work is 50 percent complete, the Owner shall pay 95 percent of the amount due to the Contractor on account of progress payments. At the time the Work is 50 percent complete and thereafter, the Contractor shall submit, for Owner's and Architect's review and approval a written request for retainage reduction. Upon Owner's approval, with written consent of the surety, the Architect may certify remaining partial payments to be paid in full.

1. The Contractor, as a condition precedent to retainage reduction, shall submit for review and approval by the Architect the required Operation and Maintenance Manuals.

J. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
2. Prior to Substantial Completion of the work, the Contractor shall transmit the record set of Contract Documents to the Architect along with a typed list of each change or revision made during construction of the project. This list shall include change order numbers, authorization dates, and other information relevant to each change. Record Drawings must be received and approved prior to issuance of Final Payment.

K. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
6. AIA Document G707, "Consent of Surety to Final Payment."
7. Evidence that claims have been settled.
8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Final Acceptance or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. Coordination drawings.
2. Administrative and supervisory personnel.
3. Requests for Information (RFIs).
4. Project information management system.
5. Project meetings.

1.2 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Prior to starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project. Keep list current at all times.

1.3 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to assure proper performance of components where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

1.4 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to the following requirements:

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

   a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
   b. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

2. Review: Architect will review coordination drawings to verify that components requiring coordination have been included, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.
3. Coordination Drawing Format: Prepare coordination drawings according to requirements in Section 013300 "Submittal Procedures" for Shop Drawings and post to Project Information Management System.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire protection, fire alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire protection, fire alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Mechanical and Plumbing Work: Show the following:

   a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
   b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
   c. Fire-rated enclosures around ductwork.

7. Electrical Work: Show the following:

    a. Runs of vertical and horizontal conduit 1-1/4 inch diameter and larger.
    b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire alarm locations.
    c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
    d. Location of pull boxes and junction boxes, dimensioned from column center lines.

8. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility.

1.5 REQUESTS FOR INFORMATION (RFIs)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI via the Project Information Management System.

1. Architect will not respond to RFIs submitted to Architect by other entities controlled by Contractor.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Specification Section number and title and related paragraphs, as appropriate.
2. Drawing number and detail references, as appropriate.
3. Field dimensions and conditions, as appropriate.
4. Contractor's suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
5. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation. Attachments shall be electronic files in Acrobat PDF format.

C. RFI Forms: Software-generated form via the Project Information Management System.

1. Attachments shall be electronic files in Acrobat PDF format.

D. Architect's and Construction Manager's Action: Architect and Construction Manager will review each RFI, determine action required, and respond. Allow five working days for Architect's response for each RFI. RFIs received by Architect and Construction Manager after 1:00 p.m. will be considered as received the following working day.

1. The following RFIs will not be reviewed:

    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for coordination information already indicated in the Contract Documents.
    d. Requests for adjustments in the Contract Time or the Contract Sum.
    e. Requests for interpretation of Architect's actions on submittals.
    f. Incomplete RFIs or inaccurately prepared RFIs.

2. Architect's and Construction Manager's action may include a request for additional information, in which case Architect's and Construction Manager's time for response will date from time of receipt of additional information.
3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."

a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect and Construction Manager in writing within 10 days of receipt of the RFI response.

E. RFI Log: The Project Information Management System will create and maintain the RFI log.

F. On receipt of Architect's and Construction Manager's action, immediately distribute the RFI response to affected parties. Review response and notify Architect and Construction Manager within seven days if Contractor disagrees with response.

1.6 WEB-BASED PROJECT INFORMATION MANAGEMENT SYSTEM

A. The Architect has established a web-based Project Information Management System to facilitate communication and record-keeping during the project. Architect will provide access to Contractor's key personnel. Refer to www.NewForma.com.

1. Use Architect's web-based Project Information Management System for purposes of managing project communication and documentation until Final Completion.
2. Due to the size restrictions on email communication, all electronic files must be submitted through NewForma. Architect assumes no responsibility for information not received by Contractor's failure to use NewForma and such loss or delay of information will not be considered as a delay claim.

B. Project Information Management System shall include the following functions:

1. Project directory.
2. Project correspondence.
3. Meeting minutes.
4. Contract modifications forms and logs.
5. RFI forms and logs.
6. Submittals forms and logs.
7. Reminder and tracking functions.
8. Task and issue management.
9. Photo documentation.
10. Schedule and calendar management.
11. Payment application forms.
12. Drawing and specification document hosting, viewing, and updating.
13. Online document collaboration.
14. Archiving functions.

C. Contractor, subcontractors, and other parties granted access by Contractor to Project Information Management System shall execute a data licensing agreement in the form of Agreement included in this Project Manual.

1.7 PROJECT MEETINGS

A. General: Construction Manager will schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record discussions and agreements achieved. Distribute the meeting minutes to attendees, including Owner, Construction Manager, and Architect, within three days of the meeting.

B. Preconstruction Conference: Construction Manager will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner, Architect, and Contractor.

1. Attendees: Authorized representatives of Owner, Construction Manager, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:

a. Tentative construction schedule.
b. Critical work sequencing and long-lead items.
c. Designation of key personnel and their duties.
d. Procedures for processing field decisions and Change Orders.
e. Procedures for RFIs.
f. Procedures for testing and inspecting.
g. Procedures for processing Applications for Payment.
h. Distribution of the Contract Documents.
i. Submittal procedures.
j. Preparation of record documents.
k. Use of the premises.
l. Work restrictions and work hours.
m. Owner's occupancy requirements.
n. Responsibility for temporary facilities and controls.
o. Procedures for moisture and mold control.
p. Procedures for disruptions and shutdowns.
q. Construction waste management and recycling.
r. Parking availability.
s. Office, work, and storage areas.
t. Equipment deliveries and priorities.
u. First aid.
v. Security.
w. Progress cleaning.
x. Bonds and insurance.

3. Minutes: Architect will record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect and Construction Manager of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

a. Contract Documents.
b. Options.
c. Related RFIs and change orders.
d. Purchases, deliveries and submittals.
e. Review of mockups.
f. Possible conflicts and material compatibility problems.
g. Time schedules and weather limitations.
h. Manufacturer's written instructions.
i. Warranty requirements.
j. Acceptability of substrates.
k. Temporary facilities and controls.
l. Space and access limitations.

m. Regulations of authorities having jurisdiction.
n. Testing and inspecting requirements.
o. Installation procedures.
p. Coordination with other work.
q. Required performance results.
r. Protection of construction, personnel, and adjacent work.

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

D. Progress Meetings: Construction Manager will conduct progress meetings at monthly intervals.

1. Attendees: In addition to representatives of Owner, Construction Manager, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

1) Review schedule for next period.

b. Review present and future needs of each entity present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Status of submittals, material deliveries, and off-site fabrication.
4) Site access and utilization.
5) Temporary facilities and controls.
6) Progress cleaning.
7) Quality and work standards.
8) Status of correction of deficient items.
9) Field observations.
10) Status of RFIs.
11) Status of proposal requests and pending changes.
12) Status of Change Orders.
13) Pending claims and disputes.
14) Documentation of information for payment requests.

3. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Startup construction schedule.
2. Construction schedule.
3. Construction schedule updating reports.
4. Daily construction reports.
5. Site condition reports.
6. Special reports.

1.2 DEFINITIONS

A. General: Refer to glossary of terms in AGC's "Construction Planning & Scheduling" for terminology used in this section.

B. Float: The measure of leeway in starting and completing an activity.

1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

1.3 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in PDF electronic file format.

B. Startup construction schedule.

C. Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

1. Submit a working electronic copy of schedule, labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date.

D. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.

1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
3. Total Float Report: List of all activities sorted in ascending order of total float.

E. Construction Schedule Updating Reports: Submit with Applications for Payment.

F. Daily Construction Reports: Submit at monthly intervals.

G. Site Condition Reports: Submit at time of discovery of differing conditions.

H. Special Reports: Submit at time of unusual event.

1.4 COORDINATION

A. Coordinate construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONSTRUCTION SCHEDULE, GENERAL

A. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."

B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Final Completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
2. The Contractor shall conduct his operations so the completion date in the Agreement is met.

C. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Concrete Slabs: Schedule, coordinate, and install concrete slabs in a timely manner to allow concrete to cure sufficiently for moisture-sensitive floor finishes. Failure to do so, resulting in the requirement for moisture mitigation, will be Contractor's responsibility.
2. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
3. Punch List and Final Completion: Include not more than 30 days or the number of days indicated in the Agreement for punch list and Final Completion.

D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Work Restrictions: Show the effect of work restrictions on the schedule.
2. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:

a. Structural completion.
b. Temporary enclosure and space conditioning.
c. Permanent space enclosure.
d. Completion of mechanical installation.
e. Completion of electrical installation.
f. Substantial Completion.

E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.

F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.
2. Unanswered Requests for Information.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.
5. Pending modifications affecting the Work and Contract Time.

G. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.

H. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

2.2 STARTUP CONSTRUCTION SCHEDULE

A. Bar-Chart Schedule: Submit startup, horizontal, bar-chart-type construction schedule within seven days of date established for the Notice to Proceed.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 90 days of construction. Include skeleton diagram for the remainder of the Work.

2.3 CONSTRUCTION SCHEDULE (CPM SCHEDULE)

A. General: Prepare network diagrams using AON (activity-on-node) format.

B. CPM Schedule: Prepare construction schedule using a time-scaled CPM network analysis diagram for the Work.

1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 30 days after date established for the Notice to Proceed.
    a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.
2. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
3. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule in order to coordinate with the Contract Time.

C. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
    a. Preparation and processing of submittals.
    b. Mobilization and demobilization.
    c. Utility interruptions.

d. Testing.
e. Punch list and Final Completion.

2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.

   a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

5. Float: Indicate float time for each activity.

   a. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.

D. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall project schedule.

E. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:

1. Contractor or subcontractor and the Work or activity.
2. Description of activity.
3. Main events of activity.
4. Immediate preceding and succeeding activities.
5. Early and late start dates.
6. Early and late finish dates.
7. Activity duration in workdays.
8. Total float or slack time.

F. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:

1. Identification of activities that have changed.
2. Changes in early and late start dates.
3. Changes in early and late finish dates.
4. Changes in activity durations in workdays.
5. Changes in the critical path.
6. Changes in total float or slack time.
7. Changes in the Contract Time.

2.4 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors.
2. List of separate contractors.
3. Approximate count of personnel.
4. Equipment.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Accidents.

8. Meetings and significant decisions.
9. Unusual events (see special reports).
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.
14. Change Orders received and implemented.
15. Field Orders received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.
18. Partial completions and occupancies.
19. Substantial Completion authorized.

B. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.5 SPECIAL REPORTS

A. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONSTRUCTION SCHEDULE

A. Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate completion percentage for each activity.

B. Distribution: Distribute copies of approved schedule to Architect, Construction Manager, Owner, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 013200

SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Predemolition photographs.
2. Periodic construction photographs.

1.2 INFORMATIONAL SUBMITTALS

A. Digital Photographs: Submit unaltered, original, full-size image files within three days of taking photographs.

1. Digital Camera: Minimum sensor resolution of 8 megapixels.
2. Identification: Provide the following information with each image description in file metadata tag:

a. Name of Project.
b. Date photograph was taken.
c. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

A. Digital Images: Provide images in JPG format, with minimum size of 8 megapixels.

PART 3 - EXECUTION

3.1 PHOTOGRAPHS

A. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.

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

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

1. Date and Time: Include date and time in file name for each image.

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

1. Flag construction limits before taking construction photographs.
2. Provide a minimum of 15 photographs showing existing building conditions adjacent to or adjoining the construction area to accurately record physical conditions prior to starting the Work.

D. Additional Photographs: Architect or Construction Manager may request photographs in addition to preconstruction photographs specified. Architect will determine number and frequency of photographs and general directions on vantage points.

END OF SECTION 013233

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's and Construction Manager's responsive action.

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's and Construction Manager's responsive action. Submittals may be rejected for not complying with requirements.

1.3 ACTION SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and Construction Manager and additional time for handling and reviewing submittals required by those corrections.

1. Submit within 7 calendars days after Notice to Proceed.

1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Architect's Digital Data Files: Electronic copies of digital data files of the Contract Drawings may be available from Architect for Contractor's use in preparing submittals.

1. The digital data files are available under the following conditions:

    a. Contractor shall execute a data licensing agreement in the form of Digital Data Letter of Agreement.
    b. Digital data drawings are not to be considered Contract Documents as defined by the General Conditions for the Contract for Construction.
    c. The Contract Documents executed or identified in the Owner/Contractor Agreement, shall prevail in case of an inconsistency with subsequent versions made through manipulatable electronic operations involving computers.
    d. The Contractor shall not transfer or reuse Instruments of Service in electronic or machine-readable form without the prior written consent of the Architect.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

    a. Architect and Construction Manager reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's and Construction Manager's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Construction Manager will advise Contractor when a submittal being processed must be delayed for coordination.
2. Resubmittal Review: Allow 15 days for review of each resubmittal.
3. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to Construction Manager, through Architect before being returned to Contractor.

D. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
    a. File name shall be Specification Section number followed by a hyphen and then a sequential number (e.g. 081113 - 01 HM Doors and Frames). Resubmittals shall include a digital suffix after another hyphen (e.g. 081113 - 01 - 01 HM Doors and Frames).
3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
4. Transmittal Form for Electronic Submittals: Use software-generated form from electronic project information management system.
5. Metadata: Include the following information as keywords in the electronic file metadata:
    a. Project name.
    b. Number and title of appropriate Specification Section.
    c. Manufacturer name.
    d. Product name.

E. Options: Identify options requiring selection by Architect.

F. Deviations: Identify deviations from the Contract Documents on submittals.

G. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

H. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

I. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's and Construction Manager's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements:

1. Post electronic submittals as PDF electronic files directly to Project Information Management System specifically established for Project.

a. Architect through Construction Manager will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

2. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.

a. Provide a digital signature with digital certificate on electronically-submitted certificates and certifications.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

a. Manufacturer's catalog cuts, installation instructions, and product specifications.
b. Color charts.
c. Statement of compliance with specified referenced standards.
d. Testing by recognized testing agency.
e. Application of testing agency labels and seals.
f. Notation of coordination requirements.
g. Availability and delivery time information.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or manufacturer's standard printed data or details. Submittals based on Architect's digital data drawing files are permitted.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

a. Identification of products.
b. Schedules.
c. Compliance with specified standards.
d. Notation of coordination requirements.
e. Notation of dimensions established by field measurement.
f. Relationship and attachment to adjoining construction clearly indicated.
g. Seal and signature of professional engineer if specified.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

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

2. Identification: Attach label on unexposed side of Samples that includes the following:

    a. Product name and name of manufacturer.
    b. Number and title of applicable Specification Section.

3. Provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

    a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

    a. Number of Samples: Submit two sets of Samples. Architect will retain one Sample sets; remainder will be returned.

E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location.

F. Subcontractor, Supplier and Manufacturer List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including major subcontractors, suppliers, and manufacturers.

G. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

H. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

I. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

J. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

K. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

L. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

M. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

N. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

O. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project.

P. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

Q. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

R. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

S. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED-DESIGN SERVICES

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

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

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

C. Professional Engineer Qualifications: Professional engineer performing delegated-design services shall be legally qualified to practice in jurisdiction where Project is located and shall be experienced in providing engineering services of the kind indicated.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect and Construction Manager.

B. Contractor's Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1. Architect and Construction Manager will not review submittals that do not bear Contractor's approval stamp and will return them without action.

3.2 ARCHITECT'S AND CONSTRUCTION MANAGER'S ACTION

A. Action Submittals: Architect and Construction Manager will review each submittal, annotate to indicate corrections or revisions required, and return it. Architect and Construction Manager will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.

1. No Exceptions Taken: The work covered by the submittal may proceed.
2. Note Markings: The work covered by the submittal may proceed provided it complies with both the Architect’s notations and corrections on the submittal and the Contract Documents.
3. Rejected: Do not proceed with the Work covered by the submittal. Prepare a new submittal for a product that complies with the contract document.

B. Informational Submittals: Architect and Construction Manager will review each submittal and will return it, noting "No Action Taken." If it does not comply with requirements, Architect will return it noting "Revise and Resubmit." Architect and Construction Manager will forward each submittal to appropriate party.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect and Construction Manager.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review, with notation "Revise and Resubmit."

E. Submittals not required by the Contract Documents may be returned by the Architect and Construction Manager without action, with notation "No Action Taken."

END OF SECTION 013300

LS3P ENGAGE DESIGN TRANSFORM

DIGITAL DATA LETTER OF AGREEMENT

An Agreement Between the Architect and _____ (the "Transferee," either Original or Third Party, as the case may be) for Transfer of Digital Data

Architect: LS3P ASSOCIATES LTD.
434 Fayetteville Street, Suite 1700
Raleigh, NC 27601
Contact: Mary Brehler

Transferee:
Original
3rd Party

Project No.: 8201-191240
Project Name: Waccamaw Elementary School
Location: 5901 Waccamaw School Road, Ash, NC
Date:

The Architect will provide the following Digital Data, dated as of the particular transmission, to the Transferee **for information purposes only (NOT FOR CONSTRUCTION, COST ESTIMATES, OR FABRICATION):**

_____
_____
_____
_____
_____

Digital Data was prepared using the following:

Software: AutoCAD (.dwg) **Version:**

Digital Data to be delivered via the following media: Newforma Website posting

Transferee shall pay the Architect a service fee of $ 0.00 and other good and valuable consideration.

TERMS AND CONDITIONS

1. The Architect and its consultants make no representation as to the compatibility of the Digital Data with any hardware or software. The Transferee shall notify the Architect within five (5) business days of any problems associated with accessing and/or using the Digital Data.

2. The Transferee acknowledges and agrees that the Digital Data may change or degrade during the transfer process. The Transferee acknowledges and agrees that the Architect and its consultants may remove all indications of ownership from the Digital Data prior to transmission.

3. All Digital Data shall be considered the property of the Architect and/or its consultants and shall not be used for other Projects, for additions to this Project, or for completion of this Project without the prior written permission of the Architect and/or its consultants. Digital Data shall not be re-transmitted by the Original Transferee to a Third Party Transferee without prior execution of an agreement identical to this Agreement between the Architect, the Original Transferee, and the Third Party Transferee. Under no circumstances shall the transmission of the Digital Data be considered a sale of goods or a sale of copyrights.

4. **THE ARCHITECT AND THE ARCHITECT'S CONSULTANTS HEREBY EXPRESSLY DISCLAIM ANY AND ALL WARRANTIES, BOTH EXPRESS AND IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY AND THE IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE AS WELL AS ANY WARRANTY OF ACCURACY, COMPLETENESS, AND/OR PERMANENCE. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE**

DESCRIPTION ON THE FACE HEREOF. Addenda information and/or revisions made to the most current Digital Data after any date of transmission may not have been incorporated into the transmitted Digital Data. In the event of a conflict between the Architect's printed instruments of service (whether sealed or not) and the Digital Data, the printed instruments of service shall govern. The Transferee acknowledges and agrees that the duty to determine the existence of any and all conflicts between the Digital Data and any other information upon which the Transferee relies rests solely upon the Transferee. The Digital Data shall not be considered Contract Documents or Construction Documents as defined by any General Conditions of Contract for Construction. The Digital Data is being provided on a strictly "AS IS" basis.

5. The use and/or provision of the Digital Data prepared by the Architect and/or its consultants shall not in any way reduce or obviate the Transferee's duty to check and coordinate dimensions, details, and quantities of materials as required to facilitate construction of the Project in a complete and quality manner consistent with the applicable standards of care. Confirmation of existing conditions is the sole responsibility of the Transferee.

6. The Transferee agrees to the extent permitted by applicable law, to indemnify, hold harmless, release, and defend the Architect and/or its consultants, their officers, shareholders, employees, and sub-consultants from any and all injuries, claims, demands, expenses, suits, liabilities, losses, damages, costs, disputes, other matters in question, third party claims, pass-through claims, subrogated claims, and/or claim expenses related to the Digital Data, including but not limited to, attorneys' fees, expert witness fees, and court costs arising out of or in any way related to or connected with any negligent act and/or omission in the generation, provision, and/or use of the Digital Data by the Transferee and/or any of its subcontractors, suppliers, and/or consultants and waive any and all rights to such claims and causes of action.

7. The Transferee waives damages against the Architect for any and all injuries, claims, losses, expenses, damages, disputes, other matters in question, and/or claim expenses arising out of or relating to this Agreement and/or generation, provision, and/or use of the Digital Data, including, but not limited to, consequential damages and reasonable attorneys' fees and defense costs.

8. The Architect's and/or the Architect's consultants' liability to the Transferee and/or any of its subcontractors, suppliers, and/or consultants for any and all injuries, claims, losses, expenses, damages, disputes, other matters in question, third party claims, pass-through claims, subrogated claims, and/or claim expenses arising out of or relating to this Agreement and/or the Digital Data, including, but not limited to, reasonable attorneys' fees and defense costs, regardless of the nature of the claim or damage, shall not exceed, either individually or in the aggregate, the total amount of $1,000.00. Such causes include, but are not limited to, the Architect's and/or the Architect's consultants' negligence, errors, omissions, strict liability, breach of contract, and/or breach of warranty.

9. To the best of the Architect's knowledge, information and belief, there are no licensing or copyright fees due to others based on the transmission of the Digital Data, but to the extent that such unknown fees do exist, the Transferee agrees to pay the required fees and hold the Architect and/or its consultants harmless from any associated costs or penalties.

10. Upon execution of this Agreement, the Architect grants to the Transferee a non-exclusive, non-transferable (except as set forth herein) license to use the Digital Data solely and exclusively for informational purposes only, provided that the Transferee substantially performs its obligations under this Agreement.

11. Any purchase order number provided by the Transferee is for the Transferee's accounting purposes only. The Transferee acknowledges and agrees that purchase order terms and conditions are null, void, and inapplicable to this Agreement.

12. This Agreement constitutes the entire agreement between the parties relative to the Digital Data and shall be governed by the laws of the State of North Carolina.

AUTHORIZED ACCEPTANCE

by Architect:
LS3P ASSOCIATES LTD.

_____
Signature

_____
Print Name and Title

_____
Date

by Original Transferee:
_____

_____
Signature

_____
Print Name and Title

_____
Date

by Third Party Transferee:
_____

_____
Signature

_____
Print Name and Title

_____
Date

WE SO CONSENT:

by Owner:
_____

_____
Signature

_____
Print Name and Title

_____
Date

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
2. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Construction Manager, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
3. Specific test and inspection requirements are not specified in this Section.

1.2 DEFINITIONS

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

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

C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

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

D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.

E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

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

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

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

I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.3 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.4 INFORMATIONAL SUBMITTALS

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

1.5 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
5. Other required items indicated in individual Specification Sections.

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

1.6 QUALITY ASSURANCE

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

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

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

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. Manufacturer's Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor responsibilities include the following:

   a. Provide test specimens representative of proposed products and construction.
   b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
   c. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
   d. When testing is complete, remove test specimens, assemblies, and mockups; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, through Construction Manager, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

J. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect and Construction Manager.
2. Notify Architect and Construction Manager seven days in advance of dates and times when mockups will be constructed.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Obtain Architect's and Construction Manager's approval of mockups before starting work, fabrication, or construction.

   a. Allow seven days for initial review and each re-review of each mockup.

5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

6. Demolish and remove mockups when directed unless otherwise indicated.

K. Composite Exterior Wall Mockups: Before ordering materials or commencing elements of the Work noted as part of the exterior wall mockup, build mockup for approval of exterior materials and finishes. Coordinate installation of exterior envelope materials and products in individual Specification Sections, along with supporting materials.

1. The mockup includes, but is not limited to, the following materials:

   a. Structural framing.
   b. Masonry.
   c. Aluminum-framed entrances and storefront.
   d. Glazing.
   e. Sealants.
   f. Air barrier.
   g. Insulation.
   h. Flashing.

2. Schedule: Allow time for the construction of the mockup and review by Architect and Construction Manager.
3. Submittal: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, finish and color designations, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

L. In-Place Mockups: Before installing portions of the Work requiring in-place mockups, construct mockups incorporating required materials, assemblies, and mechanical and electrical systems, finished according to requirements. Provide required lighting and additional lighting where required to enable Architect to evaluate quality of the Work.

1. Approved mockups may be incorporated into the Work.

1.7 QUALITY CONTROL

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

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.

1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.

a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a manufacturer's representative to observe and inspect the Work. Manufacturer's representative's services include examination of substrates and conditions, verification of materials, inspection of completed portions of the Work, and submittal of written reports.

D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

E. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect, Construction Manager, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.

6. Do not perform any duties of Contractor.

F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

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

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's and Construction Manager's reference during normal working hours.

3.2 REPAIR AND PROTECTION

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

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

1. ICC - International Code Council; www.iccsafe.org.
2. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 014533 - SPECIAL INSPECTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary General Conditions and other Division I Specification Sections, apply to this Section.

1.2 GENERAL REQUIREMENTS

A. Special Inspections and Structural Testing shall be in accordance with Chapter 17 of the North Carolina Building Code.

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

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

1.3 SCHEDULE OF INSPECTIONS AND TESTS

A. Required inspections and tests are described in the attached Schedule of Special Inspections and in the individual Specification Sections for the items to be inspected or tested.

1.4 QUALIFICATIONS

A. The Special Inspector shall be a licensed Professional Engineer who is approved by the Structural Engineer of Record (SER) and Building Official.

B. The Testing Company/Testing Laboratory and individual technicians shall be approved by the Structural Engineer of Record (SER) and Building Official.

C. The Testing Company/Testing Laboratory shall retain a full-time licensed Professional Engineer on staff who shall certify all test reports. The Engineer shall be responsible for the training of the testing technicians and shall be in responsible charge of the field and laboratory testing operations.

1. Special Inspections of soils and foundations may be performed by inspectors with an education and background in geotechnical engineering in lieu of a background in structural engineering.
2. Technicians performing sampling and testing of concrete shall be ACI certified Concrete Field Testing Technicians-Grade 1.
3. Inspectors performing inspections of concrete work such as inspections of concrete placement, batching, reinforcing placement, curing and protection, may be ACI certified Concrete Construction Inspectors or ICBO certified Reinforced Concrete Special Inspector in lieu of being a licensed P.E. or EIT.
4. Inspectors performing inspections of prestressed concrete work may be ICBO/BOCA/SBCCI certified Prestressed Concrete Special Inspector.
5. Inspectors performing inspections of masonry may be ICBO certified Structural Masonry Special Inspector.
6. Technicians performing visual inspection of welding shall be AWS Certified Welding Inspectors or ICBO certified Structural Steel and Welding Special Inspectors, technicians performing non-destructive testing such as ultrasonic testing, radiographic testing, magnetic particle testing, or dye-penetrant testing shall be certified as an ASNT-TC Level II or Level III technician.

7. Inspectors performing inspections of spray fireproofing may be ICBO certified Spray-Applied Fireproofing Special Inspector.
8. Technicians performing standard tests described by specific ASTM Standards shall have training in the performance of such tests and must be able to demonstrate either by oral or written examination competence for the test to be conducted. They shall be under the supervision of a licensed Professional Engineer and shall not be permitted to independently evaluate test results.

1.5 SUBMITTALS

A. The Special Inspector and Testing Company/Testing Laboratory shall submit to the SER and Building Official for review a copy of their qualifications which shall include the names and qualifications of each of the individual inspectors and technicians who will be performing inspections or tests.

B. The Special Inspector and Testing Company/Testing Laboratory shall disclose any past or present business relationship or potential conflict of interest with the Contractor or any of the Subcontractors whose work will be inspected or tested.

1.6 PAYMENT

A. The Owner shall engage and pay for the services of the Special Inspector, Agents of the Special Inspector or Testing Company/Testing Laboratory.

B. If any materials which require Special Inspections are fabricated in a plant that is not certified and is not located within 150 miles of the project, the Contractor shall be responsible for the travel expenses of the Special Inspector of Testing Company/Testing Laboratory.

C. The Contractor shall be responsible for the cost of any retesting or reinspection of work which fails to comply with the requirements of the Contract Documents.

1.7 CONTRACTOR RESPONSIBILITIES

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

B. The Contractor shall review the Statement of Special Inspections and shall be responsible for coordinating and scheduling inspections and tests. The Contractor shall notify the Structural Engineer of Record, Special Inspector or Testing Company/Testing Laboratory at least 48 hours in advance of a required inspection or test. Uninspected work that required inspection may be rejected solely on that basis.

C. The Contractor shall complete the attached Contractor Statement of Responsibility and submit to owner with the signed contracts.

D. The Contractor shall provide the form for the Final Report of Special Inspections to the Special Inspector for completion at the completion of the project.

E. The Statement of Special Inspections will be completed by the Structural Engineer of Record and the Owner and provided to the Contractor after the contracts are signed and returned to the Owner. The Contractor shall submit the completed Statement of Special Inspections to the Building Official for acceptance at the time the building permit is applied for.

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

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

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

I. The Contractor shall be solely responsible for construction site safety.

1.8 LIMITS ON AUTHORITY

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

B. The Special Inspector or Testing Company/Testing Laboratory will not have control over the Contractor's means or methods of construction.

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

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

1.9 STATEMENT OF SPECIAL INSPECTIONS

A. The Statement of Special Inspections will be prepared by the Structural Engineer of Record.

B. The attached Statement of Special Inspections shall be used.

C. The Statement of Special Inspections shall be provided to the Contractor after the contracts are signed and returned to the Owner and shall be submitted with the application of Building Permit.

1.10 RECORDS AND REPORTS

A. Detailed daily reports shall be prepared of each inspection or test and submitted to the Special Inspector. Reports shall include:

1. date of test or inspection
2. name of inspector or technician
3. location of specific areas tested or inspected
4. description of test or inspection and results
5. applicable ASTM standard
6. weather conditions
7. Engineer's seal and signature

B. The Special Inspector shall submit interim reports to the Building Official at the end of each month which include all inspections and test reports received last week. Copies shall be sent to the SER, Architect and Contractor.

C. Any discrepancies from the Contract Documents found during a Special Inspection shall be immediately reported to the Contractor. If the discrepancies are not corrected, the Special Inspector shall notify the SER and Building Official. Reports shall document all discrepancies identified and the correction action taken.

D. The Testing Company/Testing Laboratory shall immediately notify the Special Inspector and the SER by telephone, fax or electronic mail any test results which fail to comply with the requirements of the Contract Documents.

E. Reports shall be submitted to the Special Inspector within 7 days of the inspection or test. Legible hand written reports may be submitted if final typed copies are not readily available. Formal reports shall follow.

F. At the completion of the work requiring Special Inspections, each inspection agency and Testing Company/Testing Laboratory shall provide a statement to the Special Inspector that all work was completed in substantial conformance with the Contract Documents and that all appropriate inspections and tests were performed.

1.11 FINAL REPORT OF SPECIAL INSPECTIONS

A. The Final Report of Special Inspections shall be completed by the Special Inspector and submitted to the SER and Building Official prior to the issuance of a Certificate of Use and Occupancy.

B. The attached Final Report of Special Inspections shall be used.

C. The Final Report of Special Inspections will certify that all required inspections have performed and will itemize any discrepancies that were not corrected or resolved.

PART 2 - PRODUCTS (not applicable)

PART 3 - EXECUTION (not applicable)

Attached are the following forms:

1. Statement of Special Inspections
2. Schedule of Special Inspection Services
3. Quality Assurance Plan
4. Qualifications of Inspectors and Testing Technicians
5. Schedule of Special Inspection Services
6. Final Report of Special Inspections
7. Final Report of Special Inspections (Agent’s Final Report)
8. Contractor’s Statement of Responsibility
9. Fabricator’s Certificate of Compliance

END OF SECTION 014533

Statement of Special Inspections

Project: Waccamaw Elementary School K-8
Location: 5901 Waccamaw School Rd NW, Ash, NC 28420
Owner's Representative:
Owner's Address:

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

Structural	Don R. Woods		
	(Type or print name)	(Signature)	(Date)
Architectural			
	(Type or print name)	(Signature)	(Date)
Mechanical			
	(Type or print name)	(Signature)	(Date)
Other			
	(Type or print name)	(Signature)	(Date)

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

Interim reports shall be submitted to the State Construction Office, Owner, and the Designers of Record.

Interim Report Frequency: Monthly

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

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

Owner's Authorization

Signature Date

Accepted for the SCO by:

Signature Date

Schedule of Special Inspection Services [a]

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

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

a. The inspection frequency indicated on the following inspection tables are "C" continuous, "P" periodic, & "O" random on a daily basis.

b. Level A is the minimum inspection program for empirically / prescriptively designed masonry in Risk Category I, II or III structures. Level B is the minimum inspection program for empirically / prescriptively designed masonry in Risk Category IV structures and engineered masonry in Risk Category I, II or III structures. Level C is the minimum inspection program for engineered masonry in Risk Category IV structures. Engineered masonry structures are those designed in accordance with portions of the TMS 402-13 / ACI 530-13/ASCE 5-13 other than Part 4 or Appendix A.

Inspection Agents	**Firm Name & Point of Contact**	**Address / Phone / E-mail**
1. Special Inspector (SI-1)		
2. Testing Agency (TA-1)		
3. Testing Agency (TA-2)		
4. Geotechnical Engineer (GE-1)	S&ME, Inc Adam Browning	3201 Spring Forest Road Raleigh, NC 27616 919-872-2660
5. Other (O-1)		

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

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

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

Wind Exposure Category: ☐ B ☒ C ☐ D

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

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

c. Document acceptance or rejection of composite construction elements	☐	P	Tbl N6.1		

Schedule of Special Inspection Services
Welding of Structural Steel

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

j. Conduct magnetic particle testing (MT) or liquid penetrant testing (PT) at thermally cut surfaces of access holes for rolled section with tf > 2” and built-up shape with tw > 2”	☐	C	N5.5c		
k. Radiographic or ultrasonic inspection at joints subject to fatigue	☐	C	N5.5d, Tbl A-3.1		
l. Document acceptance / rejection of welded joints and members	☒	C	Tbl N5.4-3, N5.5g		

Schedule of Special Inspection Services
Cold-Formed Steel Deck

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

d. Verify repair activities	☒	C	Tbl 1.8		
9. Document acceptance or rejection of deck & deck accessories for all phases of construction	☒	C	Tbls 1.1 thru 1.8		

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

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

Schedule of Special Inspection Services
Cold-Formed Steel Framing

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

Schedule of Special Inspection Services
Concrete Construction

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

used by SFRS special moment frames, special structural walls or coupling beams			20.2.2.5		

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

Schedule of Special Inspection Services
Soils

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

Schedule of Special Inspection Services
Special Inspections for Wind Resistance

Inspection Task	Task Req'd	Freq	Reference for Criteria		Agent
			Standard	NCBC	
1. Prior to any work taking place, each contractor responsible for the construction of a wind-resisting system or component shall submit a written statement of contractor responsibility	☒	C		1704.4	
2. Structural Wood					
a. Verify field gluing operations pertinent to the main wind force-resisting system	☐	C		1705.11.1	
b. Inspect nailing, anchoring, and fastening of components within the main windforce-resisting system including shear walls, diaphragms, drag struts, braces & hold-downs	☐	P		1705.11.1	
3. Cold-Formed Steel Light Frame Construction					
a. Inspect welding operations at elements of the main windforce-resisting system	☒	P		1705.11.2	
b. Inspect screw attachment, bolting, anchoring, and fastening of elements within the main windforce-resisting system including shear walls, braces, diaphragms collectors, drag struts and hold-downs	☒	P		1705.11.2	
4. Wind-resisting components					
a. Inspect the fastening of roof covering, roof deck and supporting roof framing connections	☒	P		1705.11.3.1	
b. Inspect the fastening of exterior wall coverings & the wall connections to the roof / floor diaphragms & framing members	☒	P		1705.11.3.2	

Structural Wood and Cold-Formed Steel Light-Frame Construction Main Wind-Force Resisting System(s) Subject to Special Inspections:

Light Gauge Shear walls – see plans and S5.01.

Roof Cladding Components and Connections Subject to Special Inspections:

Roof deck attachment – plan.

Roof membrane attachment.

Wall Cladding Components and Connections Subject to Special Inspections:

Brick tie spacing

Wall attachments top and bottom.

Parapet connections

Schedule of Special Inspection Services
Special Inspections for Seismic Resistance

Inspection Task	Task Req'd	Freq	Reference for Criteria		Agent
			Standard	NCBC	
1. Prior to any work taking place, each contractor responsible for the construction of a seismic-resisting system or component shall submit a written statement of contractor responsibility	☒	C		1704.4	
2. Structural Steel (see following tables)	☐	O/C		1705.12.1	
3. Structural Wood					
a. Verify field gluing operations of elements of the seismic force-resisting system (SFRS)	☐	C		1705.12.2.1	
b. Inspect nailing, bolting, anchoring & other fastening at elements of SFRS	☐	P		1705.12.2.2	
4. Cold-Formed Steel Light Frame Construction					
a. Verify welding operations of elements of the SFRS	☒	P		1705.12.3.1	
b. Inspect screw attachment, bolting, anchoring, & fastening used by SFRS	☒	P		1705.12.3.2	
c. Inspect special bolted moment frames	☐	P		1705.12.9	
5. Verify erection & fastening of exterior cladding, non-bearing walls and veneer	☒	P		1705.12.5	
6. Confirm anchorage of access floors	☐	P		1705.12.5.1	
7. Confirm anchorage of storage racks	☐	P		1705.12.7	
8. Collect certificates of compliance for qualifying equipment, supports, attachments & components; verify correctness of labels & installation	☒	C	ASCE7 13.2.2, 13.2.1	1705.12.4, 1705.13.2	
9. Plumbing, Mechanical, Electrical Components					
a. Verify anchorage of elec. equip for emergency & standby power systems	☒	P		1705.12.6	
b. Verify installation & anchorage of pipe & duct systems carrying hazardous materials & associated mech units	☐	P		1705.12.6	

c. Confirm the installation & anchorage of vibration isolation systems with nominal clearances ≤¼"	☒	P		1705.12.6	
d. Inspect & test seismic isolation systems at seismic isolated structures	☐	P	ASCE7 17.8	1705.12.8, 1705.13.4	

Seismic-Force Resisting System(s) subject to Special Inspections:

Light Gauge Shear walls – see plans and S5.01.

Seismic-Resisting Components and Connections Subject to Special Inspections:

Sprinkler Piping

FINAL REPORT OF SPECIAL INSPECTIONS

Project: Waccamaw Elementary School K-8

Location: Wilmington, NC

Owner: Brunswick County Schools

Owner's Address:

Architect of Record:

Structural Engineer of Record: Don R. Woods, PE

To the best of my information, knowledge and belief, the Special Inspections required for this project, and itemized in the State of Special Inspections submitted for permit, have been performed and all discovered discrepancies have been reported and resolved other than the following:

Comments:

(Attach continuation sheets if required to complete the description of corrections).

Interim reports submitted prior to this final report form a basis for and are to be considered an integral part of this final report.

Respectfully submitted,
Special Inspector

Licensed Professional Seal

_____
Signature Date

FINAL REPORT OF SPECIAL INSPECTIONS

AGENT'S FINAL REPORT

Project: Waccamaw Elementary School K-8

Agent:

Special Inspector:

To the best of my information, knowledge and belief, the Special Inspections or testing required for this project, and designated for this Agent in the *Statement of Special Inspections* submitted for permit, have been performed and all discovered discrepancies have been reported and resolved other than the following:

Comments:

(Attach continuation sheets if required to complete the description of corrections).

Interim reports submitted prior to this final report form a basis for and are to be considered an integral part of this final report.

Respectfully submitted,

Agent of the Special Inspector

Licensed Professional Seal

_____

Signature Date

CONTRACTOR'S STATEMENT OF RESPONSIBILITY

Each contractor responsible for the construction or fabrication of a system or component designated in the Quality Assurance Plan must submit a Statement of Responsibility.

Project: Waccamaw Elementary School K-8

Contractor's Name:

Address:

License No.:

Description of designated building systems and components included in the Statement of Responsibility:

Contractor's Acknowledgment of Special Requirements

I hereby acknowledge that I have received, read, and understand the Quality Assurance Plan and Special Inspection program.

I hereby acknowledge that control will be exercised to obtain conformance with the construction documents approved by the Building Official.

_____ _____
Signature Date

Contractor's Provisions for Quality Control

Procedures for exercising control within the contractor's organization, the method and frequency of reporting and the distribution of reports is attached to this Statement.

Identification and qualifications of the person(s) exercising such control and their position(s) in the organization are attached to this Statement.

FABRICATOR'S CERTIFICATE OF COMPLIANCE

Each approved fabricator that is exempt from Special Inspection of shop fabrication and implementation procedures per section 1704.2 of the International Building Code must submit a *Fabricator's Certificate of Compliance* at the completion of fabrication.

Project: Waccamaw Elementary School K-8

Fabricator's Name:

Address:

Certification or Approval Agency:

Certification Number:

Date of Last Audit or Approval:

Description of structural members and assemblies that have been fabricated:

I hereby certify that items described above were fabricated in strict accordance with the approved construction documents.

_____ _____
Signature Date

_____
Title

Attach copies of fabricator's certification or building code evaluation service report and fabricator's quality control manual.

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

1.2 DEFINITIONS

A. Permanent Enclosure: As determined by Architect, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

1.3 USE CHARGES

A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Architect, testing agencies, and authorities having jurisdiction.

B. Water and Electric Power Service from Existing System: Water and electric power from Owner's existing system is available for use without metering and without payment of use charges.

1. Provide connections and extensions of services as required for construction operations.
2. Utility connections shall not interrupt existing utilities during normal business working hours.

1.4 INFORMATIONAL SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

D. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:

1. Locations of dust-control partitions at each phase of work.
2. HVAC system isolation schematic drawing.
3. Location of proposed air-filtration system discharge.
4. Waste handling procedures.
5. Other dust-control measures.

1.5 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

C. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.6 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Chain-Link Fencing: Minimum 2-inch0.148-inch thick, galvanized steel, chain-link fabric fencing; minimum 6 feethigh with galvanized steel pipe posts and top rails.

B. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.

C. Dust-Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches.

2.2 TEMPORARY FACILITIES

A. Field Offices, General: Provide prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

1. Coordinate location of field offices with Owner.

B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, Construction Manager and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:

1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
2. Conference room of sufficient size to accommodate meetings of 25 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot square tack and marker boards.
3. Drinking water and private toilet.
4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
5. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.

C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. Self-Contained Toilet Units: Single-occupant units of chemical, aerated recirculation, or combustion type; vented; fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.

C. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
3. Permanent HVAC System: Owner must authorize use of permanent HVAC system for temporary use during construction. If permanent HVAC system is used for temporary conditioning during construction, Contractor is responsible to protect return air from contamination by covering open end of duct with MERV 8 filter. Remove filter media at end of construction.

D. Electrical Outlets: Properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120-V plugs into higher-voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.

E. Power Distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125-V ac, 20-A rating, and lighting circuits may be nonmetallic sheathed cable.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 SITE USE PLAN

A. Confine operations within the areas indicated and as shown on the site use plan and as permitted by law, ordinances, and permits. Site shall not be unreasonably encumbered with materials, products, or construction equipment.

B. The Contractor in reviewing the use of the site shall include access to proposed building for construction purposes, parking where possible for employees, temporary facilities including offices, storage, and workshop sheds or portable trailers, utility hookups, staging areas, storage materials and products, and unloading space.

C. The Contractor shall show additional area needed in the use of the site beyond that which may be indicated on the Drawings. Where additional fencing is required, such fencing shall be included at no additional cost to the Owner.

3.3 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

2. Provide adequate capacity at each stage of construction. Before temporary utility is available, provide trucked-in services.
3. Obtain easements to bring temporary utilities to Project site where Owner's easements cannot be used for that purpose.

B. Storm Sewers and Storm Drainage: If storm sewers are available, provide temporary connections to remove effluent that can be discharged lawfully. If storm sewers are not available or cannot be used, provide storm drainage ditches, dry wells, stabilization ponds, and similar facilities. If neither storm sewers nor storm drainage facilities can be lawfully used for discharge of effluent, provide containers to remove and dispose of effluent off-site in a lawful manner.

1. Connect temporary storm sewers to municipal system as directed by authorities having jurisdiction.
2. Filter out excessive soil, construction debris, chemicals, oils, and similar contaminants that might clog storm sewers or pollute waterways before discharge.
3. Maintain temporary storm sewers and storm drainage facilities in a clean, sanitary condition. After heavy use, restore normal conditions promptly.

C. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

D. Sanitary Facilities: Provide temporary toilets and wash facilities for use of construction personnel. Coordinate and comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

1. Toilets: Install self-contained toilet units. Use of Owner's existing toilets will not be permitted.
2. Disposable Supplies: Provide, and maintain adequate supply of, toilet tissue and similar disposable materials for use of construction personnel.
3. Contractors shall provide drinking water for use of their personnel.
4. Provide safety showers, eyewash fountains, and similar facilities where required by authorities having jurisdiction.

E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

1. Maintain a minimum temperature of 50 deg F in permanently enclosed portions of building for normal construction activities, and 65 deg F for finishing activities and areas where finished Work has been installed.

F. Ventilation and Humidity Control: Provide temporary ventilation and humidity control required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.

G. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.

H. Electric Distribution: Provide receptacle outlets adequate for connection of power tools and equipment.

1. Provide waterproof connectors to connect separate lengths of electrical power cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.

I. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

J. Electronic Communication Service: Provide wireless connectivity in the primary field office adequate for use by Architect and Owner to access Project electronic documents and maintain electronic communications.

3.4 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
3. Locate field offices, storage sheds, sanitary facilities, and other temporary construction and support facilities for easy access.

B. Temporary Use of Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.

1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Contract Documents.
3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to Contract Documents.

C. Traffic Controls: Coordinate and comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

D. Parking: Provide temporary parking areas for construction personnel.

E. Dewatering Facilities and Drains: Coordinate and comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Before connection and operation of permanent drainage piping system, provide temporary drainage where roofing or similar waterproof deck construction is completed.

F. Project Signs: Provide Project sign as indicated on sign sample following this Section. Unauthorized signs are not permitted.

1. Temporary Signs: Provide signs as required to inform public and individuals seeking entrance to Project. Provide temporary, directional signs for construction personnel and visitors.
2. Engage an experienced sign painter to apply graphics for Project identification signs.
3. Construct signs of exterior-type Grade B-B high-density concrete form overlay plywood unless indicated otherwise, and in sizes and thicknesses indicated. Support on posts and framing of preservative-treated wood.
4. Paint sign panel and applied graphics with exterior-grade alkyd gloss enamel over exterior primer.
5. Location of project identification sign as directed by Architect.

G. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction.

H. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties. Repair damage to existing facilities.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects. Avoid using tools and equipment that produce harmful noise. Restrict use of noisemaking tools and equipment to normal business hours.

C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant- protection zones.
2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

D. Stormwater Control: Coordinate and comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

F. Pest Control: Perform control operations lawfully, using environmentally safe materials.

G. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.

1. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.
2. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.

H. Barricades, Warning Signs, and Lights: Coordinate and comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

I. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
2. Vertical Openings: Close openings of 25 sq. ft. or less with plywood or similar materials.
3. Horizontal Openings: Close openings in floor or roof decks and horizontal surfaces with load-bearing, wood-framed construction.
4. Where temporary wood or plywood enclosure exceeds 100 sq. ft. in area, use fire-retardant-treated material for framing and main sheathing.

J. Temporary Partitions: Provide floor-to-ceiling dustproof non-combustible partitions to limit dust and dirt migration to completed areas. Protect air-handling equipment. Provide walk-off mats at each entrance through temporary partition.

K. Protect air-handling equipment.

L. Temporary Egress: Maintain temporary egress from existing occupied facilities as required by authorities having jurisdiction.

M. Covered Walkway: Erect protective, covered walkway for passage of individuals through or adjacent to Project site. Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction and requirements indicated on Drawings.

1. Provide overhead decking, protective enclosure walls, handrails, barricades, warning signs, exit signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage.
2. Paint and maintain appearance of walkway for duration of the Work.

N. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.

1. Provide fire extinguishers, installed on walls on mounting brackets, visible and accessible from space being served, with sign mounted above.
2. Prohibit smoking on school premises.
3. Store combustible materials in containers in fire-safe locations.
4. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for firefighting.
5. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.

3.6 MOISTURE AND MOLD CONTROL

A. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect porous materials from water damage, protect

stored and installed material from water, keep porous materials from coming into prolonged contact with concrete, remove standing water from decks, and keep deck openings covered or dammed.

B. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials, into partially enclosed building.
2. Keep interior spaces clean and protected from water damage.
3. Discard or replace water-damaged material. Do not install material that is wet.
4. Discard, replace, or clean stored or installed material that begins to grow mold.
5. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

C. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. If authorized by Owner, use permanent HVAC system to control humidity.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

3.7 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

Waccamaw Elementary School
Addition



BORDEAUX Construction Company, Inc.
CONTRACTOR

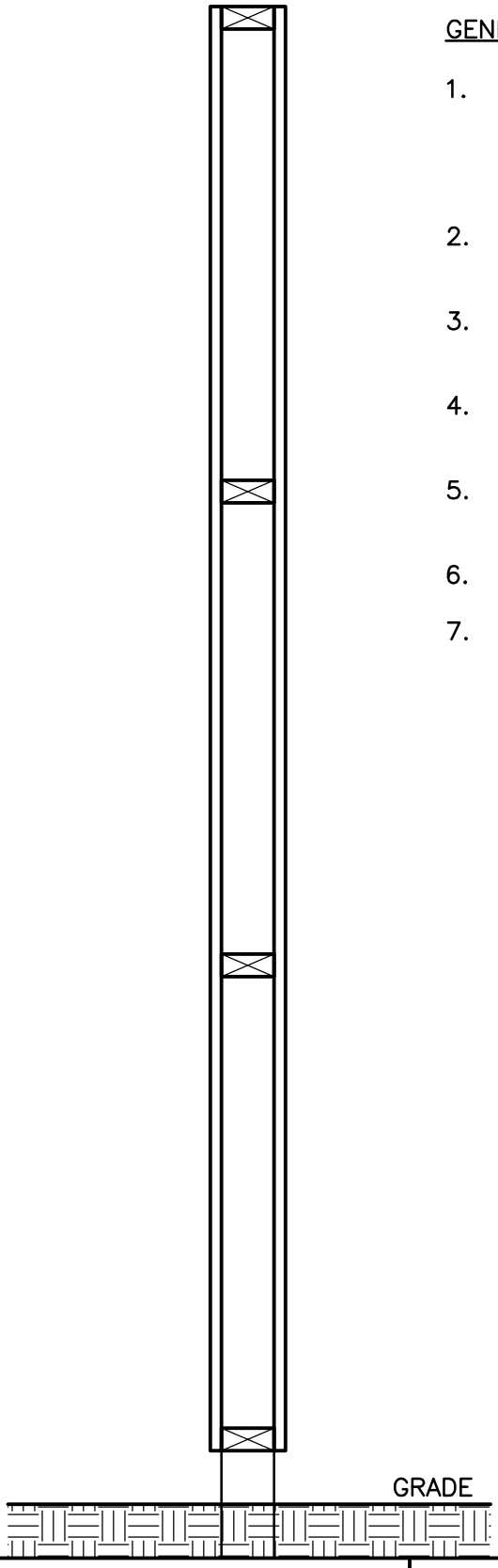
LS3P
ARCHITECT

PARAMOUNTE ENGINEERING, INC.
CIVIL

WOODS ENGINEERING
STRUCTURAL

CHEATHAM AND ASSOCIATES, P.A.
M/E/P

Brunswick County Schools bond project



GENERAL NOTES:

1. SIGN TO BE CONSTRUCTED OF TWO (2) 4X4 TREATED WOOD POSTS WITH TREATED 2X4 FRAMING AND 3/4" A/D EXTERIOR PLYWOOD. SEAL ALL SURFACES TO BE PAINTED. USE STAINLESS STEEL SCREWS.

2. POSTS SHOULD EXTEND BELOW GRADE 3'–0" MINIMUM OR AS REQUIRED TO PROVIDE A STABLE INSTALLATION.

3. ALL TEXT SHALL BE APPLIED BLACK VINYL DYE CUT LETTERS, TRAJAN FONT IN SIZES AS INDICATED.

4. SUBMIT SIGNAGE LAYOUT FOR APPROVAL PRIOR TO FABRICATION.

5. LOCATION OF SIGN TO BE AS DIRECTED BY THE ARCHITECT.

6. ARCHITECT WILL PROVIDE ARTWORK FOR LS3P LOGO.

7. BACK AND LEGS TO BE PAINTED PMS 485 RED.

LS3P
ENGAGE DESIGN **TRANSFORM**
LS3P ASSOCIATES LTD.
NORTH CAROLINA SOUTH CAROLINA
WWW.LS3P.COM
MEMBERS OF THE AMERICAN INSTITUTE OF ARCHITECTS

SECTION @
PROJECT CONSTRUCTION SIGN

02

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SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

1.2 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.3 ACTION SUBMITTALS

A. Comparable Product Requests: Comply with requirements in Section 012500 "Substitution Procedures."

B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

1.4 QUALITY ASSURANCE

A. Compatibility: Contractor is responsible for providing products and construction methods compatible with other products and construction methods used on the Project.

B. Asbestos: No asbestos or asbestos-containing material may be incorporated into the Work.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.

1.6 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
3. Refer to other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 017836 "Warranties."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

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

2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

B. Product Selection Procedures:

1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements.
4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.

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

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the conditions of Section 012500 "Substitution Procedures" are satisfied. If the conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.
8. Correction of the Work.

1.2 INFORMATIONAL SUBMITTALS

A. Qualification Data: For land surveyor.

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

C. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

D. Certified Surveys: Submit two copies signed by surveyor.

1.3 QUALITY ASSURANCE

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

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

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

1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural element during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.

4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility, Architect, and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect through Construction Manager according to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect and Construction Manager promptly.

B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.

C. Inform installers of lines and levels to which they must comply.

1. Check the location, level and plumb, of every major element as the Work progresses.
2. Notify Architect and Construction Manager when deviations from required lines and levels exceed allowable tolerances.
3. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

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

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

F. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect and Construction Manager.

3.4 FIELD ENGINEERING

A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect or Construction Manager. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect and Construction Manager before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

C. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

3.5 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 CUTTING AND PATCHING

A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

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

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

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Adjacent Occupied Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.

5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

    a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

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

3.7 PROGRESS CLEANING

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

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

    a. Use containers intended for holding waste materials of type to be stored.

4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

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

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

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

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

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

D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.9 PROTECTION OF INSTALLED CONSTRUCTION

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

B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.10 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes.

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

END OF SECTION 017300

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Recycling nonhazardous construction waste.
2. Disposing of nonhazardous construction waste.

1.2 DEFINITIONS

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

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

C. Recycle: Recovery of construction waste for subsequent processing in preparation for reuse.

1.3 PERFORMANCE REQUIREMENTS

A. Contractor is encouraged to recycle as much nonhazardous construction waste as practical, without incurring additional costs to the Owner.

1.4 QUALITY ASSURANCE

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 WASTE MANAGEMENT AND DISPOSAL

A. General: Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."

B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.

1. Review plan procedures and locations established for recycling and disposal.

C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 RECYCLING CONSTRUCTION WASTE, GENERAL

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

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

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

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

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

3.3 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

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

END OF SECTION 017419

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final Completion procedures.
3. Final cleaning.
4. Repair of the Work.

1.2 ACTION SUBMITTALS

A. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

B. Certified List of Incomplete Items: Final submittal at Final Completion.

1.3 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

1.4 MAINTENANCE / EXTRA MATERIALS

A. Schedule of Maintenance / Extra Materials: For extra materials specified in other Sections.

1.5 SUBSTANTIAL COMPLETION PROCEDURES

A. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
2. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
3. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, damage or settlement surveys, stair surveys, property surveys, and similar final record information.
4. Submit closeout submittals specified in individual Divisions 02 through 33 Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
5. Submit extra materials specified in individual Divisions 02 through 33 Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Owner. Label with manufacturer's name and model number where applicable.

a. Schedule of Extra Materials: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Owner's signature for receipt of submittals.

6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
7. Submit test/adjust/balance records.
8. Camera inspection of sanitary sewer system and final cleaning of the sewer line. Provide copy of video in acceptable format on a disc.

B. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
6. Advise Owner of changeover in heat and other utilities.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements, including touchup painting.
10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

C. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection, or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for final completion.

1.6 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:

1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. Inspection: Submit a written request for final inspection to determine Final Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of

unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection, or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.7 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Submit list of incomplete items to Architect and Owner in the following format:

a. MS Excel electronic file. Architect will return annotated copy.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion:

a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
g. Sweep concrete floors broom clean in unoccupied spaces.

h. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
i. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
j. Remove labels that are not permanent.
k. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
l. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
m. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
n. Clean ducts, blowers, and coils that display contamination with particulate matter on inspection.

1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.

o. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
p. Leave Project clean and ready for occupancy.

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.

a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.

3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.
2. Emergency manuals.
3. Operation manuals for systems, subsystems, and equipment.
4. Product maintenance manuals.
5. Systems and equipment maintenance manuals.

1.2 CLOSEOUT SUBMITTALS

A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Architect will comment on whether content of operations and maintenance submittals are acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operations and maintenance manuals in the following formats:

1. Two paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves.
2. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
    a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
    b. Enable inserted reviewer comments on draft submittals.

C. Manual Submittal: Submit operation and maintenance manual prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.

1. Correct or revise each manual to comply with Architect's comments.

PART 2 - PRODUCTS

2.1 REQUIREMENTS FOR OPERATION AND MAINTENANCE MANUALS

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain a title page, table of contents, and manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.

3. Name and address of Owner.
4. Date of Substantial Completion.
5. Project number.
6. Name and contact information for Contractor.
7. Name and contact information for Construction Manager.
8. Name and contact information for Architect.
9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Manuals:

1. Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
    a. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
    b. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products included in the section on each divider, cross-referenced to Specification Section number.
    c. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
    d. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
        1) If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
        2) If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.
2. Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
    a. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
    b. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system names used in manual directory and table of contents. Configure electronic manual to display bookmark panel on opening file.

2.2 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for type of emergency, emergency instructions and procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.

3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include instructions on stopping, shutdown instructions, operating instructions for conditions outside normal operating limits, required sequences for electric or electronic systems and special operating instructions and procedures.

2.3 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.4 PRODUCT, SYSTEMS, AND EQUIPMENT MAINTENANCE MANUALS

A. Content: Include source information, product information, manufacturers' maintenance documentation, maintenance procedures, repair materials and sources, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds, as described below.

B. Source Information: List each product, system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

C. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

E. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Test and inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Troubleshooting guide.
5. Precautions against improper maintenance.
6. Schedule for routine cleaning and maintenance.
7. Disassembly; component removal, repair, and replacement; and reassembly instructions.
8. Aligning, adjusting, and checking instructions.
9. Repair instructions.

F. Repair Materials and Sources: Include lists of materials and local sources of materials.

G. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.

H. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

I. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

J. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of operation and maintenance manuals.
2. Comply with requirements of newly prepared record Drawings in Section 017839 "Project Record Documents."

END OF SECTION 017823

SECTION 017836 - WARRANTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for warranties required by the Contract Documents, including manufacturer's standard warranties on products and special warranties.

1. Refer to the General Conditions for terms of the Contractor's period for correction of the Work.

B. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products. Manufacturer's disclaimers and limitations on product warranties do not relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

1.2 DEFINITIONS

A. Standard product warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.

B. Special warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

1.3 WARRANTY REQUIREMENTS

A. Related Damages and Losses: When correcting failed or damaged warranted construction, remove and replace construction that has been damaged as a result of such failure or must be removed and replaced to provide access for correction of warranted construction.

B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of the Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.

D. Owner's Recourse: Expressed warranties made to the Owner are in addition to implied warranties and shall not limit the duties, obligations, rights, and remedies otherwise available under the law. Expressed warranty periods shall not be interpreted as limitations on the time in which the Owner can enforce such other duties, obligations, rights, or remedies.

1. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selection to products with warranties not in conflict with requirements of the Contract Documents.

E. Where the Contract Documents require a special warranty or similar commitment on the Work or part of the Work, the Owner reserves the right to refuse to accept the Work, until the Contractor presents evidence that entities required to countersign such commitments are willing to do so.

F. Warranty Commencement: Warranties required by the Contract Documents shall commence on the Date of Substantial Completion of the Work or designated portion thereof.

1.4 SUBMITTALS

A. Submit written warranties to the Architect prior to the date certified for Substantial Completion. If the Architect's Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Architect.

1. When a designated portion of the Work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Architect within 15 days of completion of that designated portion of the Work.

B. When the Contract Documents require the Contractor, or the Contractor and a subcontractor, supplier or manufacturer to execute a special warranty, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner, through the Architect, for approval prior to final execution.

C. Prepare a written document utilizing the sample “General Warranty” form located at the end of this Section, ready for execution by the Contractor. The Contractor shall submit subcontractor, supplier, or manufacturer draft warranties to the Owner, through the Architect, for approval prior to final execution.

1. Refer to Divisions 2 through 33 Sections for specific content requirements and particular requirements for submitting special warranties.

D. Form of Submittal: At Final Completion compile two (2) copies of each required warranty properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.

E. Bind warranties and bonds in heavy-duty, commercial-quality, durable 3-ring, vinyl-covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.

1. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product, and the name, address, and telephone number of the Installer.
2. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project title or name, name of the Contractor and date of Substantial Completion.
3. When warranted construction requires operation and maintenance manuals, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.
4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 017836

Attachment: Sample General Warranty

SAMPLE GENERAL WARRANTY

(To Be Printed on Company Letterhead. Letterhead Shall Include Phone and Fax Numbers)

GENERAL WARRANTY

Date:

Contractor: Name
Address
City, State, Zip Code

Owner: Name
Address
City, State Zip Code

Project: Name
Project Location: City, State

The above named contractor as the General Contractor for the Work on the above project, does hereby warrant that for a period of one (1) year from the date of the Date of Substantial Completion, the above Work that will remain free from all defects in workmanship and material, and that it will comply with all the specific requirements of the Contract Documents governing the Work.

_____
Signature

_____
Printed Name and Title

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for project record documents.

1.2 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit copies of Record Drawings as follows:

a. Initial Submittal:

1) Submit PDF electronic files of scanned record prints.
2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

b. Final Submittal:

1) Submit one paper-copy set of marked-up record prints.
2) Submit PDF electronic files of scanned record prints.
3) Include each drawing, whether or not changes and additional information were recorded.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally.

a. Provide information on concealed elements that would be difficult to identify or measure and record later.
b. Record data as soon as possible after obtaining it.
c. Record and check the markup before enclosing concealed installations.
d. Scan completed Record Prints containing recorded changes and save data in current Windows file format required by Owner. Deliver files on CD-ROM or DVD medium.

2. Content: Types of items requiring marking include, but are not limited to, the following:

a. Dimensional changes to Drawings.
b. Revisions to details shown on Drawings.
c. Depths of foundations below first floor.
d. Locations and depths of underground utilities.
e. Revisions to routing of piping and conduits.
f. Revisions to electrical circuitry.
g. Actual equipment locations.
h. Duct size and routing.
i. Locations of concealed internal utilities.
j. Changes made by Change Order or Construction Change Directive.
k. Changes made following Architect's written orders.

l. Details not on the original Contract Drawings.
m. Field records for variable and concealed conditions.
n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.

1. New drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
2. Consult Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.

C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Identification: Provide project name, date, designation "PROJECT RECORD DRAWINGS", name of architect and name of contractor.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's and Construction Manager's reference during normal working hours.

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Demonstration of operation of systems, subsystems, and equipment.
2. Training in operation and maintenance of systems, subsystems, and equipment.

1.2 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program, including a list of training modules and a schedule of proposed dates, times, and length of instruction time for each training module.

B. Qualification Data: For facilitator and instructor.

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.3 CLOSEOUT SUBMITTALS

A. At completion of training, submit complete training manual(s) for Owner's use. Prepare training manual in format matching operation and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative experienced in operation and maintenance procedures and training.

1.5 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved operation and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

   a. System, subsystem, and equipment descriptions.
   b. Performance and design criteria if Contractor is delegated design responsibility.
   c. Operating standards.
   d. Regulatory requirements.
   e. Equipment function.
   f. Operating characteristics.
   g. Limiting conditions.
   h. Performance curves.

2. Documentation: Review the following items in detail:

   a. Operations manuals.
   b. Maintenance manuals.
   c. Project record documents.
   d. Identification systems.
   e. Warranties and bonds.
   f. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

   a. Instructions on meaning of warnings, trouble indications, and error messages.
   b. Instructions on stopping.
   c. Shutdown instructions for each type of emergency.
   d. Operating instructions for conditions outside of normal operating limits.
   e. Sequences for electric or electronic systems.
   f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

   a. Startup procedures.
   b. Equipment or system break-in procedures.
   c. Routine and normal operating instructions.
   d. Regulation and control procedures.
   e. Control sequences.
   f. Safety procedures.
   g. Instructions on stopping.
   h. Normal shutdown instructions.
   i. Operating procedures for emergencies.
   j. Operating procedures for system, subsystem, or equipment failure.
   k. Seasonal and weekend operating instructions.
   l. Required sequences for electric or electronic systems.
   m. Special operating instructions and procedures.

5. Adjustments: Include alignments, checking adjustments, noise and vibration adjustments, economy and efficiency adjustments.
6. Troubleshooting: Include diagnostic instructions and test and inspection procedures.

7. Maintenance: Include the following:

    a. Inspection procedures.
    b. Types of cleaning agents to be used and methods of cleaning.
    c. List of cleaning agents and methods of cleaning detrimental to product.
    d. Procedures for routine cleaning
    e. Procedures for preventive maintenance.
    f. Procedures for routine maintenance.
    g. Instruction on use of special tools.

8. Repairs: Include the following:

    a. Diagnosis instructions.
    b. Repair instructions.
    c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
    d. Instructions for identifying parts and components.
    e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module.

3.2 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Owner will furnish Contractor with names and positions of participants.

C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season. Schedule training with Owner, through Construction Manager.

D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.

F. Cleanup: Restore systems and equipment to condition existing before initial training use.

END OF SECTION 017900

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.

1.2 DEFINITIONS

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

B. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

C. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

D. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.3 MATERIALS OWNERSHIP

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

1.4 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property and for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

C. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.

2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.

D. Predemolition Photographs: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by demolition operations. Comply with Section 013233 "Photographic Documentation." Submit before Work begins.

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

F. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.6 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.7 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

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

C. Standards: Comply with ANSI A10.6 and NFPA 241.

1.8 PROJECT CONDITIONS

A. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

B. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

C. Buildings nearby to demolition area will be occupied. Conduct building demolition so operations of occupied buildings will not be disrupted.

1. Provide not less than 72 hours' notice of activities that will affect operations of adjacent occupied buildings.
2. Do not close or obstruct walkways, exits, or other facilities used by occupants of nearby buildings without written permission from authorities having jurisdiction.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner.
2. If hazardous materials are present, Owner shall have the following options:
    a. Direct the Contractor to remove the hazardous materials and adjust the Contract Sum by Change Order,
    b. Remove hazardous materials under a separate contract.

E. Storage or sale of removed items or materials on-site is not permitted.

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

1. Maintain fire-protection facilities in service during selective demolition operations.

1.9 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Coordinate with Owner for any existing warranties.

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

1.10 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting demolition operations.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

D. Perform a survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

E. Survey of Existing Conditions: Record existing conditions by use of predemolition photographs.

1. Comply with Section 013233 "Photographic Documentation".
2. Architect-Directed Photographs: From time to time, Architect may request additional photographs. Architect will determine number and frequency of photographs and general directions on vantage points. Select actual vantage points and take photographs to show the status of demolition and progress since last photographs were taken.

3.2 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during demolition.

B. Protect existing site improvements to remain from damage during demolition.

1. Restore damaged improvements to their original condition as acceptable to Owner.

C. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

D. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Comply with requirements for access and protection specified in Section 015000 "Temporary Facilities and Controls."
2. 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.

E. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures and dust control specified in Section 015000 "Temporary Facilities and Controls."

F. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.

1. Comply with requirements for existing services/systems interruptions specified in Section 011000 "Summary."

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Arrange to shut off indicated utilities with utility companies.
2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to nearby occupied buildings.

3. Disconnect, demolish, and remove plumbing and HVAC systems, equipment, and components indicated to be removed.

    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    e. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    f. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. 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. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
3. 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.
4. Maintain adequate ventilation when using cutting torches.
5. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
6. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
7. Dispose of demolished items and materials promptly.

B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

C. Explosives: Use of explosives is not permitted.

3.5 REPAIRS

A. Promptly repair damage to nearby buildings and related improvements caused by demolition operations.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.7 CLEANING

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn demolished materials.

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

END OF SECTION 024119

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1. Footings.
2. Slabs-on-grade.

B. Related Sections:

1. Section 321313 "Concrete Paving" for concrete pavement and walks.

1.3 DEFINITIONS

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

1.4 ACTION SUBMITTALS

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

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

1. Location of construction joints is subject to approval of the Architect.

E. Samples: For vapor retarder.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Welding certificates.

C. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Steel reinforcement and accessories.
4. Curing compounds.
5. Bonding agents.
6. Adhesives.
7. Vapor retarders.
8. Semirigid joint filler.
9. Joint-filler strips.
10. Repair materials.

D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

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

F. Field quality-control reports.

G. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. 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.

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."

E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5."
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

1. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

a. 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.
b. 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.

G. Preinstallation Conference: Conduct conference at Project site.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Concrete subcontractor.
e. Special concrete finish subcontractor.

2. Review testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips**,** vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.
3. Review floor finishes to be installed and coordinate with curing methods to be used.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. 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.

B. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

C. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

2.3 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.4 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I/II. Supplement with the following:

a. Fly Ash: ASTM C 618, Class F.

B. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94/C 94M and potable.

2.5 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

C. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494/C 494M, Type C.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Axim Italcementi Group, Inc.; CATEXOL CN-CI
b. BASF Construction Chemicals - Building Systems; Rheocrete CNI
c. Euclid Chemical Company (The), an RPM company; ARRMATECT, EUCON BCN, or EUCON CIA
d. GCP Applied Technologies; DCI
e. Sika Corporation; Sika CNI

D. Synthetic Macro-Fiber: Polyolefin macro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, 1 to 2-1/4 inches long.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Euclid Chemical Company (The), an RPM company; Tuf-Strand SF.
b. FORTA Corporation; FORTA FERRO.
c. GCP Applied Technologies; Strux 90/40.
d. Nycon, Inc.; XL.

e. Propex Concrete Systems Corp.; Fibermesh 650.
f. Sika Corporation; Sika Fiber MS.

2.6 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape. Maximum perm rating of 0.02.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Fortifiber Building Systems Group; Moistop Ultra 15
b. GCP Applied Technologies; Florprufe 120
c. Insulation Solutions, Inc.; Viper VaporCheck II
d. Meadows, W. R., Inc.; Perminator 15 mil
e. Raven Industries Inc.; Vapor Block 15
f. Reef Industries, Inc.; Griffolyn 15 mil Green
g. Stego Industries, LLC; Stego Wrap 15 mil Class A

2. Provide manufacturer's compatible sealer system for penetrations.

B. Granular Fill: Provide one of the following:

C. Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

D. Clean sands with less than 3 percent fines. Materials to be verified by a qualified Geotechnical Engineer.

2.7 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Products: Subject to compliance with requirements, provide one of the following:

a. BASF Construction Chemicals - Building Systems; Confilm
b. ChemMasters; SprayFilm
c. Conspec by Dayton Superior; Aquafilm
d. Dayton Superior Corporation; Sure Film (J-74)
e. Euclid Chemical Company (The), an RPM company; Eucobar
f. L&M Construction Chemicals, Inc.; E-CON
g. Meadows, W. R., Inc.; EVAPRE
h. Sika Corporation; SikaFilm
i. Symons by Dayton Superior; Finishing Aid
j. Unitex; PRO-FILM

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Anti-Hydro International, Inc.; AH Clear Cure WB
b. BASF Construction Chemicals - Building Systems; Kure-N-Seal WB
c. ChemMasters; Safe-Cure & Seal 20
d. Conspec by Dayton Superior; Cure and Seal WB
e. Cresset Chemical Company; Crete-Trete 309-VOC Cure & Seal
f. Dayton Superior Corporation; Safe Cure and Seal (J-18)
g. Euclid Chemical Company (The), an RPM company; Aqua Cure VOX; Clearseal WB 150
h. L&M Construction Chemicals, Inc.; Dress & Seal WB
i. Meadows, W. R., Inc.; Vocomp-20
j. Symons by Dayton Superior; Cure & Seal 18 Percent E

2.8 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.

C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.9 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.10 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash: 25 percent.
2. Combined Fly Ash and Pozzolan: 25 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.11 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 3000 psi at 28 days.
2. Slump Limit: 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.

B. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength – typical interior slab: 3000 psi at 28 days.
2. Minimum Compressive Strength: 4000 psi at 28 days.
3. Slump Limit: 4 inches, plus or minus 1 inch.
4. Air Content: For exterior broom finished concrete only; 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
5. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
6. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 3.0 lb/cu. yd.

2.12 FABRICATING REINFORCEMENT

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

2.13 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

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

B. 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.

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

D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

E. 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.

F. 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.

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

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

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

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

K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.3 VAPOR RETARDERS

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.

1. Following leveling and tamping of granular base for slabs on grade, place vapor barrier sheeting with longest dimension parallel with direction of pour and face laps away from the expected direction of the placement whenever possible.
2. 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.
3. Lap joints 6 inches and seal with manufacturer's recommended tape.
4. Apply seam tape to a clean and dry vapor barrier.
5. Seal all penetrations (including pipes) per manufacturer’s instructions.
6. Avoid the use of non-permanent stakes driven through vapor retarder.
7. If non-permanent stakes are driven through vapor retarder, repair as recommended by vapor retarder manufacturer.
8. Repair damaged areas with vapor barrier material of similar (or better) permeance, puncture and tensile.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

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

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

1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

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

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

3.5 JOINTS

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

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.

3. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

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. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

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

F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

G. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.7 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete.

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

3.8 FINISHING FLOORS AND SLABS

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

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.

1. Apply scratch finish to surfaces indicated and to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces indicated to receive trowel finish.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:

a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.9 MISCELLANEOUS CONCRETE ITEMS

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

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

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

3.10 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

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

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

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

    a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

    a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

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 joint clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.12 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.13 FIELD QUALITY CONTROL

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

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

C. Inspections:

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

D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Samples for strength tests of each class of concrete placed each day shall be taken not less than once a day, nor less than once for each 150 cu. yd. of concrete, nor less than once for each 5,000 sq. ft. of surface area for slabs or walls.
2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
6. Compression Test Specimens: ASTM C 31/C 31M.
    a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
8. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture

proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
10. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

E. Measure floor and slab flatness and levelness according to ASTM E 1155 within 48 hours of finishing.

END OF SECTION 033000

SECTION 042613 - MASONRY VENEER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Clay face brick.
2. Mortar.
3. Ties and anchors.
4. Embedded flashing.
5. Miscellaneous masonry accessories.

B. Products Installed but not Furnished under This Section:

1. Steel lintels in masonry veneer.
2. Steel shelf angles for supporting masonry veneer.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples: For each type and color of the following:

1. Clay face brick.
2. Pigmented and colored-aggregate mortar. Make Samples using same sand and mortar ingredients to be used on Project.
3. Weep holes and vents.
4. Accessories embedded in masonry.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

1. Submit list of minimum of five similar projects, including description of project size and scope, and name and contact information for architect, for Installer, superintendent, and crew chiefs. Indicate total years of experience for each.

B. Material Certificates: For each type and size of the following:

1. Masonry units.

a. Include material test reports substantiating compliance with requirements.
b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.

c. For exposed brick, include test report for efflorescence according to ASTM C67.

2. Cementitious materials. Include name of manufacturer, brand name, and type.
3. Mortar admixtures.
4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
5. Anchors, ties, and metal accessories.

C. 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 C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.

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

1.5 QUALITY ASSURANCE

A. Masonry Installer: A single, experienced firm specializing in masonry construction with a minimum five year record of successful completion of projects of similar scope, capable of providing labor and material and performance bonds for its portion of the Work that are acceptable to the Owner. Installer shall furnish all required materials and equipment and perform the work of this Section with its own regular employees.

1. The masonry supervisor/foreman shall have had at least 5 years of experience with at least 5 projects of similar size and nature; he shall not act as or become a production worker.
2. The lead/crew chief masons shall have had at least 3 years of experience with at least 5 projects of similar size and nature;
3. Installer shall have experienced superintendent and crew chiefs on site supervising the work whenever work is in progress.
4. Contractor’s Own Forces: Contractor may utilize own forces for work of this Section when Contractor and Contractor’s superintendent and crew chiefs meet the above qualifications.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups for typical exterior wall in sizes approximately 48 inches long by 48 inches high by full thickness, including face and backup wythes and accessories.

a. Include a sealant-filled joint at least 16 inches long in mockup.
b. Include lower corner of window opening at upper corner of exterior wall mockup. Make opening approximately 12 inches wide by 16 inches high.
c. Include through-wall flashing installed for a 24-inch length in corner of exterior wall mockup approximately 16 inches down from top of mockup, with a 12-inch length of flashing left exposed to view (omit masonry above half of flashing).
d. Include metal studs, sheathing, water-resistive barrier, sheathing joint-and-penetration treatment, veneer anchors, flashing, cavity drainage material, and weep holes in exterior masonry-veneer wall mockup.

2. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.
3. Protect accepted mockups from the elements with weather-resistant membrane.
4. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.

a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.

b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.6 DELIVERY, STORAGE, AND HANDLING

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

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

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

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

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

1.7 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of veneer, 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 face of veneer, and hold cover securely in place.

B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry. Immediately remove grout, mortar, and soil that come in contact with 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 TMS 602/ACI 530.1/ASCE 6.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

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

2.2 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.

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

2.3 BRICK

A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

B. Clay Face Brick: Facing brick complying with ASTM C216.

1. Grade: MW or SW.
2. Type: FBS.
3. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested according to ASTM C7.
4. Efflorescence: Provide brick that has been tested according to ASTM C67 and is rated "not effloresced."
5. Color and Texture: Match existing.
6. Size: Match existing.
7. Application: Use where brick is exposed unless otherwise indicated.

2.4 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

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

D. Masonry Cement: Not permitted.

E. Mortar Cement: ASTM C1329/C1329M.

F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.

G. Colored Cement Products: Packaged blend made from portland cement and hydrated lime and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Colored Portland Cement-Lime Mix:

a. Products: Subject to compliance with requirements, provide one of the following:

1) Essroc, Italcementi Group; 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) Lehigh Cement Company.; Lehigh Custom Color Portland/Lime Cement.

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 mortar cement by weight.

H. Aggregate for Mortar: ASTM C144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

I. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Addiment Incorporated; Mortar Kick
b. BASF Construction Chemicals - Building Systems; Trimix-NCA.
c. Euclid Chemical Company (The); Accelguard 80.
d. GCP Applied Technologies; Morset.
e. Sonneborn, Div. of ChemRex; Trimix-NCA

J. Water-Repellent Admixture: Liquid water-repellent mortar admixture.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ACM Chemistries; RainBloc for Mortar.
b. BASF Corporation, Construction Chemicals; Rheopel Mortar Admixture.

c. GCP Applied Technologies; Dry-Block Mortar Admixture.

K. Water: Potable.

2.5 TIES AND ANCHORS

A. General: Ties and anchors shall extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Mill-Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A641/A641M, Class 1 coating.
2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A153/A153M, Class B-2 coating.
3. Stainless Steel Wire: ASTM A580/A580M, Type 304.
4. Galvanized-Steel Sheet: ASTM A653/A653M, Commercial Steel, G60 zinc coating.
5. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.
6. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.

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. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- diameter, hot-dip galvanized steel wire.
2. Tie Section: Triangular-shaped wire tie made from 0.187-inch- diameter, hot-dip galvanized steel wire.

D. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist a 100-lbf load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch.
2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.105-inch- thick steel sheet, galvanized after fabrication.
3. Fabricate wire ties from 0.187-inch- diameter, hot-dip galvanized-steel wire unless otherwise indicated.
4. Screw-Attached Masonry Veneer Anchor: Units consisting of a wire tie and a metal anchor section.
    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
        1) Hohmann & Barnard, Inc.
        2) Dayton Superior Corporation; Dur-O-Wal Division
        3) Heckmann Building Products Inc.
        4) Wire-Bond
    b. Contractor's Option: Provide one of the following types.
        1) Anchor Section: Sheet metal plate, 1-1/4 inches wide by 6 inches long, with screw holes top and bottom and with raised rib-stiffened strap, 5/8 inch wide by 3-5/8 inches long, stamped into center to provide a slot between strap and plate for inserting wire tie. Fabricate sheet metal anchor section from 1.05 inch thick steel

sheet, galvanized after fabrication. Provide self-healing strip under each clip. Basis of Design: Hohmann & Barnard, Inc.; Model # X-Seal.

2) Anchor Section: Corrosion-resistant, self-drilling, eye-screw designed to receive wire tie. Eye-screw has spacer that seats directly against framing and is same thickness as sheathing and has gasketed, washer head that covers hole in sheathing. Basis of Design: Heckmann Building Products Inc.; Pos-I-Tie.

E. Continuous Horizontal Masonry Joint Reinforcement for Masonry-Veneer Anchors: Single 0.188-inch diameter, hot-dip galvanized, carbon-steel continuous wire.

1. Provide at all bed joints in soldier coursing.

2.6 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.016 inch thick.
2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
3. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
4. Fabricate through-wall flashing with drip edge where indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
5. Fabricate metal drip edges from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.

B. Flexible Flashing: Use one of the following unless otherwise indicated:

1. Copper-Laminated Flashing: 5-oz./sq. ft. copper sheet bonded between 2 layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry. Subject to compliance with requirements, provide one of the following products:

a. Advanced Building Products Inc.; Copper Fabric Flashing
b. AFCO Products Inc.; Copper Fabric
c. Hohmann & Barnard, Inc.; H & B C-Fab Flashing
d. Phoenix Building Products; Type FCC-Fabric Covered Copper
e. Polytite Manufacturing Corp.; Copper Fabric Flashing
f. Sandell Manufacturing Co., Inc.; Copper Fabric Flashing
g. York Manufacturing, Inc.; York Copper Fabric Flashing

2. Laminated Stainless Steel Fabric Flashing, Non-Asphaltic: Stainless steel core with polymer fabric laminated to one stainless steel face with non-asphalt adhesive. Provide with manufacturer recommended accessory items for a complete compatible system. Subject to compliance with requirements, provide one of the following:

a. Hohman and Bernard, Inc.; Mighty-Flash Stainless Steel Fabric Flashing.
b. York Manufacturing, Inc.; Multi-Flash SS
c. STS Coatings, Inc.; Gorilla Flash Stainless Fabric
d. Illinois Products, Inc.; IPCO Stainless Steel Fabric Flashing
e. TK Products, Inc.; TK TWF

3. Self-Adhering Stainless Steel Flashing: 2 mil., Type 304 stainless steel with butyl rubber adhesive on one face. Use where flashing is fully concealed in masonry. Subject to compliance with requirements, provide one of the following:

a. Hohman and Bernard, Inc.; Mighty-Flash SA.

b. York Manufacturing, Inc.; York 304 SS.
c. Illinois Products, Inc.; IPCO Self-Adhering Stainless Steel Fabric Flashing
d. Vapro Shield, Inc.; Vapro SS Flashing.

C. Corners and End Dams: Provide prefabricated corners and end dams of same material and thickness as primary material and from the same flashing manufacturer.

D. Application: Unless otherwise indicated, use the following:

1. Where flashing is indicated to receive counterflashing, use metal flashing.
2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
3. Where flashing is fully concealed, use flexible flashing.

E. Sealants for Sheet Metal Flashings: As specified in Section 076200 "Sheet Metal Flashing and Trim."

1. Elastomeric Sealant: ASTM C920, chemically curing silicone sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and remain watertight.

F. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

G. Termination Bars for Flexible Flashing: Stainless steel sheet 0.019 inch by 1-1/2 inches with a 3/8 inch sealant flange at top.

1. Provide stainless steel fasteners.

2.7 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene or urethane.

B. Weep/Vent Products: Use the following unless otherwise indicated:

1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.

a. Advanced Building Products Inc.; Mortar Maze weep vent.
b. Dayton Superior Corporation, Dur-O-Wal Division; Cell Vents.
c. Heckmann Building Products Inc.; No. 85 Cell Vent.
d. Hohmann & Barnard, Inc.; Quadro-Vent.
e. Wire-Bond; Cell Vent

C. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Products:

a. Advanced Building Products Inc.; Mortar Break (1 to 1-3/4 inch air space) or Mortar Break II (2-inch airspace).
b. Archovations, Inc.; CavClear Masonry Mat.
c. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop
d. Heckmann Building Products Inc.; Weep-Thru Mortar Deflector.
e. Hohmann & Barnard, Inc.; Mortar Trap.
f. Mortar Net USA, Ltd.; Mortar Net.
g. Wire-Bond; Cavity Net II.

2. Configuration: Provide one of the following:

a. Strips, full depth of cavity and 10 inches high, with dovetail-shaped notches 7 inches deep that prevent clogging with mortar droppings.
b. Strips, not less than 1-1/2 inches thick and 10 inches high, with dimpled surface designed to catch mortar droppings and prevent weep holes from clogging with mortar.

2.8 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Diedrich Technologies, Inc.
b. EaCo Chem, Inc.
c. ProSoCo, Inc.

2.9 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 or grout.
2. Use portland cement-lime or mortar cement 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. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification.

1. For masonry below grade or in contact with earth, use Type S.
2. For veneer masonry, use Type N.

D. Pigmented Mortar: Use colored cement product.

1. Pigments shall not exceed 10 percent of portland cement by weight.
2. Pigments shall not exceed 5 percent of mortar cement by weight.
3. Color: Match existing.
4. Application: Use pigmented mortar for exposed mortar joints.

PART 3 - EXECUTION

3.1 EXAMINATION

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

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

3.2 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. 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 30 g/30 sq. in. per minute when tested according to ASTM C67. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

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

B. Lines and Levels:

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

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.

3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

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

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

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

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.

3.5 MORTAR BEDDING AND JOINTING

A. 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.

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

3.6 ANCHORED MASONRY VENEERS

A. Anchor masonry veneers to wall framing with masonry-veneer anchors to comply with the following requirements:

1. Fasten screw-attached anchors through insulation and sheathing to wall framing with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
2. Embed tie sections in masonry joints.
3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors as indicated, but not more than 16 inches o.c. vertically and horizontally. Install additional anchors within 12 inches of openings and at intervals, not exceeding 24 inches, around perimeter.

B. Provide not less than 1 inch of airspace between back of masonry veneer and face of insulation.

1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

C. Provide continuous wire reinforcement in soldier and stacked courses.

3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete to comply with the following:

1. Provide an open space not less than 1 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.8 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 as follows:

1. Build in compressible joint fillers where indicated.
2. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Section 079200 "Joint Sealants."

C. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 079200 "Joint Sealants," but not less than.

1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.9 LINTELS

A. Install steel lintels where indicated. Secure lintels immediately after placing into position to prevent movement and collapse. Unsecured lintels shall be removed and replaced when they can be secured immediately.

B. Provide minimum bearing of 16 inches at each jamb unless otherwise indicated.

3.10 FLASHING, WEEP HOLES, 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.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. Extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under water-resistive barrier, lapping at least 4 inches. Fasten upper edge of flexible flashing to sheathing through termination bar.
3. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
4. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

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

D. Install weep holes in veneers in head joints of first course of masonry immediately above embedded flashing.

1. Use specified weep/vent products to form weep holes.
2. Space weep holes 24 inches o.c. unless otherwise indicated.

E. Place cavity drainage material in airspace behind veneers to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

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 comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.

C. Flashing Inspections: Prior to concealment by closure of wall, coordinate and schedule inspection of through-wall flashings with Architect.

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 nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20 or low-pressure spray method, using 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. At completion of unit masonry work, remove from Project site.

END OF SECTION 042613

SECTION 052100 - STEEL JOIST FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. K-series steel joists.
2. Joist accessories.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for field-welded shear connectors.

1.3 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 nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.4 ACTION SUBMITTALS

A. Product Data: For each type of joist, accessory, and product.

B. Shop Drawings:

1. Include layout, designation, number, type, location, and spacing of joists.
2. Include joining and anchorage details, bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
3. Indicate locations and details of bearing plates to be embedded in other construction.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and professional engineer.

B. Welding certificates.

C. Manufacturer certificates.

D. Mill Certificates: For each type of bolt.

E. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications" and "Standard Specifications for Composite Steel Joists, CJ-Series" in "Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice."

B. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.

C. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.

1. 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. Roof Joists: Vertical deflection of 1/240 of the span.

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

2.2 K-SERIES STEEL JOISTS

A. Manufacture steel joists of type indicated according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.

1. Joist Type: K-series steel joists.

B. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.

C. Provide holes in chord members for connecting and securing other construction to joists.

D. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications."

E. Camber joists according to SJI's "Specifications."

F. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.3 PRIMERS

A. Primer: SSPC-Paint 20 – Zinc-Rich Coating (Type 1 Inorganic and Type II Organic).

2.4 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. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A, carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.

1. Finish: Plain, uncoated.

D. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.

1. Finish: Plain.

E. Welding Electrodes: Comply with AWS standards.

F. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.5 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. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.

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

3.2 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.

1. Before installation, splice joists delivered to Project site in more than one piece.
2. Space, adjust, and align joists accurately in location before permanently fastening.
3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.

C. Field weld joists to supporting steel 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. Bolt joists to supporting steel framework using carbon-steel bolts.

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.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and bolted connections and to perform field tests and inspections and prepare test and inspection reports.

B. Visually inspect field welds according to AWS D1.1/D1.1M.

C. Visually inspect bolted connections.

D. Correct deficiencies in Work that test and inspection reports have indicated are not in compliance with specified requirements.

E. Perform additional testing to determine compliance of corrected Work with specified requirements.

3.4 PROTECTION

A. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.

1. Clean and prepare surfaces by hand-tool cleaning according to SSPC-SP 2, or power-tool cleaning according to SSPC-SP 3.
2. Apply a compatible primer of same type as primer used on adjacent surfaces.

END OF SECTION 052100

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Roof deck, 1.5" type B.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

1. Power-actuated mechanical fasteners.

D. Evaluation Reports: For steel deck.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

2.2 ROOF DECK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ASC Profiles, Inc.; a Blue Scope Steel company.
2. Canam United States; Canam Group Inc.
3. CMC Joist & Deck.
4. Consolidated Systems, Inc.; Metal Dek Group.
5. Cordeck.
6. DACS, Inc.
7. Epic Metals Corporation.
8. Marlyn Steel Decks, Inc.
9. New Millennium Building Systems, LLC.
10. Nucor Corp.; Vulcraft Group.
11. Roof Deck, Inc.
12. Valley Joist; Subsidiary of EBSCO Industries, Inc.
13. Verco Manufacturing Co.
14. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

B. Roof Deck, 1.5": Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:

1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33, G60 zinc coating.
2. Deck Profile: Type WR, wide rib.
3. Profile Depth: 1-1/2 inches.
4. Design Uncoated-Steel Thickness: 0.0358 inches.
5. Span Condition: Triple span or more.
6. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.3 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile indicated.

G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.

I. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch- wide flanges and level recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.

J. Galvanizing Repair Paint: ASTM A 780.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

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

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:

1. Provide Hilti X-HSN 24 pins at bar joist supports.
2. Provide Hilti X-ENP 19 pins at structural steel supports, for steel ¼" think or greater.
3. Fastener spacing: Provide a 36/4 fastening pattern otherwise unless noted on plan.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or 36 inches, or as noted on plans and as follows:

1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:

1. End Joints: Lapped 2 inches minimum or butted at Contractor's option.

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 12 inches apart with at least one fastener at each corner.

1. Install reinforcing channels or zees in ribs to span between supports and mechanically fasten.

E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 053100

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Exterior load-bearing wall framing.
2. Interior load-bearing wall framing.
3. Exterior non-load-bearing wall framing.
4. Soffit framing.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for masonry shelf angles and connections.
2. Section 092216 "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated.
2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
    a. Exterior Load-Bearing Wall Framing: Horizontal deflection of 1/240 of the wall height.
    b. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/240 of the wall height.
    c. Interior Load-Bearing Wall Framing: Horizontal deflection of 1/240 of the wall height under a horizontal load of 5 lbf/sq. ft.
    d. Ceiling Joist Framing: Vertical deflection of 1/360 of the span.
3. 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 120 deg F.
4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
    a. Upward and downward movement of 3/4 inch.

B. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."

1. Headers: Design according to AISI's "Standard for Cold-Formed Steel Framing - Header Design."
2. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of cold-formed steel framing product and accessory.

B. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

C. Delegated-Design Submittal: For cold-formed steel framing.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Product Test Reports: For each listed product, for tests performed by manufacturer and witnessed by a qualified testing agency.

1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Vertical deflection clips.
6. Horizontal drift deflection clips
7. Miscellaneous structural clips and accessories.

D. Research Reports: For non-standard cold-formed steel framing, from ICC-ES.

1.6 QUALITY ASSURANCE

A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.

C. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

D. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

E. 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."

F. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

G. 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. Comply with AISI's "Standard for Cold-Formed Steel Framing - Truss Design."
2. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."

H. Preinstallation Conference: Conduct conference at Project site.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AllSteel & Gypsum Products, Inc.
2. California Expanded Metal Products Company.
3. ClarkWestern Building Systems, Inc.
4. Consolidated Fabricators Corp.; Building Products Division.
5. Craco Mfg., Inc.
6. Custom Stud Inc.
7. Design Shapes in Steel.
8. Dietrich Metal Framing; a Worthington Industries Company.
9. Formetal Co. Inc. (The).
10. MarinoWARE.
11. Nuconsteel; a Nucor Company.
12. Olmar Supply, Inc.
13. Quail Run Building Materials, Inc.
14. SCAFCO Corporation.
15. Southeastern Stud & Components, Inc.
16. State Building Products, Inc.
17. Steel Construction Systems.
18. Steel Network, Inc. (The).
19. Steel Structural Systems.
20. Steeler, Inc.
21. Super Stud Building Products, Inc.
22. Telling Industries, LLC.
23. United Metal Products, Inc.
24. United Steel Manufacturing.

B. Cold-Formed Steel Framing Design Standards:

1. Wall Studs: AISI S211.
2. Headers: AISI S212.
3. Lateral Design: AISI S213.

C. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.

D. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content 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: As required by structural performance.
2. Coating: G60.

C. Steel Sheet for Vertical Deflection Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: As required by structural performance.
2. Coating: G60.

2.3 LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch.
2. Flange Width: As required by design.
3. Section Properties: As required by design.

B. Steel Track: Sigma Track by The Steel Network or approved equal, of web depths indicated, unpunched, with straight flanges, and as follows:

1. Minimum Base-Metal Thickness: 16 gauge minimum or match steel studs.
2. Flange Width: 1-1/2 inches.

C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch.
2. Flange Width: As required by design.
3. Section Properties: As required by design.

D. Steel Double-L Headers: Manufacturer's standard L-shapes used to form header beams, of web depths indicated, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch.
2. Top Flange Width: As required by design.
3. Section Properties: As required by design.

2.4 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch.
2. Flange Width: As required by design.
3. Section Properties: As required by design.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: Matching steel studs.
2. Flange Width: 1-1/4 inches.

C. Vertical Deflection Clips: Manufacturer's standard head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AllSteel & Gypsum Products, Inc.
b. ClarkWestern Building Systems, Inc.
c. Dietrich Metal Framing; a Worthington Industries company.
d. MarinoWARE.
e. SCAFCO Corporation.
f. Steel Network, Inc. (The).
g. Steeler, Inc.

D. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

a. Minimum Base-Metal Thickness: 0.0428 inch.
b. Flange Width: 1 inch plus the design gap of 3/4 inch.

2. Inner Track: Of web depth indicated, and as follows:

a. Minimum Base-Metal Thickness: 0.0428 inch.
b. Flange Width: 2-3/4 inches.

2.5 SOFFIT FRAMING

A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch.
2. Flange Width: 1-5/8 inches, minimum.
3. Section Properties: As required by design.

2.6 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers and knee braces.
9. Joist hangers and end closures.
10. Hole reinforcing plates.
11. Backer plates.

2.7 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.8 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B.

B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107/C 1107M, with fluid consistency and 30-minute working time.

D. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.

E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.9 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
    a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.
4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

H. Install insulation, specified in Section 072100 "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

J. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.3 LOAD-BEARING WALL INSTALLATION

A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:

1. Anchor Spacing: As shown on Shop Drawings.

B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/16 inch between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:

1. Stud Spacing: 16 inches.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.

D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.

E. Align floor and roof framing over studs. Where framing cannot be aligned, continuously reinforce track to transfer loads.

F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.

G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.

1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.
2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.

H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.

1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.

I. Install horizontal bridging in stud system, spaced 48 inches. Fasten at each stud intersection.

1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of 2 screws into each flange of the clip angle for framing members up to 6 inches deep.
2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
3. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

J. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: As indicated.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install double deep-leg deflection tracks and anchor outer track to building structure.
2. Connect vertical deflection clips to infill studs and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.

1. 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.

3.5 FIELD QUALITY CONTROL

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

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel framing and supports for countertops, mechanical and electrical equipment, and applications where framing and supports are not specified in other Sections.
2. Shelf angles.
3. Loose bearing and leveling plates.
4. Steel weld plates and angles for casting into concrete not specified in other Sections.
5. Miscellaneous steel trim.
6. Metal ladders.
7. Metal downspout boots.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Paint products.
2. Grout.

B. Shop Drawings: Show fabrication and installation details for metal fabrications.

1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
2. Provide templates for anchors and bolts specified for installation under other Sections.

C. Delegated-Design Submittal: For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified registered professional engineer in the state of North Carolina responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Welding Certificates: For installer and fabricator for shop and field welds verifying AWS qualification within previous 12 months, submit prior to start of welding.

B. Qualification Data: For professional engineer.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.4 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."

2. AWS D1.3, "Structural Welding Code--Sheet Steel."

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
2. Provide allowance for trimming and fitting at site.

1.6 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for 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.

C. Coordinate installation of steel weld plates and angles for casting into concrete 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

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance of Ladders: Provide ladders capable of withstanding the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

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, 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.

C. Delegated Design: Design metal fabrications, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Steel Tubing: ASTM A 500, cold-formed steel tubing.

D. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.

E. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide 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.

1. Select fasteners for type, grade, and class required.

B. Anchors, General: Anchors capable of sustaining, without failure, load equal to 6 times load imposed when installed in unit masonry and 4 times load imposed when installed in concrete, as determined by testing per ASTM E488, conducted by qualified independent testing agency.

C. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47 malleable iron or ASTM A27 cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329.

2.4 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Shop Primers: Provide primers that comply with Division 09 painting Sections.

C. Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.

1. Products:

a. Benjamin Moore; Epoxy Zinc-Rich Primer CM18/19.
b. Carboline Company; Carbozinc 621.
c. ICI Devoe Coatings; Catha-Coat 313.
d. International Coatings Limited; Interzinc 315 Epoxy Zinc-Rich Primer.
e. PPG; Aquapon Zinc-Rich Primer 97-670.
f. Sherwin-Williams; Corothane I GalvaPac Zinc Primer.
g. Tnemec Company, Inc.; Tneme-Zinc 90-97.

D. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

E. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

G. Spray Polyurethane Foam Insulation: Refer to Section 072100 "Thermal Insulation" for spray polyurethane foam insulation to be used in miscellaneous voids and tube steel.

H. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

I. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.

J. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: At exterior locations and where indicated provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work true to line and level with accurate angles and surfaces and straight edges.

E. Connections: Provide welded connections unless otherwise indicated.

F. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

G. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

H. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts, unless otherwise indicated. Locate joints where least conspicuous.

I. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

J. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

K. 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.

L. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts if units are installed after concrete is placed.
3. Equip units with integrally welded anchors for casting into concrete or building into masonry.
4. Except as otherwise indicated, space anchors 24 inches o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches wide x 1/4 inch x 8 inches long.

C. Galvanize exterior miscellaneous framing and supports and where indicated.

D. Prime miscellaneous framing and supports with zinc-rich primer.

2.7 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.

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 1/12 of clear span but not less than 8 inches, unless otherwise indicated.

D. Galvanize loose steel lintels located in exterior walls using G-90 coating.

E. Prime loose steel lintels with zinc-rich primer.

2.8 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.

1. Provide mitered and welded units at corners.

2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.

B. Galvanize shelf angles located in exterior walls.

2.9 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize plates after fabrication.

C. Prime plates with zinc-rich primer.

2.10 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with not less than two integrally welded steel strap anchors for embedding in concrete.

2.11 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Galvanize exterior miscellaneous steel trim.

D. Prime interior miscellaneous steel trim, where indicated with zinc-rich primer.

2.12 METAL LADDERS

A. General:

1. Comply with ANSI A14.3, unless otherwise indicated.
2. For ladders in excess of 24 feet in length, provide OSHA compliant ladder safety system or personal fall-arrest system.

B. Steel Ladders:

1. Siderails: Continuous, 1/2-by-2-1/2-inch steel flat bars, with eased edges.
2. Space siderails 18 inches apart, unless otherwise indicated.
3. Rungs: 3/4-inch diameter steel bars.
4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.

6. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted brackets, made from same metal as ladder.
7. Galvanize exterior and interior ladders, including brackets and fasteners.

2.13 METAL DOWNSPOUT BOOTS

A. Downspout Boots: Provide downspout boots made from 11-gauge carbon steel or cast iron in heights indicated with inlets of size and shape to suit downspouts. Provide units with flanges and holes for countersunk anchor bolts.

1. Outlet: As required to discharge into pipe.
2. Finish: Powder coat finish to match downspout.

2.14 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

2.15 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) and Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."

C. Shop Priming: 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: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

1. Do not weld, cut, or abrade surfaces of components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Adjust fabrications before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.

F. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

G. Corrosion Protection: Coat concealed surfaces of metals that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

H. Connections:

1. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting fabrication components. Use wood blocks and padding to prevent damage to members and fittings.
2. Welded Connections: Use fully welded joints for permanently connecting fabrication components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for ceiling hung toilet partitions, operable partitions, and overhead coiling doors securely to, and rigidly brace from, building structure.

3.3 INSTALLING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Use nonshrink grout, nonmetallic, in all locations, unless otherwise indicated.
2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 FIELD QUALITY CONTROL

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

B. Extent and Testing Methodology: Testing agency will randomly select completed metal fabrication assemblies for testing that are representative of different designs and conditions in the completed Work. Railings will be tested according to ASTM E 894 and ASTM E 935 for compliance with performance requirements.

C. Remove and replace fabrications where test results indicate that they do not comply with specified requirements unless they can be repaired in a manner satisfactory to Architect and will comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil 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

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior galvanized steel pipe and tube railings.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Railing brackets.
2. Grout, anchoring cement, and paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified professional engineer.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

D. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.7 COORDINATION AND SCHEDULING

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1. Professional engineer shall be legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated.

B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:

1. Steel: 72 percent of minimum yield strength.

C. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 pound-force per foot applied in any direction.
b. Concentrated load of 200 pound-force applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 pound-force applied horizontally on an area of 1 square foot.
b. Uniform load of 25 lbf/sq. ft. applied horizontally.
c. Infill load and other loads need not be assumed to act concurrently.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

1. Provide type of bracket with predrilled hole for exposed bolt anchorage and that provides 1-1/2 inch clearance from inside face of handrail to finished wall surface.

2.3 STEEL AND IRON

A. Tubing: ASTM A500 (cold formed) or ASTM A513 unless indicated otherwise.

B. Pipe: ASTM A53, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

1. Provide galvanized finish for exterior installations and where indicated.

C. Plates, Shapes, and Bars: ASTM A36.

2.4 FASTENERS

A. General: Provide the following:

1. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
2. Dissimilar Metals: Type 304 stainless-steel fasteners.
3. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other Work, unless otherwise indicated.
2. Provide concealed fasteners for interconnecting railing components and for attaching them to other Work, unless exposed fasteners are unavoidable or are standard fastening method for railings indicated.
3. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Etching Cleaner for Galvanized Metal: Complying with MPI #25.

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Epoxy Zinc-Rich Primer: Complying with MPI #20 and compatible with intermediate and topcoat specified in Section 099600 "High Performance Coatings."

E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

G. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

H. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.6 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Shop-assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form Work true to line and level with accurate angles and surfaces.

E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

J. Form changes in direction as follows:

1. Form rail-to-end post connections and changes in rail direction by radius bends, unless mitered corners are indicated.
2. Form elbow and wall returns by bending or by inserting prefabricated elbow fittings.

K. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

L. Close exposed ends of railing members with prefabricated end fittings.

M. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

N. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

O. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

P. For railing posts set in concrete, provide steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.

Q. Toe Boards: Provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

R. For removable railing posts, fabricate slip-fit sockets from steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than 1/40 of post height. Provide socket covers designed and fabricated to resist being dislodged.

1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.

2.7 STEEL AND IRON FINISHES

A. Galvanized Railings:

1. Hot-dip galvanize exterior steel railings, and other railings where indicated, including hardware, after fabrication.
2. Comply with ASTM A123 for hot-dip galvanized railings.
3. Comply with ASTM A153 for hot-dip galvanized hardware.
4. Do not quench or apply galvanizing treatments that might interfere with paint adhesion.
5. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
6. Provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
7. After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with requirements indicated below:

1. Exterior Railings: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Railings Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Railings Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

4. Other Railings: SSPC-SP 3, "Power Tool Cleaning."

C. Primer Application: Apply shop primer to prepared surfaces of railings. Comply with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Shop prime railings with zinc-rich primer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

3.4 ANCHORING POSTS

A. Use metal sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

C. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material unless attaching to post with set screws is acceptable.

D. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

E. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.5 ATTACHING RAILINGS

A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends.

C. Attach railings to wall with wall brackets, except where end flanges are used. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

D. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. Steel-Framed Partitions: At steel framed partitions, use one of the following methods:
    a. Set hanger or lag bolts into wood backing between studs. Coordinate with stud installation to locate backing members.
    b. Self-tapping screws fastened to steel framing or to concealed steel reinforcements.
    c. Toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

3.6 ADJUSTING AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780.

B. 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 dry film thickness.

3.7 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 055213

SECTION 057500 - CUSTOM METAL CANOPY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior custom metal canopy.

B. Related Sections:

1. Section 051200 "Structural Steel Framing."
2. Section 053100 "Steel Decking."
3. Section 075423 "Polyvinyl-Chloride (PVC) Roofing" for canopy roofing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include finishing materials.

B. Shop Drawings: Show fabrication and installation details for custom metal canopy.

1. Include plans, elevations, component details, and attachments to other work.
2. Indicate materials and profiles of custom canopy, fittings, joinery, finishes, fasteners, anchorages, and accessory items.

C. Samples: For each type of exposed finish required, prepared on 6-inch square Samples of metal of same thickness and material indicated for the Work.

D. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified fabricator and professional engineer.

B. Welding certificates.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm with a minimum of three years experience in producing custom fabricated metal similar to that indicated for this Project, a minimum of two projects of similar size and complexity, and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. Installer Qualifications: Fabricator of products.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Preinstallation Conference: Conduct conference at Project site.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls, columns, beams, and other construction contiguous with custom metal canopy by field measurements before fabrication and indicate measurements on Shop Drawings.

1.6 COORDINATION

A. Coordinate installation of anchorages for custom metal canopy. 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 custom metal canopy with adjacent construction to ensure that wall assemblies, flashings, trim, and joint sealants, are protected against damage from the effects of weather, age, corrosion, and other causes.

1.7 WARRANTY

A. Special Warranty on Aluminum Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal wall panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design exterior custom canopy, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1. Professional engineer shall be legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated.

B. Structural Performance: Custom metal canopy, including anchors and connections, shall withstand the effects of gravity loads and the following loads and stresses without exceeding the allowable design working stress of materials involved and without exhibiting permanent deformation in any components:

1. Wind, Live and Snow Loads on Exterior Items: As indicated on Structural Drawings.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

2.2 MATERIALS

A. General: Provide sheet metal without pitting, seam marks, roller marks, stains, discolorations, or other imperfections where exposed to view on finished units.

B. Aluminum Sheet: Coil-coated sheet, ASTM B209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

1. Surface: Smooth, flat finish.
2. Thickness: 0.040 inch.

C. Bars: Hot-rolled, carbon steel complying with ASTM A 29/A 29M, Grade 1010.

D. Plates, Shapes, and Bars: ASTM A 36/A 36M.

E. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.

F. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.

G. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M unless otherwise indicated.

2.3 EXTERIOR CANOPIES

A. Soffit, Fascia and Coping Material: Aluminum sheet.

1. Panel Coverage: As indicated on Drawings.
2. Reveal Width: 1 inch.
3. Panel Height: 1 inch.
4. Color: As selected by Architect from manufacturer's full range.

B. Structural Framing and Decking: Galvanized steel, in configurations and sizes as indicated on Drawings.

1. Shop Finish of Exposed Framing and Decking: Comply with Section 099600 "High-Performance Coatings" for shop-applied coatings.

C. Roofing: Refer to Section 075423 "Polyvinyl-Chloride (PVC) Roofing."

D. Gutters and Downspouts:

1. Built-in Gutters: Fabricate to cross section required, with riveted and soldered joints, complete with end pieces, outlet tubes, and other special accessories as required. Fabricate in minimum 96-inch- long sections. Fabricate expansion joints and accessories from same metal as gutters unless otherwise indicated. Fabricate gutters with built-in expansion joints and gutter-end expansion joints at walls.

a. Fabricate from aluminum, 0.032 inch thick.
b. Finish: Two coat fluoropolymer.
c. Color: As selected by Architect from manufacturer's full range.

2. Downspouts: Fabricate downspouts to dimensions indicated, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors.

a. Style: Rectangular.
b. Fabricate from aluminum, 0.024 inch thick.
c. Finish: Two coat fluoropolymer.
d. Color: As selected by Architect from manufacturer's full range.

2.4 MISCELLANEOUS MATERIALS

A. Gaskets: As required to seal joints in custom metal canopy and remain weathertight; as recommended in writing by manufacturer.

1. ASTM D 1056, Type 1, Class A, grade as recommended by gasket manufacturer to obtain seal for application indicated.
2. Closed-cell polyurethane foam, adhesive on two sides, release paper protected.

B. Sealants, Exterior: ASTM C 920; elastomeric silicone sealant; of type, grade, class, and use classifications required to seal joints in custom metal canopy and remain weathertight; and as recommended in writing by custom metal canopy manufacturer.

C. Filler Metal and Electrodes: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded or brazed and as necessary for strength, corrosion resistance, and compatibility in fabricated items.

1. Use filler metals that will match the color of metal being joined and will not cause discoloration.

D. Fasteners: Fabricated from same basic metal and alloy as fastened metal unless otherwise indicated. Do not use metals that are incompatible with materials joined.

1. Provide concealed fasteners for interconnecting custom fabricated metal items and for attaching them to other work unless otherwise indicated.
2. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

E. Structural Anchors: For applications indicated to comply with certain design loads, provide torque-controlled expansion anchors with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

F. Nonstructural Anchors: For applications not indicated to comply with design loads, provide powder-actuated fasteners, metal expansion sleeve anchors, or metal-impact expansion anchors of type, size, and material necessary for type of load and installation indicated, as recommended by manufacturer, unless otherwise indicated.

G. Anchor Materials: Alloy Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

H. Isolation Coating: Manufacturer's standard system.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble custom metal canopy in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Coordinate dimensions and attachment methods of custom metal canopy with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.

C. Form metal to profiles indicated, in maximum lengths to minimize joints. Produce flat, flush surfaces without cracking or grain separation at bends. Fold back exposed edges of unsupported sheet metal to form a 1/2-inch wide hem on the concealed side, or ease edges to a radius of approximately 1/32 inch and support with concealed stiffeners.

D. Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide surface flatness equivalent to stretcher-leveled standard of flatness and sufficient strength for indicated use.

1. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.

E. Build in straps, plates, and brackets as needed to support and anchor fabricated items to adjoining construction. Reinforce custom metal canopy as needed to attach and support other construction.

F. Provide support framing, mounting and attachment clips, splice sleeves, fasteners, and accessories needed to install custom metal canopy.

G. Where welding or brazing is indicated, weld or braze joints and seams continuously. Grind, fill, and dress to produce smooth, flush, exposed surfaces in which joints are not visible after finishing is completed.

1. Use welding and brazing procedures that will blend with and not cause discoloration of metal being joined.

2.6 PAINTS AND COATINGS

A. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

B. Shop Primers: Comply with Division 09 painting Sections.

2.7 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Complete mechanical finishes of flat sheet metal surfaces before fabrication where possible. After fabrication, finish all joints, bends, abrasions, and other surface blemishes to match sheet finish.

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 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) and Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."

C. Shop Priming: 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: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

D. Painting: Comply with Section 099600 "High-Performance Coatings."

2.9 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Exposed Coil-Coated Finishes:

1. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

C. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of custom metal canopy.

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

3.2 INSTALLATION

A. Install canopy level and plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required to install custom metal canopy.

1. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where needed to protect metal surfaces and to make a weathertight connection.

C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.

D. Install concealed gaskets, joint fillers, insulation, sealants, and flashings, as the Work progresses, to make exterior custom metal canopy weatherproof.

E. Corrosion Protection: Apply bituminous paint or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.

F. Built-in Gutters:

1. Join sections with riveted and soldered joints or joints sealed with sealant.
2. Provide for thermal expansion.
3. Slope to downspouts.
4. Provide end closures and seal watertight with sealant.
5. Install roofing membrane in built-in gutter trough and extend to drip edge. Lap ends minimum of 4 inches.
6. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 18 inches apart.
7. Install gutter with expansion joints not exceeding 50 feet apart. Install expansion-joint caps.

G. Downspouts:

1. Join sections with 1-1/2-inch telescoping joints.
2. Provide hangers with fasteners designed to hold downspouts securely to walls.
3. Locate hangers at top and bottom and at approximately 60 inches o.c.
4. Connect downspouts to underground drainage system.

3.3 ADJUSTING AND CLEANING

A. Unless otherwise indicated, clean metals by washing thoroughly with clean water and soap, rinsing with clean water, and drying with soft cloths.

B. 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 dry film thickness.

C. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

3.4 PROTECTION

A. Protect finishes from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

END OF SECTION 057500

SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood blocking, cants, and nailers.
2. Plywood backing panels.

1.2 DEFINITIONS

A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.

B. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NLGA: National Lumber Grades Authority.
3. SPIB: The Southern Pine Inspection Bureau.
4. WCLIB: West Coast Lumber Inspection Bureau.
5. WWPA: Western Wood Products Association.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
4. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:

1. Preservative-treated wood.
2. Fire-retardant-treated wood.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers between each bundle to provide air circulation.

B. Lumber shall be stored off of the ground.

C. Provide for air circulation around stacks and under coverings with breathable tarps.

D. Deliver interior wood materials that are to be exposed to view only after building is enclosed and weatherproof, wet work other than painting is dry, and HVAC system is operating and maintaining temperature and humidity at occupancy levels.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. 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.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
3. Use Categories:

    a. AWPA U1-UC1: Interior, dry applications, such as furniture, some millwork.
    b. AWPA U1-UC2: Interior, potentially damp applications, such as beams, timbers, flooring, framing, millwork, sill plates.
    c. AWPA U1-UC3A: Exterior, coated not in contact with ground, such as coated millwork, siding, trim.
    d. AWPA U1-UC4A: Exterior, in contact with ground normal, such as fence/deck posts.
    e. AWPA U1-UC5B: Exposed to salt water between NJ and Georgia/south of San Francisco

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, blocking, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, blocking, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Comply with performance requirements in AWPA C20 (lumber) and AWPA C27 (plywood).

1. Use treatment that does not promote corrosion of metal fasteners.
2. Exterior: Use type for exterior locations and where indicated.
3. Interior: Use Type A, High Temperature (HT) for enclosed roof framing and where indicated.
4. Interior: Use Type A, unless otherwise indicated.

B. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.

C. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.

D. Application: Treat all interior and concealed wood blocking in and attached to rated walls and miscellaneous carpentry, unless otherwise indicated.

2.4 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including blocking, nailers, and cants.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 19 percent maximum moisture content of any species.

C. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:

1. Spruce-pine-fir (south) or spruce-pine-fir, Construction or 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
2. Eastern softwoods, No. 2 Common grade; NELMA.

D. For blocking not used for attachment of other construction Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.5 PLYWOOD BACKING PANELS

A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness and fire-retardant treated per AWPA C27.

1. Use treatment that does not promote corrosion of metal fasteners.
2. Use Interior Type A, unless otherwise indicated.
3. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 316 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Wood Screws: ASME B18.6.1.

D. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

E. Lag Bolts: ASME B18.2.1.

F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Do not splice structural members between supports, unless otherwise indicated.

C. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated.

D. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

E. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

F. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

G. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight

connections between members. Install fasteners without splitting wood; do not countersink nail heads, unless otherwise indicated.

3.2 WOOD BLOCKING AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

1. Do not use wood blocking in fire-resistance-rated assemblies.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

3.3 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061053

SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall sheathing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory."

1.4 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WALL SHEATHING

A. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.

1. Product: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corporation; GlasRoc
b. G-P Gypsum Corporation; DensGlass Gold
c. Lafarge North America; Weather Defense Platinum
d. National Gypsum; eXP Sheathing
e. United States Gypsum; Securock

2. Type and Thickness: Type X, 5/8 inch thick.
3. Size: 48 by 96 inches.

2.2 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

1. For gypsum wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing board to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

1. For steel framing less than 0.0329-inch-thick, attach sheathing to comply with ASTM C 1002.
2. For steel framing from 0.033 to 0.112-inch-thick, attach sheathing to comply with ASTM C 954.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."

D. Coordinate wall sheathing installation with flashing and joint-treatment installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.

1. Fasten gypsum sheathing to cold-formed metal framing with screws.
2. Install boards with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
3. Install boards with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing boards but do not cut into facing.

C. 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 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.

3.3 SHEATHING JOINT-AND-PENETRATION TREATMENT

A. Refer to Section 072726 "Fluid-Applied Membrane Air Barriers" for joint and penetration treatment.

3.4 FLEXIBLE FLASHING INSTALLATION

A. Apply flexible flashing in accordance with Section 072726 "Fluid Applied Membrane Air Barriers" and manufacturer’s written instructions.

END OF SECTION 061600

SECTION 071326 - SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Modified bituminous sheet waterproofing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.

B. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field quality-control reports.

C. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

B. Mockups: Build mockups to verify selections made under Sample submittals and to set quality standards for installation.

1. Build for each typical waterproofing installation including accessories to demonstrate surface preparation, crack and joint treatment, corner treatment, and protection.

a. Size: 100 sq. ft. in area.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.

1. Do not apply waterproofing in snow, rain, fog, or mist.

B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer's standard materials-only warranty in which manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Source Limitations for Waterproofing System: Obtain waterproofing materials from single source from single manufacturer. Provide auxiliary materials as recommended by waterproofing manufacturer.

2.2 MODIFIED BITUMINOUS SHEET WATERPROOFING

A. Modified Bituminous Sheet: Minimum 60-mil nominal thickness, self-adhering sheet consisting of 56 mils of rubberized asphalt laminated on one side to a 4-mil-thick, polyethylene-film reinforcement, and with release liner on adhesive side.

1. Products: Subject to compliance with requirements, provide one of the following:

a. American Hydrotech, Inc.; VM75
b. Carlisle Coatings & Waterproofing Inc; CCW MiraDRI 860/861
c. CETCO, a Minerals Technologies company; Envirosheet
d. GCP Applied Technologies.; Bituthene 3000
e. Henry Company; Blueskin WP 200
f. Mar-Flex; ArmorSheet 600/601
g. Soprema; Colphene 3000
h. Tamko; TW-60
i. W. R. Meadows, Inc; Mel-Rol

2. Physical Properties:

a. Tensile Strength, Membrane: 250 psi minimum; ASTM D 412, Die C, modified.
b. Ultimate Elongation: 300 percent minimum; ASTM D 412, Die C, modified.
c. Low-Temperature Flexibility: Pass at minus 20 deg F; ASTM D 1970.
d. Crack Cycling: Unaffected after 100 cycles of 1/8-inch movement; ASTM C 836.
e. Puncture Resistance: 50 lbf minimum; ASTM E 154.
f. Water Absorption: 0.2 percent weight-gain maximum after 48-hour immersion at 70 deg F; ASTM D 570.
g. Water Vapor Permeance: 0.05 perms maximum; ASTM E 96/E 96M, Water Method.

h. Hydrostatic-Head Resistance: 150 feet minimum; ASTM D 5385.

2.3 AUXILIARY MATERIALS

A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.

1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.

B. Primer: Liquid waterborne or solvent-borne primer recommended for substrate by sheet-waterproofing material manufacturer.

C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by sheet-waterproofing material manufacturer.

D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, of trowel grade or low viscosity.

E. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating.

F. Sheet Strips: Self-adhering, rubberized-asphalt strips of same material and thickness as sheet waterproofing.

G. Mastic, Adhesives, and Tape: Liquid mastic and adhesives, and adhesive tapes recommended by waterproofing manufacturer.

1. Detail Tape: Two-sided, pressure-sensitive, self-adhering reinforced tape, 4-1/2 inches wide, with a tack-free protective adhesive coating on one side and release film on self-adhering side.
2. Detail Strips: 62.5-mil thick, felt-reinforced self-adhesive strip, 9 inches wide, with release film on adhesive side.

H. Metal Termination Bars: Stainless steel bars, approximately 1 by 1/8 inch thick, predrilled at 6-inch centers. Provide stainless-steel fasteners.

I. Protection Board: Unfaced, extruded-polystyrene board insulation, nominal thickness 2 inches with compressive strength of not less than 25 psi per ASTM D 1621.

J. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Manufactured composite subsurface drainage panels consisting of a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 sieve laminated to one side with a polymeric film bonded to the other side of a studded, nonbiodegradable, molded-plastic-sheet drainage core, with a vertical flow rate of 9 to 15 gpm per ft.

1. Product: Subject to compliance with requirements, provide one of the following:

a. American Wick Drain; Amerdrain
b. Carlisle Coatings & Waterproofing; Miradrain 6200
c. Hydraway Drainage Systems; Hydraway 2000

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the waterproofing.

1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D 4263.

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

3.2 SURFACE PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.

E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.

1. Install sheet strips of width according to manufacturer's written instructions and center over treated construction and contraction joints and cracks exceeding a width of 1/16 inch.

F. Bridge and cover isolation joints, expansion joints, and discontinuous deck-to-wall and deck-to-deck joints with overlapping sheet strips of widths according to manufacturer's written instructions.

1. Invert and loosely lay first sheet strip over center of joint. Firmly adhere second sheet strip to first and overlap to substrate.

G. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.

1. Install membrane strips centered over vertical inside corners. Install 3/4-inch fillets of liquid membrane on horizontal inside corners and as follows:

a. At footing-to-wall intersections, extend liquid membrane in each direction from corner or install membrane strip centered over corner.

H. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to ASTM D 6135.

3.3 MODIFIED BITUMINOUS SHEET-WATERPROOFING APPLICATION

A. Install modified bituminous sheets according to waterproofing manufacturer's written instructions and recommendations in ASTM D 6135.

B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.

C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch-minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.

1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F.

D. Application: Apply sheets from low to high points to ensure that laps shed water.

E. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.

F. Seal edges of sheet-waterproofing terminations with mastic.

G. Install sheet-waterproofing and auxiliary materials to tie into adjacent waterproofing.

H. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches beyond repaired areas in all directions.

I. Immediately install protection course with butted joints over waterproofing membrane.

J. Molded-Sheet Drainage Panel: Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesives or other methods that do not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

1. For vertical applications, install protection course before installing drainage panels.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components; and to furnish daily reports to Architect.

3.5 PROTECTION, REPAIR, AND CLEANING

A. Protect waterproofing from damage and wear during remainder of construction period.

B. Protect installed protection board from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

C. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

D. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 071326

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Foam-plastic board insulation.
2. Glass-fiber blanket insulation.
3. Mineral-wool blanket insulation.
4. Mineral-wool board insulation.

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

1.4 QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1. Surface-Burning Characteristics: ASTM E 84.
2. Fire-Resistance Ratings: ASTM E 119.
3. Combustion Characteristics: ASTM E 136.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 FOAM-PLASTIC BOARD INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and minimum compressive strength indicated below, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. DiversiFoam Products.
   b. Dow Chemical Company (The).
   c. Owens Corning.

2. Type IV, 25 psi, 1.6 lb./cu. ft. minimum density, unless otherwise indicated.
3. Provide manufacturer's standard shiplap or tongue and groove edges on vertical applications below grade and over exterior sheathing on metal stud cavity wall assembly.
4. Thickness: As indicated on Drawings or as required to meet R-value indicated on Drawings.
5. Thermal Resistance, per ASTM C518, at 75 deg. F mean temperature shall be R-5 per inch.

2.2 GLASS-FIBER BLANKET INSULATION

A. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. CertainTeed Corporation.
   b. Johns Manville.
   c. Knauf Insulation.
   d. Owens Corning.

2. Free of Formaldehyde: Provide fiber-glass blanket insulation manufactured with 100 percent acrylic binders and no formaldehyde.

2.3 MINERAL-WOOL BLANKET INSULATION

A. Unfaced, Mineral-Wool Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Fibrex Insulations Inc.
   b. Owens Corning.
   c. Roxul Inc.
   d. Thermafiber.

2.4 MINERAL-WOOL BOARD INSULATION

A. Mineral-Wool Board, Types IA and IB, Unfaced: ASTM C 612, Types IA and IB; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics. Nominal density of 4.5 lb/cu. ft.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:

    a. Fibrex Insulation Inc.
    b. Owens Corning.
    c. Roxul Inc.
    d. Thermafiber

2.5 INSULATION FASTENERS

A. Fasteners: Product recommended and approved by insulation manufacturer, with demonstrated capability to secure insulation to substrates indicated without damaging insulation and substrates and complying with other listed performance characteristics.

B. Mastic Sealer: Type recommended by insulation manufacturer for bonding edge joints between units and filling voids in work.

2.6 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Spray Polyurethane Foam Insulation: ASTM C 1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

B. Adhesive for Bonding Insulation: Product recommended and approved by manufacturer, with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.3 INSTALLATION OF SLAB INSULATION

A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.

1. If not otherwise indicated, extend insulation a minimum of 36 inches below exterior grade line.

B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

1. If not otherwise indicated, extend insulation a minimum of 24 inches in from exterior walls.

3.4 INSTALLATION OF CAVITY-WALL INSULATION

A. Board Insulation: Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face, and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.

1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042613 "Masonry Veneer."

3.5 INSTALLATION OF BLANKET INSULATION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

C. Head-of-Wall Joints in Non-Rated Walls and Miscellaneous Voids:

1. Install insulation in miscellaneous voids, head-of-wall joints in non-rated walls, and cavity spaces where required to prevent gaps in insulation using the following materials:

a. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

2. Refer to Section 078446 "Fire-Resistive Joint System" for head-of-wall sealant in rated walls.

3.6 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 072726 - FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fluid-applied membrane air barrier, vapor permeable.

1.2 DEFINITIONS

A. ABAA: Air Barrier Association of America.

B. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

C. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

D. Air Barrier Assembly: The collection of air barrier materials and auxiliary materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.3 PERFORMANCE REQUIREMENTS

A. General: Air barrier shall be capable of performing as a continuous vapor-permeable air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air barrier meets ABAA performance for vapor-permeable air barrier assemblies.

C. Air Barrier Assembly Air Leakage: Not to exceed 0.01 cfm x sq. ft. of surface area at 1.57 lbf/sq. ft.; ASTM E 283.

D. Water Resistance: Material shall resist 22 inches water for 5 hours before and after aging when tested per AATCC 127.

E. Nail Seal-Ability: Material shall allow no water found on nail shanks, on underside of sheathing and/or between sheathing and product coating when tested per ASTM D 1970.

F. Flammability: Material shall allow a flame spread of less than 25 and smoke development of less than 450 when tested per ASTM E 84.

G. Adhesion: Material shall exhibit a minimum adhesion of 16 psi when tested per ASTM D 4541.

H. Compatibility: Material shall be compatible with adjacent materials.

I. UV Stability: Material shall survive a minimum of six months UV exposure during construction.

J. System Continuity: Material Manufacturer shall provide materials/system for an interface with windows, door and other penetrations that integrate into a compatible and continuous air barrier assembly.

1.4 ACTION SUBMITTALS

A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of air barrier.

B. Shop Drawings: Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strip, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.

1. Include details of interfaces with other materials that form part of air barrier.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For air barriers, certifying compatibility of air barrier and accessory materials with Project materials that connect to or that come in contact with the barrier; signed by product manufacturer.

B. Qualification Data: For Installer.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for air barriers.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm with three to five years experience in applying air barrier materials similar in material, design, complexity, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

B. Manufacturer’s Technical Representative Qualifications: An authorized full-time employee representative of manufacturer experienced in the installation and maintenance of the specified system and qualified to determine Installer’s compliance with the requirements of this Project.

C. Source Limitations: Obtain each type of air barrier material, fluid-applied and sheet membrane, through one source from a single manufacturer.

D. Installer Limitations: Each type of air barrier material, fluid-applied and sheet membrane, shall be installed by a single installation firm.

E. All associated products used in conjunction with air barrier membranes and forming an integral part of the waterproofing system must meet the approval of the air barrier manufacturer and maintain applicable warranties.

F. Mockups: Before beginning installation of air barrier, build mockups of exterior wall assembly, incorporating backup wall construction, external cladding, window, door frame and sill, insulation, and flashing to demonstrate surface preparation, crack and joint treatment, and sealing of gaps, penetration and barrier flashings, terminations, and penetrations of air barrier membrane.

1. Mockup can be a designated area of the actual wall construction or a freestanding wall assembly mockup panel.
2. Coordinate construction of mockup to permit inspection by Owner's testing agency of air barrier before external insulation and cladding is installed.
3. Include junction with roofing membrane, building corner condition, and foundation wall intersection.
4. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.

5. If designated area of the actual wall construction is used as a mockup, the approved mockups may become part of the completed Work if undisturbed at time of Final Acceptance.

G. Preinstallation Conference: Conduct conference at Project site.

1. Include Owner, Architect, Installer, Manufacturer's technical representative, and installers of other construction affecting or connecting to air barrier, including roofing, waterproofing, architectural precast concrete, masonry, sealants, windows, glazed curtain walls, and door frames.
2. Review air barrier requirements including surface preparation, substrate condition and pretreatment, minimum substrate curing period, forecasted weather conditions, special details and sheet flashings, mockups, installation procedures, sequence of installation, testing and inspecting procedures, and protection and repairs.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in their original undamaged packages, with labels intact and legible.

B. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air barrier manufacturer.

C. Remove and replace liquid materials that cannot be applied within their stated shelf life.

D. Store materials according to manufacturer's written instructions.

E. Protect stored materials from direct sunlight.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air barrier manufacturer. Protect substrates from environmental conditions that affect performance of air barrier. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

1. Apply materials when ambient temperature is above minimum temperature recommended by the manufacturer for a period of 24 hours prior to the application and when air temperature during the cure period is expected to remain above minimum temperature recommended by the manufacturer.

B. Product selection shall be coordinated with construction sequence to ensure that manufacturer's exposure limits are adequate for anticipated schedule. Air barrier membrane exposed beyond the manufacturer's exposure limits shall be recoated, reinspected and reapproved at Contractor's own expense.

PART 2 - PRODUCTS

2.1 FLUID-APPLIED MEMBRANE AIR BARRIER

A. High-Build, Vapor-Permeable Membrane Air Barrier: Synthetic polymer membrane with an installed dry film thickness, according to manufacturer's written instructions to meet physical and performance properties indicated, of 35 milsor thicker over smooth, void-free substrates.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Carlisle Coatings & Waterproofing; Barritech VP
b. GCP Applied Technologies; Perm-A-Barrier VP
c. Henry Company; Air Bloc 17MR
d. Meadows, W.R.; Air Shield LMP

e. Soprema; SopraSeal LM 204 VP
f. Sto Corporation; AirSeal
g. Tremco Incorporated; ExoAir 230

2. Physical and Performance Properties:

a. Membrane Air Permeance: Not to exceed 0.004 cfm/ sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
b. Membrane Vapor Permeance: Not less than 10.5 perms; ASTM E 96.

2.2 AUXILIARY MATERIALS

A. General: Auxiliary materials recommended by air barrier manufacturer for intended use and compatible with air barrier membrane. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

B. Primer: Liquid waterborne primer recommended for substrate by manufacturer of air barrier material.

C. Barrier Flashing: Vapor-retarding, 40-mil- thick, smooth-surfaced, self-adhering; consisting of 36 mils of rubberized asphalt laminated to a 4-mil- thick polyethylene film with release liner backing.

D. Elastomeric Flashing Sheet: ASTM D 2000, 2BC415 to 3BC620, minimum 50- to 65-mil- thick, cured sheet neoprene with manufacturer's recommended contact adhesives and lap sealant with stainless-steel termination bars and fasteners.

E. Counterflashing and Transition Strip: Modified bituminous, 40-mil- thick, self-adhering sheet consisting of 32 mils of rubberized asphalt laminated to an 8-mil- thick, crosslaminated polyethylene film with release liner backing.

F. Joint Reinforcing Strip: Air barrier manufacturer's glass-fiber-mesh tape.

G. Substrate Patching Membrane: Manufacturer's standard trowel-grade substrate filler.

H. Adhesive and Tape: Air barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.

I. Termination Mastic: Air-barrier manufacturer's standard cold fluid-applied elastomeric liquid; trowel grade.

J. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0187 inch thick, and Series 300 stainless-steel fasteners.

K. Sprayed Polyurethane Foam Sealant: 1- or 2-component, foamed-in-place, polyurethane foam sealant, 1.5 to 2.0 lb/cu. ft density; flame spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.

L. Preformed Silicone-Sealant Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.

M. Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low-modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer and Manufacturer's Technical Representative present, for compliance with requirements and other conditions affecting performance.

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that concrete has cured and aged for minimum time period recommended by air barrier manufacturer.
3. Verify that concrete is visibly dry and free of moisture. Test concrete substrates for moisture using method as recommended in writing by air barrier manufacturer.
4. Verify that masonry joints are flush and completely filled with mortar.
5. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate patching membrane.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.3 JOINT TREATMENT

A. Gypsum Sheathing: Fill joints greater than 1/4 inch with sealant according to ASTM C 1193 and with air barrier manufacturer's written instructions. Apply first layer of fluid air barrier membrane at joints. Tape joints with joint reinforcing strip after first layer is dry. Apply a second layer of fluid air barrier membrane over joint reinforcing strip.

3.4 FLASHING INSTALLATION

A. Install flashings and auxiliary materials according to air barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.

1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
2. Protect air barrier from contact with creosote, uncured coal-tar products, TPO, EPDM, PVC membranes, and sealants not approved by air barrier manufacturer.

B. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by air barrier sheet in same day. Reprime areas exposed for more than 24 hours.

1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

C. Penetration Flashing: Apply penetration flashing at all openings and penetrations so that a minimum of 3 inches of coverage is achieved over both substrates.

D. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air barrier membrane with foam sealant.

E. Barrier Flashing: Apply barrier flashing to connect and seal exterior wall air barrier membrane continuously to perimeter frame surfaces of windows, curtain walls, storefronts, doors, and miscellaneous penetrations.

F. Install transition strip, of compatible material, over roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over both substrates.

G. Apply joint sealants forming part of air barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

H. Seal flashings around masonry reinforcing or ties and penetrations with termination mastic.

I. Seal top of through-wall flashings to air barrier with an additional 6-inch wide, counterflashing strip.

J. Seal exposed edges of flashings at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

K. Repair punctures, voids, and deficient lapped seams in flashings. Slit and flatten fishmouths and blisters. Patch with flashings extending 6 inches beyond repaired areas in strip direction.

L. At end of each working day, seal top edge of flashings to substrate with termination mastic.

3.5 AIR BARRIER MEMBRANE INSTALLATION

A. Begin application in presence of, and after the Manufacturer’s Technical Representative has approved mockup. Commencement of application constitutes Contractor’s acceptance of substrates and conditions.

B. Apply air barrier membrane to form a seal with flashings and to achieve a continuous air barrier according to air barrier manufacturer's written instructions.

C. Apply air barrier membrane within manufacturer's recommended application temperature ranges.

D. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by air barrier sheet in same day. Reprime areas exposed for more than 24 hours.

1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

E. Apply a continuous unbroken air barrier to substrates according to the following minimum thickness. Apply membrane in full contact around protrusions such as masonry ties.

1. Vapor-Permeable, High-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, but not less than 35 mils, applied in one or more equal coats.

    a. Thin mil product will not be acceptable.

F. Apply flashings over cured air barrier membrane overlapping 3 inches onto each surface according to air barrier manufacturer's written instructions.

G. Do not cover air barrier until it has been inspected by Owner's testing agency.

H. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air barrier components.

3.6 FIELD QUALITY CONTROL

A. Contractor/Installer Testing: Installer shall have a wet film thickness gauge at all times during application and shall periodically check thickness of membrane during application with wet film thickness gauge.

B. Manufacturer’s Technical Representative: Contractor will engage a qualified Manufacturer’s Technical Representative for a minimum of two full-time days to perform on-site inspections and prepare reports.

1. Manufacturer’s representative shall conduct inspections at start of installation, twenty-five percent complete, fifty percent complete and final, with reports to Architect. Deficiencies shall be listed on the inspection reports and repairs/corrections certified completed with next or final report.

C. Inspections: Air barrier materials and installation are subject to inspection for compliance with requirements. Inspections may include the following:

1. Continuity of air barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Continuous structural support of air barrier system has been provided.
3. Masonry and concrete surfaces are smooth, clean and free of cavities, protrusions, and mortar droppings.
4. Site conditions for application temperature and dryness of substrates have been maintained.
5. Maximum exposure time of materials to UV deterioration has not been exceeded.
6. Surfaces have been primed, if applicable.
7. Laps in flashings have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
8. Termination mastic has been applied on cut edges.
9. Flashings have been firmly adhered to substrate.
10. Compatible materials have been used.
11. Transitions at changes in direction and structural support at gaps have been provided.
12. Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, preparation and priming of surfaces, structural support, integrity, and continuity of seal.
13. All penetrations have been sealed.

D. Remove and replace deficient air barrier components and reinspect as specified above.

3.7 CLEANING AND PROTECTION

A. Protect air barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Remove and replace air barrier showing signs of deterioration or when left exposed beyond manufacturer's approved exposure limitation.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.

C. Remove masking materials after air barrier installation is complete.

END OF SECTION 072726

SECTION 075423 - POLYVINYL-CHLORIDE (PVC) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Mechanically fastened PVC membrane roofing system.
2. Roof insulation.

1.2 ACTION SUBMITTALS

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

B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.

1. Base flashings and membrane terminations.
2. Tapered insulation, including slopes.
3. Roof plan showing orientation of steel roof deck and orientation of membrane roofing and fastening spacings and patterns for mechanically fastened membrane roofing.
4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
5. Indicate roof design of fasteners and specifications to meet wind force loads indicated on the Structural Drawings and in the building code.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: Submit name and qualification data for qualified roofing Installer and membrane manufacturer, indicating full compliance with specification requirements. Architect and Owner reserve the right to reject roof Installer and/or membrane manufacturer if documentation of full compliance with specifications is not provided.

1. Submit certificate from manufacturer certifying that Installer has been trained by the manufacturer and is an authorized/certified installer of the specific roof membrane proposed for this Project.
2. The Installer through the Contractor shall submit references, stating satisfactory performance of installation, from five different Architects or Owners for projects that the Installer has completed and have been in service for a minimum of two years. Include complete contact information, also completion date, size and location of project.

B. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

1. Submit evidence of compliance with performance requirements.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of membrane roofing system.

D. Research/Evaluation Reports: Evidence of roofing system's compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

E. Inspection Report: Copy of roofing system manufacturer's inspection report with written approval as to specification compliance and acceptance of completed roofing system installation.

F. Field quality-control reports.

G. Warranties: Sample of special warranties.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that has FM, Miami Dade or Florida Building Code Approvals approved for membrane roofing system identical to that used for this Project.

1. A manufacturing firm that has specialized in the manufacture of membrane roofing of the type specified for at least 10 years.
2. The manufacturer shall provide all materials marketed and labeled by a single source for a complete system; sheet goods, weldable flashings, coated metals, corrosion resistant fastenings, sealants, adhesives, primers, seam caulk, and all other components which may be required for this roof to receive a 20 year warranty.
3. Manufacturer shall provide the technical inspection such that manufacturer's intent and contractor's efforts remain coordinated.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1. The installer shall demonstrate and offer written attested certification that he has installed; a minimum of 500 squares (50,000 sq. ft.) per year for each of the past three years, of the material that he is bidding.
    a. Installation of other types of membranes, or another manufacturer's goods is not considered as meeting the above requirement.
    b. Installer shall have been in business under its present name for at least 5 years prior to start of this project.
2. The installer shall substantiate a track record of the manufacturer's working with the installer, for three consecutive years, and at a scale of operations cited above.
3. The Crew Chief/Foreman, shall be physically on-site, directly supervising the Work, during the entire period of installation of roof membrane.
    a. Crew Chief/Forman shall be trained and certified by the roofing system manufacturer and shall have on their person an identification card, certifying completion of training and approval of the manufacturer for the roofing system being installed. The installer shall have been actively installing the type of roofing system defined in these specifications for a minimum of 3 years.
    b. Quality Incident Rate: Less than 5.0.

C. Source Limitations: Obtain components, including adhesives, for membrane roofing system from same manufacturer as membrane roofing.

1. The roofing system specified herein shall be the warranted system/product of a single manufacturer.
2. The incorporation of products not specifically by the roofing manufacturer shall be recommended and approved by the roofing manufacturer and shall be included within the roofing system warranty.
3. Pre-manufactured roof curbs may carry their own warranty but the flashing of these curbs into the roofing system shall be included in the roofing system warranty.

D. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening and wind uplift.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

E. Roofing Inspections: Make required notifications, secure required inspections and pay fees such that the specified systems warranty are assured at the time of completion of the Work.

1. Contractor and Manufacturer's assigned representative shall inspect and warrant the Work as a condition of acceptance.
2. Manufacturer shall provide project start-up guidance and direction at start of installation and then provide inspections by manufacturer's technical inspector at 25 percent, 50 percent and final, with inspection reports submitted to the Roofing Installer, General Contractor and Architect/Owner. Deficiencies shall be listed on the inspection reports and all repairs/corrections made and certified completed and approved by the inspector submitted with next and final report.
3. Manufacturer's Final Completion/Warranty Inspection: Upon completion of the Work and prior to final payment, the roofing manufacturer's representative, in the presence of the Owner and Architect, shall inspect the roofing Work. Discrepancies shall be recorded and immediately rectified. Final payment will not be issued until the manufacturer's representative has given his certification/approval of the Work and close-out submittals, including Roofing Warranties and roof maintenance instructions, have been received by the Architect. Warranties issued prior to final inspection are not acceptable and shall not qualify for release of final payment for roofing work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.7 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.8 WARRANTY

A. Warranty: Manufacturer's standard or customized weathertightness warranty form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.

1. Warranty includes membrane roofing, base flashings, roof insulation, fasteners, cover boards, roofing accessories, manufacturer's edge metal products and other components of membrane roofing system.
2. Provide manufacturer's standard wind warranty, not less than 60 mph.
3. Warranty Period: 20 years from date of Substantial Completion.
4. System Warranty: As a part of the work of this Section, pay all required fees, secure all required inspections, and do all things necessary to secure and deliver to the Owner a 20-year Total System Warranty from the manufacturer of the approved materials. The bond shall provide no dollar limit (NDL) liability when all published conditions are met.

B. Special Project Warranty: Submit roofing Installer's warranty, on form acceptable to Architect, signed by Installer, covering the Work of this Section, including all components of roofing system such as roofing, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, and walkway products, for the following warranty period:

1. Warranty Period: Two years from date of Substantial Completion.

C. Warranty Plaque: The Contractor shall provide a roof warranty plaque for mounting on the wall beside the roof access ladder/hatch. The plaque shall have a warning stating the following:

"Prior to making modifications or repairs to the existing roof, approval for modifications and repairs from the manufacturer, must be obtained. All work on existing warranted roofing system shall be performed so as to maintain existing warranties. Work that would void warranties is prohibited. Entities performing work that would void existing roof warranties shall be liable for cost to make necessary repairs required to reinstate warranties."

1. The plaque shall also contain the name of the manufacturer, serial number of warranty, date of issue of the warranty, length of warranty, and names and telephone numbers of manufacturer contacts. Include a copy of the warranty. The plaque shall be covered/protected by a clear acrylic/polycarbonate sheet screwed or otherwise attached to substrate of plaque, which shall be sealed wood, plastic or non-corrosive metal. Provide one at each access ladder/hatch or at location to be selected during construction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.

1. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
2. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.
3. Roofing system shall comply with design criteria of the North Carolina Building Code, latest edition.

    a. Design wind speed as indicated on Drawings.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.

C. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7.

1. Field-of-Roof Uplift Pressure: Refer to Structural Drawings for load requirements.
2. Perimeter Uplift Pressure: Refer to Structural Drawings for load requirements.
3. Corner Uplift Pressure: Refer to Structural Drawings for load requirements.

D. FM Global Listing: Roofing, base flashings, and component materials shall comply with requirements in FM Global 4450 or FM Global 4470 as part of a membrane roofing system, and shall be listed in FM Global's "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.

1. Hail Resistance: MH.
2. Fire/Windstorm Classification: Class 1-90.

E. Exterior Fire-Test Exposure: ASTM E 108, UL, & FM, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.

F. Fire-Resistance Ratings: Where indicated, provide fire-resistance-rated roof assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

2.2 PVC MEMBRANE ROOFING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carlisle Syntec Systems
2. Durolast
3. Flex
4. Sika Sarnafil Inc.
5. Seaman Corporation; FiberTite
6. Soprema
7. Versico

B. PVC Sheet: ASTM D4434, Type III - polyester fiber reinforced, or ASTM D6754.

1. Thickness: 60 mils, nominal for ASTM D4434 and 45 mils for ASTM D6754.
2. Exposed Face Color: White.

2.3 AUXILIARY MEMBRANE ROOFING MATERIALS

A. General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use, and compatible with membrane roofing.

1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as sheet membrane.

C. Bonding Adhesive: Manufacturer's standard, solvent or water based.

D. Slip Sheet (if required by Manufacturer): Manufacturer's standard, of thickness required for application.

E. Metal Termination Bars: Manufacturer's standard, predrilled aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

F. Metal Battens (if required by Manufacturer): Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick, prepunched.

G. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.

H. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.4 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by membrane roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated and that produce FM Approvals-approved roof insulation.

B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, felt or glass-fiber mat facer on both major surfaces.

C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches unless otherwise indicated.

D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.5 INSULATION ACCESSORIES

A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with membrane roofing.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

C. Insulation Adhesive: Provide as recommended by insulation manufacturer:

1. Modified Asphaltic Insulation Adhesive: Insulation manufacturer's recommended modified asphalt, asbestos-free, cold-applied adhesive formulated to attach roof insulation to another insulation layer.
2. Bead-Applied Insulation Adhesive: Insulation manufacturer's recommended bead-applied, low-rise, one- or multicomponent urethane adhesive formulated to attach roof insulation to another insulation layer.
3. Full-Spread Applied Insulation Adhesive: Insulation manufacturer's recommended spray-applied, low-rise, two-component urethane adhesive formulated to attach roof insulation to another insulation layer.

D. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, Type X, 1/2 inch or greater as required to meet manufacturer's wind uplift and warranty requirements, factory primed.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Georgia-Pacific Corporation; Dens Deck Prime.
b. National Gypsum; DEXcell
c. United States Gypsum; Securock.
d. Roofing membrane manufacturer's tested, approved, and warranted cover board that is equivalent to specified product.

2.6 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16-inch-thick and acceptable to roofing system manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:

1. Verify that roof openings and penetrations are in place and curbs are set and braced.
2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."

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

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.3 ROOFING INSTALLATION, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.4 INSULATION INSTALLATION

A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with membrane roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Install tapered insulation under area of roofing to conform to slopes indicated.

D. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.

E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.

1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

G. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:

1. Prime surface of concrete deck with asphalt primer at rate of 3/4 gal./100 sq. ft. and allow primer to dry.
2. Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

H. Mechanically Fastened Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.

1. Fasten insulation according to requirements in FM Approvals' "RoofNav" for specified Windstorm Resistance Classification.
2. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.

I. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction. Loosely butt cover boards together and fasten to roof deck.

1. Fasten cover boards according to requirements in FM Approvals' "RoofNav" for specified Windstorm Resistance Classification.
2. Fasten cover boards to resist uplift pressure at corners, perimeter, and field of roof.

J. Install slip sheet over cover board and immediately beneath membrane roofing if required by membrane manufacturer.

3.5 MECHANICALLY FASTENED MEMBRANE ROOFING INSTALLATION

A. Mechanically fasten membrane roofing over area to receive roofing and install according to roofing system manufacturer's written instructions.

1. Install sheet according to ASTM D 5082.
2. For in-splice attachment, install membranes roofing with long dimension perpendicular to steel roof deck flutes.

B. Start installation of membrane roofing in presence of roofing system manufacturer's technical personnel.

C. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Mechanically fasten or adhere membrane roofing securely at terminations, penetrations, and perimeter of roofing.

E. Apply membrane roofing with side laps shingled with slope of roof deck where possible.

F. In-Seam Attachment: Secure one edge of roofing membrane sheet using fastening plates or metal battens centered within membrane seam and mechanically fasten roofing membrane sheet to roof deck.

G. Seams: Clean seam areas, overlap membrane roofing, and hot-air weld side and end laps of membrane roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet membrane.
2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.

H. Spread sealant bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.

3.6 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.

B. Apply bonding adhesive per the manufacturer's application instructions. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.7 WALKWAY INSTALLATION

A. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Final Roof Inspection: Upon completion of the Work and prior to final payment, the membrane manufacturer's representative, in the presence of the Owner and Architect, shall inspect Work. Discrepancies shall be recorded and immediately rectified. Final payment will not be issued until the manufacturer's representative has given his approval for Work and closeout submittals, including roof maintenance manual and warranties, have been received by the Architect.

1. Notify Architect or Owner 48 hours in advance of the date and time of inspection.

C. Verify field strength of seams a minimum of twice daily, according to manufacturer's written instructions, and repair seam sample areas.

D. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.

E. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.9 PATCHING LIMITATIONS AND CLEANING REQUIREMENTS

A. Patching Restrictions: No more than 5 (in field) patches and no more than a total of 4 linear feet of seam patching per 100 sq. ft. of roof total sq. footage and no more than 5 patches and no seam patches exceeding a total of 4 linear feet in any 100 sq. ft. roofing area as determined by Owner. Seam patches shall be minimum 8 inches wide and 24 inches long strip patch. Manufacturer required circular seam intersection patches shall not be considered when calculating number of patches. Typical patch size shall be minimum 6 inches square with rounded corners or as recommended by the membrane manufacturer. The use of large size patches (covering multiple penetrations) to avoid exceeding the limits set forth above will not be permitted. The use of large patches in excess of 24 by 36 inches shall be justification for replacement or for providing over lay membrane.

1. Any area in excess of patching limits set fort above shall be replaced with new membrane or overlaid with a new minimum 100 sq. ft un-patched membrane. Exact location and extent of new overlay membrane shall be determined by the Owner and membrane manufacturer's recommendations.

B. Final Acceptance Inspection and Cleaning: Roof surface shall be inspected for damage, trash and waste materials (fasteners and miscellaneous other construction items.) Remove all such items, and all spilled materials per manufacturer's removal instructions. Sweep clean and wash membrane to optimum cleanliness. Hand mop and hose clean (low pressure) with environmentally friendly (green) cleaners as recommended by roof membrane manufacturer. High pressure washers are not allowed. Final payment will not be made until this work has been completed and accepted.

C. Photographic Record: Upon completion of the roofing system the installer shall photo document the entire roof area to establish completion and condition. General Contractor shall assume responsibility for subsequent damage caused by construction operations carried out on/above completed roof system.

3.10 PROTECTING AND CLEANING

A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements; repair substrates; and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Daily Cleaning: Provide daily cleaning prior to stopping roofing work each day. Cleaning shall include, but not be limited to, the following:

1. Picking up and storing all lose items,
2. Sweeping clean roof surface,
3. Removal and cleaning of all stains and spills.

D. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.11 ROOFING INSTALLER'S WARRANTY

A. WHEREAS _____ of _____, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner: <**Insert name of Owner**>.
2. Address: <**Insert address**>.
3. Building Name/Type: <**Insert information**>.
4. Address: <**Insert address**>.
5. Area of Work: <**Insert information**>.
6. Acceptance Date: _____.
7. Warranty Period: <**Insert time**>.
8. Expiration Date: _____.

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
    a. lightning;
    b. peak gust wind speed exceeding design wind speed;
    c. fire;
    d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
    e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
    f. vapor condensation on bottom of roofing; and
    g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.

4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this _____ day of _____, _____.

1. Authorized Signature: _____.
2. Name: _____.
3. Title: _____.

END OF SECTION 075423

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Formed Products:

a. Formed low-slope roof sheet metal fabrications.
b. Formed wall sheet metal fabrications.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:

1. Identification of material, thickness, weight, and finish for each item and location in Project.
2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
4. Details of termination points and assemblies, including fixed points.
5. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
6. Details of special conditions.
7. Details of connections to adjoining work.
8. Detail formed flashing and trim at a scale of not less than 1-1/2 inches per 12 inches.

C. Samples: For each type of sheet metal flashing, trim, and accessory indicated with factory-applied color finishes involving color selection.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified fabricator.

B. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing, trim, and accessories to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.
2. Review methods and procedures related to sheet metal flashing and trim.
3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
4. Review special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect sheet metal flashing.
5. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

1.7 WARRANTY

A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.

B. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required.

1. Surface: Smooth, flat.
2. Exposed Coil-Coated Finishes:

    a. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

3. Color: As selected by Architect from manufacturer's full range.
4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Atlas Roofing Corporation.
    b. Carlisle Coatings & Waterproofing, Inc.
    c. GAF Materials Corporation.
    d. GCP Applied Technologies
    e. Henry Company.
    f. InterWrap Inc.
    g. Kirsh Building Products
    h. Owens Corning
    i. RKW US, Inc.
    j. Tamko Building Products, Inc.
    k. Typar

2. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F or higher.
3. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F or lower.

B. Slip Sheet: Building paper, 3-lb/100 sq. ft. minimum, rosin sized.

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.

2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.

C. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

D. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

G. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.5 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.

1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
2. Obtain field measurements for accurate fit before shop fabrication.
3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.

B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

C. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.

D. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings or as approved by Architect.

E. Fabricate cleats and attachment devices of sizes as recommended by SMACNA's "Architectural Sheet Metal Manual" and by FMG Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

F. Seams: Fabricate nonmoving seams with flat-lock seams.

1. Tin edges to be seamed, form seams, and solder.
2. Coated Metals: Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
3. Uncoated Aluminum: Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

G. Do not use graphite pencils to mark metal surfaces.

2.6 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Base Flashing: Fabricate from 0.040-inch-thick aluminum.

B. Reglets and Counterflashing: Refer to Section 077100 "Roof Specialties" for manufactured reglets and counterflashing.

C. Flashing Receivers: Fabricate from 0.040-inch-thick aluminum.

D. Roof-Penetration Flashing: Roofing membrane manufacturer's approved system.

E. Roof-Drain Flashing: Roofing membrane manufacturer's approved system.

2.7 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Refer to Section 042613 "Masonry Veneer."

B. Opening Flashings in Frame Construction: Refer to Section 072726 "Fluid-Applied Membrane Air Barriers" for flexible flashings.

2.8 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Pipe Penetrations: Premolded rubber or roof membrane manufacturer’s recommended elastomeric type.

1. Provide stainless steel clamp ring, sealant, and fasteners as recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

3.2 UNDERLAYMENT INSTALLATION

A. General: Install underlayment as indicated on Drawings.

B. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Apply primer if required by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.

3.3 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
5. Install sealant tape where indicated.
6. Torch cutting of sheet metal flashing and trim is not permitted.
7. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.

1. Coat back side of uncoated aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of underlayment and cover with a slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.

D. Fastener Sizes: Use fasteners of sizes that will penetrate metal decking not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal joints as shown and as required for watertight construction.

1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement

each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.

2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

F. Rivets: Rivet joints in uncoated aluminum where indicated and where necessary for strength.

3.4 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

B. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.

C. Counterflashing: Refer to Section 077100 "Roof Specialties."

D. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.5 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Through-Wall Flashing: Installation of through-wall flashing is specified in Section 042613 "Masonry Veneer."

C. Opening Flashings in Frame Construction: Install flexible flashings in accordance with Section 072726 "Fluid-Applied Membrane Air Barriers."

3.6 MISCELLANEOUS FLASHING INSTALLATION

A. Pipe Penetration Flashing: Install in accordance with roofing membrane manufacturer’s written instructions.

3.7 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.8 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.

E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

SECTION 077100 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copings.
2. Reglets and counterflashings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof specialties. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work. Include the following:

1. Details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.
2. Pattern of seams and layout of fasteners, cleats, clips, and other attachments.
3. Details of termination points and assemblies, including fixed points.
4. Details of special conditions.

C. Samples: For each type of roof specialty indicated with factory-applied color finishes.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for copings and roof-edge flashings.

B. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical roof edge, approximately 10 feet long, including supporting construction, seams, attachments, and accessories.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

B. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects roof specialties including installers of roofing materials and accessories.
2. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
3. Review special roof details and condition of other construction that will affect roof specialties.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.

B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof specialties installation.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of construction contiguous with copings and roof-edge flashings by field measurements before fabrication.

1.7 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Roof specialties shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. Except as otherwise shown on Drawings or specified, the workmanship of sheet metal work, method for forming joints, anchoring, cleating and provisions for expansion shall conform to the standard details and recommendations of the Copper and Brass Research Association; and workmanship shall be of the best quality, in accordance with best trade practice and the recommendations and specifications of the Sheet Metal and Air Conditioning Contractors National Association, Inc.

C. FM Approvals' Listing: Manufacture and install copings and roof-edge flashings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with FM Approvals' markings.

D. SPRI Wind Design Standard: Manufacture and install copings and roof-edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressures:

1. Design Pressure: As indicated on Drawings.

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 EXPOSED METALS

A. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.

1. Surface: Smooth, flat finish.
2. Exposed Coil-Coated Finishes: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

a. Two-Coat Fluoropolymer: AAMA 620. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.

2.3 CONCEALED METALS

A. Aluminum Sheet: ASTM B 209, alloy and temper recommended by manufacturer for type of use and structural performance indicated, mill finished.

B. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by manufacturer for type of use and structural performance indicated, mill finished.

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:

1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
2. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.

C. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

D. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

E. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.5 COPINGS

A. Copings: Manufactured coping system consisting of formed-metal coping cap in section lengths not exceeding 12 feet, concealed anchorage; corner units, end cap units, and concealed splice plates with same finish as coping caps.

1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:

a. ATAS International, Inc.
b. Merchant & Evans, Inc.

c. Metal-Era, Inc.
d. Metal Roofing Systems
e. OMG, Inc.
f. PAC-CLAD; Petersen Aluminum Corporation

2. Coping-Cap Material: Formed aluminum, 0.050 inch thick; or thickness as required to meet performance requirements.
3. Corners: Factory mitered and continuously welded.
4. Coping-Cap Attachment Method: Snap-on.

a. Snap-on-Coping Anchor Plates: Concealed, 16 gauge galvanized-steel sheet, 12 inches wide, with integral cleats.

5. Color: Color as selected by Architect from manufacturer's full range.

2.6 REGLETS AND COUNTERFLASHINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Fry Reglet Corporation.
2. Heckmann Building Products
3. Metal-Era, Inc.
4. OMG, Inc.

B. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:

1. Material: Aluminum, 0.040 inch thick.
2. Corners: Factory mitered and continuously welded.
3. Surface-Mounted Type: Provide reglets with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
4. Masonry Type, Embedded: Provide reglets with offset top flange for embedment in masonry mortar joint.
5. Color: As selected by Architect from manufacturer's full range.

C. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches and in lengths not exceeding 12 feet designed to snap into reglets and compress against base flashings with joints lapped, from the following exposed metal:

1. Formed Aluminum: 0.040 inch thick.
2. Color: As selected by Architect from manufacturer's full range.

2.7 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.

C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

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

3.2 INSTALLATION, GENERAL

A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete roof-specialty systems.

1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
2. Provide uniform, neat seams with minimum exposure of solder and sealant.
3. Install roof specialties to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
4. Torch cutting of roof specialties is not permitted.
5. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.

C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.

1. Space movement joints at a maximum of 12 feet with no joints within 18 inches of corners or intersections unless otherwise shown on Drawings.
2. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

D. Fastener Sizes: Use fasteners of sizes that will penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal joints with elastomeric sealant as required by roofing-specialty manufacturer and as required for watertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F.

F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches except reduce pre-tinning where pre-tinned surface would show in completed Work. Tin edges of uncoated copper sheets using solder for copper. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

3.3 COPING INSTALLATION

A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor copings to meet performance requirements.

1. Interlock face leg and back leg drip edges on snap-on coping cap into cleated anchored plates anchored to substrate at manufacturer's required spacing that meets performance requirements.

3.4 REGLET AND COUNTERFLASHING INSTALLATION

A. General: Coordinate installation of reglets and counterflashings with installation of base flashings.

B. Surface-Mounted Reglets: Install reglets to receive flashings where indicated on Drawings. Install at height so that inserted counterflashings overlap 4 inches over top edge of base flashings.

C. Embedded Reglets: See Section 042613 "Masonry Veneer" for installation of reglets.

D. Counterflashings: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashings into reglets or other indicated receivers and fit tightly to base flashing. Extend counterflashings 4 inches over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches and bed with elastomeric sealant. Secure in a waterproof manner by means of snap-in installation and sealant or lead wedges and sealant.

3.5 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.

D. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077100

SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof hatches.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for ladder to access roof hatches.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof accessories. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

1.5 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

2.2 ROOF HATCH

A. Roof Hatches: Metal roof-hatch units with lid and insulated double-walled curb, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, integral metal cant, and integrally formed deck-mounting flange at perimeter bottom.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Babcock-Davis
b. Bilco Company
c. J. L. Industries, Inc.
d. Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.
e. Nystrom
f. O'Keefes Inc.
g. Pate Company
h. SafePro

B. Type and Size: Single-leaf lid, 4 by 4 feet.

C. Loads: Minimum 40-lbf/sq. ft. external live load and 20-lbf/sq. ft. internal uplift load.

D. Hatch Material: Aluminum sheet, 0.090 inch thick.

1. Finish: Powder coat.
2. Color: As selected by Architect from manufacturer's full range.

E. Construction:

1. Insulation: Glass-fiber board.
2. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
3. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
4. Fabricate curbs to minimum height of 12 inches unless otherwise indicated.
5. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate curb with perimeter curb height that is tapered to accommodate roof slope so that top surfaces of perimeter curb are level. Equip hatch with water diverter or cricket on side that obstructs water flow.

F. Hardware: Stainless-steel spring latch with turn handles, pintle-type hinge system, and padlock hasps inside and outside.

G. Safety Railing System: Roof-hatch manufacturer's safety railing system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.

1. Height: 42 inches above finished roof deck.
2. Posts and Rails: Galvanized-steel pipe, 1-1/4 inches in diameter or galvanized-steel tube, 1-5/8 inches in diameter.
3. Flat Bar: Galvanized steel, 2 inches high by 3/8 inch thick.
4. Maximum Opening Size: System constructed to prevent passage of a sphere 21 inches in diameter.
5. Chain Passway Barrier: Galvanized proof coil chain with quick link on fixed end.
6. Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.
7. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members.
8. Fabricate joints exposed to weather to be watertight.
9. Fasteners: Manufacturer's standard, finished to match railing system.

10. Finish: Manufacturer's standard.

    a. Color: As selected by Architect from manufacturer's full range.

H. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.

1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
2. Height: 42 inches above finished roof deck.
3. Material: Steel tube.
4. Post: 1-5/8-inch diameter pipe.
5. Finish: Manufacturer's standard baked enamel or powder coat.

    a. Color: As selected by Architect from manufacturer's full range.

2.3 METAL MATERIALS

A. Aluminum Sheet: ASTM B 209, manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.

1. Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.

B. Aluminum Extrusions and Tubes: ASTM B 221, manufacturer's standard alloy and temper for type of use, finished to match assembly where used, otherwise mill finished.

C. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized according to ASTM A 123/A 123M unless otherwise indicated.

D. Galvanized-Steel Tube: ASTM A 500, round tube, hot-dip galvanized according to ASTM A 123/A 123M.

E. Steel Pipe: ASTM A 53/A 53M, galvanized.

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Glass-Fiber Board Insulation: ASTM C 726, nominal density of 3 lb/cu. ft., thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F, thickness as indicated.

C. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than 1-1/2 inches thick.

D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

E. Underlayment:

1. Self-Adhering, High Temperature Sheet: Refer to Section 076200 "Sheet Metal Flashing and Trim."

2. Slip Sheet: Building paper, 3-lb/100 sq. ft. minimum, rosin sized.

F. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:

1. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.

G. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.

H. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

I. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

C. Verify dimensions of roof openings for roof accessories.

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

3.2 INSTALLATION

A. General: Install roof accessories according to manufacturer's written instructions.

1. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.
2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with a slip sheet.
3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.

C. Roof-Hatch Installation:

1. Install roof hatch so top surface of hatch curb is level.
2. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
3. Attach safety railing system to roof-hatch curb.
4. Attached ladder assist post to ladder in accordance with manufacturer's written instructions.

D. Seal joints with elastomeric sealant as required by roof accessory manufacturer.

3.3 REPAIR AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780.

B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Division 09 painting Sections.

C. Clean exposed surfaces according to manufacturer's written instructions.

D. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077200

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes through-penetration firestop systems for penetrations through the following fire-resistance-rated assemblies, including both empty openings and openings containing penetrating items:

1. Floors.
2. Roofs.
3. Walls and partitions.

1.2 PERFORMANCE REQUIREMENTS

A. General: For the following constructions, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly penetrated.

1. Fire-resistance-rated load-bearing walls, including partitions, with fire-protection-rated openings.
2. Fire-resistance-rated non-load-bearing walls, including partitions, with fire-protection-rated openings.
3. Fire-resistance-rated floor assemblies.
4. Fire-resistance-rated roof assemblies.
5. Smoke barriers.

B. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, as determined per ASTM E 814, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.

C. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, as determined per ASTM E 814, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:

1. Penetrations located outside wall cavities.
2. Penetrations located outside fire-resistive shaft enclosures.
3. Penetrations located in construction containing fire-protection-rated openings.
4. Penetrating items larger than 4-inch- diameter nominal pipe or 16 sq. in. in overall cross-sectional area.

D. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that after curing do not deteriorate when exposed to these conditions both during and after construction.

1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
2. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved either by installing floor plates or by other means.
3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

E. For through-penetration firestop systems exposed to view, provide products with flame-spread ratings of less than 25 and smoke-developed ratings of less than 450, as determined per ASTM E 84.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of through-penetration firestop system product indicated.

B. Shop Drawings: For each through-penetration firestop system, show each kind of construction condition penetrated, relationships to adjoining construction, and kind of penetrating item. Include firestop design designation of testing and inspecting agency acceptable to authorities having jurisdiction that evidences compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.
2. Where Project conditions require modification of qualified testing and inspecting agency's illustration to suit a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer.

a. Engineer shall be legally qualified to practice in the state in which the project is located.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

B. Product Certificates: Signed by manufacturers of through-penetration firestop system products certifying that products furnished comply with requirements.

C. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain through-penetration firestop systems from a single manufacturer.

B. Installer's Qualifications: An experienced installer who is qualified by having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Firm shall hold current certification by third party attesting to its ability to select and install firestopping in accordance with performance requirements, have established management system for firestopping and employ trained supervisor (DRI) to maintain oversight of firestopping installation.

1. Certification for firestopping firms: Firm shall be certified by one of the following:

a. Factory Mutual Global: FM Standard 4991.
b. UL Qualified Firestop Contractor.

2. Qualification for Superintendent: Superintendent shall have a minimum of 3 years experience in firestopping.
3. Qualification for Firestop Installer: Trained individual in accordance with requirements of certification of firm.

a. Firestop Installers Training (FIT) Level 1 by Specified Technologies, Inc.
b. Certified 3M Trained by 3M Fire Protection Products.
c. Hilti Basic Firestop Training
d. Similar training by manufacturers listed in Part 2.

4. A manufacturer's willingness to sell its through-penetration firestop system products to Contractor or to an installer engaged by Contractor does not in itself confer qualification on buyer.

C. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in "Performance Requirements" Article:

1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
2. Through-penetration firestop systems are identical to those tested per ASTM E 814. Provide rated systems complying with the following requirements:
    a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
    b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by the following:
        1) UL in "Fire Resistance Directory."

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1.

1. Before installation of fire-resistance-rated assemblies and penetrating items, review through-penetration firestop system and examine procedures for ensuring quality of installed systems. Require representatives of each entity directly concerned with through-penetration firestop system to attend, including the following:
    a. Contractor's superintendent.
    b. Independent testing agency responsible for through-penetration firestop system.
    c. Through-penetration firestop system Manufacturer’s service representative.
    d. Through-penetration firestop system Installer.
    e. Fire- resistance-rated masonry Installer.
    f. Fire- resistance-rated gypsum board assembly Installer.
    g. Mechanical piping Installer.
    h. HVAC ductwork Installer.
    i. Electrical wireway Installer.
2. Review inspection and testing and inspecting agency procedures for field quality control, through-penetration firestop system installation, and coordination of penetrating item configurations with available rated through-penetration firestop system assemblies.

1.6 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 inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multicomponent 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.

1.7 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.

1.8 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, or cut openings to accommodate through-penetration firestop systems.

C. Notify Owner's inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.

D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until Owner's inspecting agency and building inspector, if required by authorities having jurisdiction, have examined each installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hilti Construction Chemicals, Inc.
2. Specified Technologies Inc.
3. 3M Fire Protection Products.
4. Tremco.

2.2 FIRESTOPPING, GENERAL

A. Compatibility: Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

2.3 PENETRATION FIRESTOPPING

A. 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.

B. 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 floors, floor/ceiling assemblies and 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.

C. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at 0.30-inch wg at both ambient and elevated temperatures.

D. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

E. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by the qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:

1. Permanent forming/damming/backing materials, including the following:
    a. Slag-/rock-wool-fiber insulation.
    b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
    c. Fire-rated form board.
2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. Steel sleeves.

2.4 MIXING

A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance.

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

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with written recommendations of firestop system manufacturer and the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

A. General: Install through-penetration firestop systems to comply with "Performance Requirements" Article and firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing 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, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for firestop systems 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 Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified independent inspecting agency to inspect through-penetration firestop systems in accordance with ASTM E 2174 and to prepare test reports.

1. Inspecting agency will state in each report whether inspected through-penetration firestop systems comply with or deviate from requirements.

B. Compliance Inspections: One week prior to inspections by authorities having jurisdiction, Manufacturer's Representative shall perform compliance inspection with General Contractor's designated representative present. Reports shall be provided to General Contractor, with a copy to the Owner, Architect, and Firestopping Installer.

C. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued.

D. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

3.5 IDENTIFICATION

A. Penetration Identification: Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on

both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:

1. The words: "Warning--Through-Penetration Firestop System--Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Through-penetration firestop system designation of applicable testing and inspecting agency.
4. Date of installation.
5. Through-penetration firestop system manufacturer's name.
6. Installer's name.

B. Wall Identification: Refer to Section 099123 "Interior Painting" for identification of fire-rated walls and smoke barriers.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure through-penetration firestop systems are without damage or deterioration at time of Final Acceptance. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce through-penetration firestop systems complying with specified requirements.

END OF SECTION 078413

SECTION 078446 - FIRE-RESISTIVE JOINT SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes fire-resistive joint systems for the following:

1. Floor-to-floor joints.
2. Floor-to-wall joints.
3. Head-of-wall joints.
4. Wall-to-wall joints.
5. Joints in smoke barriers.

1.2 PERFORMANCE REQUIREMENTS

A. General: For joints in the following constructions, provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which fire-resistive joint systems are installed. Fire-resistive joint systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

1. Fire-resistance-rated load-bearing walls, including partitions, with fire-protection-rated openings.
2. Fire-resistance-rated non-load-bearing walls, including partitions, with fire-protection-rated openings.
3. Fire-resistance-rated floor assemblies.
4. Smoke barriers.

B. Fire Resistance of Joint Systems: Assembly ratings and movement capabilities indicated, but with assembly ratings not less than that equaling or exceeding fire-resistance rating of constructions in which joints are located, as determined by UL 2079.

1. Load-bearing capabilities as determined by evaluation during the time test.

C. Fire Resistance of Perimeter Fire-Containment Systems: Integrity and insulation ratings indicated as determined by UL 2079.

D. Exposed Fire-Resistive Joint Systems: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.3 ACTION SUBMITTALS

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

B. Shop Drawings: For each fire-resistive joint system, show relationships to adjoining construction. Include firestop design designation of testing and inspecting agency acceptable to authorities having jurisdiction that evidences compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each fire-resistive joint system configuration for construction and penetrating items.

C. Product Schedule: For each fire-resistive joint system. Include location and design designation of qualified testing agency.

1. Where Project conditions require modification to a qualified testing agency's illustration for a particular fire-resistive joint system condition, submit illustration, with modifications marked, approved by fire-resistive joint system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of fire-resistive joint system, signed by product manufacturer.

B. Installer Certificates: From Installer indicating fire-resistive joint systems have been installed in compliance with requirements and manufacturer's written recommendations.

C. Qualification Data: For Installer.

D. Research/Evaluation Reports: For each type of fire-resistive joint system.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Comply with requirements of Section 078413 "Penetration Firestopping."

B. Source Limitations: Obtain fire-resistive joint systems for each kind of joint and construction condition indicated through one source from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide fire-resistive joint systems that comply with the following requirements and those specified in "Performance Requirements" Article:

1. Fire-resistive joint systems are identical to those tested per UL 2079**.** Perimeter fire-containment systems are identical to those tested per both UBC Standard 26-9 and UL 2079. Provide rated systems complying with the following requirements:

a. Fire-resistive joint systems correspond to those indicated by referencing system designations listed by the following:

1) UL in its "Fire Resistance Directory."
2) Intertek ETL SEMKO in its "Directory of Listed Building Products."

D. Preinstallation Conference: Refer to requirements of Section 078413 "Penetration Firestop Systems."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fire-resistive joint system products to Project site in original, unopened containers or packages with qualified testing and inspecting agency's classification marking applicable to Project and with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials for fire-resistive joint systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate fire-resistive joint systems per manufacturer's written instructions by natural means or, if this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.

B. Coordinate sizing of joints to accommodate fire-resistive joint systems.

C. Notify Owner's inspecting agency at least seven days in advance of fire-resistive joint system installations; confirm dates and times on days preceding each series of installations.

D. Do not cover up fire-resistive joint system installations that will become concealed behind other construction until Owner's inspecting agency and building inspector, if required by authorities having jurisdiction, have examined each installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hilti Construction Chemicals, Inc.
2. Specified Technologies Inc.
3. 3M Fire Protection Products.
4. Tremco.

2.2 FIRE-RESISTIVE JOINT SYSTEMS, GENERAL

A. Compatibility: Provide fire-resistive joint systems that are compatible with joint substrates, under conditions of service and application, as demonstrated by fire-resistive joint system manufacturer based on testing and field experience.

B. Accessories: Provide components of fire-resistive joint systems, including forming materials, that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing and inspecting agency for systems indicated.

2.3 PERIMETER FIRE-CONTAINMENT SYSTEMS

A. Joints in or between Fire-Resistance-Rated Construction: Provide fire-resistive joint systems with ratings determined per ASTM E 1966 or UL 2079:

1. Joints include those installed in or between fire-resistance-rated walls, floor or floor/ceiling assemblies and roofs or roof/ceiling assemblies.
2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of construction they will join.

B. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079.

1. L-Rating: Not exceeding 5.0 cfm/ft of joint at 0.30 inch wg at both ambient and elevated temperatures.

2.4 HEAD OF WALL SEALING

A. Head of Wall Sealing: Comply with requirements of UL HW-D-0020 or equivalent design.

1. Contractor's Option: Spray or sealant products may be used.

a. 3M; FireDam Spray or FD 150+ Sealant
b. GCP Applied Technologies; FlameSafe 3000 Spray or FS 900 Sealant
c. Hilti; CP672 Firestop Spray or CP 606 Sealant

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance.

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

3.2 PREPARATION

A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:

1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from fire-resistive joint system materials. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates.

3.3 INSTALLATION

A. General: Install fire-resistive joint systems to comply with Part 1 "Performance Requirements" Article and fire-resistive joint system manufacturer's written installation instructions for products and applications indicated.

B. Install forming/packing/backing materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings and forming/packing/backing materials as required to achieve fire-resistance ratings indicated.
2. Apply fill materials so they contact and adhere to substrates formed by joints.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Identify fire-resistive joint systems with preprinted metal or plastic labels or self-adhesive vinyl labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels will be visible to anyone seeking to remove or penetrate joint system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Fire-Resistive Joint System - Do Not Disturb. Notify Building Management of Any Damage."

3.5 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified independent inspecting agency to inspect fire-resistive joint systems according to ASTM E 2393 and to prepare inspection reports.

1. Inspecting agency will state in each report whether inspected fire-resistive joint systems comply with or deviate from requirements.

B. Compliance Inspections: One week prior to inspections by authorities having jurisdiction, Manufacturer's Representative shall perform compliance inspection with General Contractor's designated representative present. Reports shall be provided to General Contractor, with a copy to the Owner, Architect, and Firestopping Installer.

C. Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and inspecting agency has approved installed fire-resistive joint systems.

D. If deficiencies are found, repair or replace fire-resistive joint systems so they comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to joints as Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure fire-resistive joint systems are without damage or deterioration at time of Final Acceptance. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

END OF SECTION 078446

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes joint sealants for the following applications, including those specified by reference to this Section:

1. Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
2. Exterior joints in horizontal traffic surfaces.
3. Interior joints in vertical surfaces and horizontal nontraffic surfaces.
4. Interior joints in horizontal traffic surfaces.

1.2 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants and joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.3 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch wide joints formed between two 6-inch long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

C. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

A. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

B. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.

C. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Submit not fewer than eight pieces of each kind of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

B. Mockups: Build mockups incorporating sealant joints, as follows, to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution:

1. Joints in mockups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified by reference to this Section.

1.6 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 Articles.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

C. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

D. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range of available colors including premium colors.

1. Where color is indicated to “match adjacent substrates” provide either manufacturer’s standard color if matching color is available, or, if not available, provide field tintable custom color.

2.3 SILICONE JOINT SEALANTS

A. Silicone Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. Single Component, Nonsag, Neutral-Curing Silicone Sealant:

1. Products:

a. Dow Corning Corporation; 790
b. GE Momentive SilPruf LM SCS2700
c. Pecora Corporation; 890
d. Sika Corporation; 290
e. Tremco Incorporated; Spectrem 1

2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 100/50.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: M (Masonry), G (Glass), A (Aluminum), and, as applicable to joint substrates indicated, O (Other).
6. Field-tintable to match adjacent substrates.
7. Exterior Joint Locations:

a. Exterior vertical joints,
b. Unit masonry, vertical control and expansion joints,
c. Exterior perimeter joints between exterior materials and frames of doors and windows,
d. Exterior control joints in ceilings and other overhead surfaces,
e. Other vertical or horizontal non-traffic joints.

8. Interior Joint Locations:

a. Vertical control and expansion joints on exposed interior surfaces of exterior walls,
b. Interior perimeter joints of exterior openings.

C. Single-Component, Traffic Exposure, Neutral-Curing Silicone Sealant:

1. Products:

a. Dow Corning Corporation; 890-SL

b. Pecora Corporation; 300 SL
c. Sika Corporation; 728 SL
d. Tremco Incorporated; Spectrem 900 SL

2. Type and Grade: S (single component) and P (pourable).
3. Class: 100/50.
4. Uses Related to Exposure: T (traffic).
5. Uses Related to Joint Substrates: M, A, and O, as applicable to joint substrates indicated.
6. Exterior Joint Locations:

a. Cast-in-place concrete slabs, horizontal nontraffic and traffic isolation and contraction joints,
b. Other exterior horizontal traffic joints.

7. Interior Joint Locations:

a. Interior ceramic and dimension tile expansion, control, contraction, and isolation joints in horizontal traffic surfaces.

D. Single-Component, Mildew-Resistant, Neutral-Curing Silicone Sealant:

1. Products:

a. Dow Corning Corporation; 786
b. Pecora Corporation; 898
c. Sika Corporation; SikaSil N
d. Tremco; Tremsil 600 White

2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
6. Interior Joint Locations:

a. Interior tile expansion, control, contraction, and isolation joints in vertical surfaces.
b. Interior joints between plumbing fixtures and adjoining walls, floors, and counters.

2.4 BUTYL JOINT SEALANTS

A. Butyl-Rubber-Based Joint Sealants: ASTM C 1311.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Bostik; Chem-Calk 300
b. Pecora; BC-158
c. Tremco; General Purpose Butyl Sealant

2. Exterior Joint Locations: Under door thresholds.

2.5 LATEX JOINT SEALANTS

A. Latex Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1. Products:

a. BASF Building Systems; Sonolac
b. Bostik, Inc.; Chem-Calk 600
c. Pecora Corporation; AC-20+
d. Tremco Incorporated; Tremflex 834

2. Interior Joint Locations:

a. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances,

1) Color: Paintable white.

b. Other non-dynamic interior joints including between interior wall surfaces and casework.

1) Color: Clear.

2.6 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. BASF Building Systems
b. Hilti
c. Pecora Corporation
d. Tremco

2. Interior Joint Locations: Acoustical interior joints for concealed and exposed joints.

2.7 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; 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. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), or B (bicellular material with a surface skin), as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance. Consult the sealant manufacturer to confirm the specific backer material to be used for the specific project and application, and submit to Architect the manufacturer's written recommendations.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.8 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

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

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants.

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, 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 after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.
3. Remove laitance and form-release agents from concrete.
4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of type recommended by manufacturer to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Installation of Preformed Foam Sealants: Install secondary seal at depth sufficient to allow installation of properly sized backer rod and liquid sealant in front of secondary seal. Comply with manufacturer's written instructions.

1. Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, producing seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in compliance with sealant manufacturer's written instructions.

E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

F. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

H. 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 C 919 and with manufacturer's written recommendations.

3.4 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Standard interior hollow metal frames.

1.2 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, and finishes.

B. Shop Drawings: Include the following:

1. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
2. Locations of reinforcement and preparations for hardware.
3. Details of each different wall opening condition.
4. Details of anchorages, joints, field splices, and connections.
5. Details of accessories.

C. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of hollow metal frame.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to factory-finished units.

B. Store hollow-metal doors and frames vertically under cover at Project site. Place in stacks of five units maximum with head up. Place on minimum 4-inch- high wood blocking. Do not store in a manner that traps excess humidity.

C. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amweld Building Products, LLC
2. Ceco Door Products; an Assa Abloy Group company
3. Curries Company; an Assa Abloy Group company
4. Pioneer Industries, Inc.
5. Premier Products, Inc.
6. Republic Doors and Frames
7. Steelcraft; an Ingersoll-Rand company

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252.

B. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9. Label each individual glazed lite.

2.3 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 A60 (galvannealed) metallic coating.

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 1011M, 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. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

H. Glazing: Comply with requirements in Section 088000 "Glazing."

2.4 INTERIOR HOLLOW METAL FRAMES

A. Heavy-Duty Frames: SDI A250.8, Level 2.

1. Physical Performance: Level B according to SDI A250.4.
2. Materials: Uncoated, cold-rolled steel sheet, 16 gauge thickness.
3. Construction: Full profile welded.
    a. Fabricate frames with mitered or coped corners.
4. Glazing Plane: Center glazed.
5. Exposed Finish: Shop primed.

B. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

A. Jamb Anchors:

1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.

B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick.

2.6 STOPS AND MOLDINGS

A. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.

C. Loose/Removable Stops for Glazed Lites in Frames: Minimum 0.032-inch-thick, fabricated from same material as frames in which they are installed.

2.7 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.

C. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
4. Jamb Anchors: Provide number and spacing of anchors as follows:

a. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

1) Three anchors per jamb up to 60 inches high.
2) Four anchors per jamb from 60 to 90 inches high.
3) Five anchors per jamb from 90 to 96 inches high.
4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
5) Two anchors per head for frames above 42 inches wide and mounted in metal-stud partitions.

5. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.

a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

D. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.

E. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping.

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.

F. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
4. Provide loose stops and moldings on inside of hollow metal work.
5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.8 STEEL FINISHES

A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

a. At fire-protection-rated openings, install frames according to NFPA 80.
b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
c. Install frames with removable glazing stops located on secure side of opening.
d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
e. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
4. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
5. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow metal manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.2 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

C. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-core doors with wood-veneer faces.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of door indicated. Include details of core and edge construction and trim for openings. Include factory-finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.

1. Indicate dimensions and locations of mortises and holes for hardware.
2. Indicate dimensions and locations of cutouts.
3. Indicate requirements for veneer matching.
4. Indicate doors to be factory finished and finish requirements.
5. Indicate fire-protection ratings for fire-rated doors.

C. Samples for Verification: Factory finishes applied to actual door face materials, approximately 12 by 12 inches, for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain flush wood doors from single manufacturer.

B. Quality Standard: In addition to requirements specified, comply with AWI's, AWMAC's, and WI's "Architectural Woodwork Standards and WDMA I.S.1-A, "Architectural Wood Flush Doors."

C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252.

D. Preinstallation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in cardboard cartons and wrap bundles of doors in plastic sheeting.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 43 and 70 percent during the remainder of the construction period.

1.7 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.

1. Failures include, but are not limited to, the following:

a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.

2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Lambton Doors.
2. Masonite Architectural
3. Oshkosh Door Company
4. VT Industries, Inc./Eggers Industries

2.2 DOOR CONSTRUCTION, GENERAL

A. Particleboard-Core Doors:

1. Particleboard: ANSI A208.1, Grade LD-2, made with binder containing no urea-formaldehyde resin.
2. Blocking: Provide wood blocking in particleboard-core doors as follows:

a. 5-inch top-rail blocking, in doors indicated to have closers.
b. 5-inch bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.
c. 5-inch midrail blocking, in doors indicated to have exit devices.

3. Provide doors with structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.

B. Structural-Composite-Lumber-Core Doors:

1. Structural Composite Lumber: WDMA I.S.10.

a. Screw Withdrawal, Face: 700 lbf.

b. Screw Withdrawal, Edge: 400 lbf.

C. Fire-Protection-Rated Doors: Provide core specified or mineral core as needed to provide fire-protection rating indicated.

1. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
2. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.

D. Mineral-Core Doors:

1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as follows:

a. 5-inch top-rail blocking.
b. 5-inch bottom-rail blocking, in doors indicated to have protection plates.
c. 5-inch midrail blocking, in doors indicated to have armor plates.
d. 5-inch midrail blocking, in doors indicated to have exit devices.

3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

2.3 VENEERED-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors:

1. Grade: Custom (Grade A faces).
2. Species and Cut: Match existing.
3. Match between Veneer Leaves: Match existing.
4. Assembly of Veneer Leaves on Door Faces: Match existing.
5. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
6. Room Match: Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 10 feet or more.
7. Exposed Vertical and Top Edges: Same species as faces.
8. Core: Particleboard, unless otherwise indicated.
9. Construction: Five plies. Stiles and rails are bonded to core, then entire unit abrasive planed before veneering.
10. WDMA I.S.1-A Performance Grade: Heavy Duty.

2.4 LIGHT FRAMES

A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads as follows unless otherwise indicated.

1. Wood Species: Species compatible with door faces.
2. Profile: Manufacturer's standard shape.
3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

B. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch thick, cold-rolled steel sheet; with baked-enamel- or powder-coated finish; and approved for use in doors of fire-protection rating indicated.

2.5 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

1. Comply with requirements in NFPA 80 for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.

1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
2. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

C. Openings: Cut and trim openings through doors in factory.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."

2.6 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

1. Finish faces, all four edges, edges of cutouts, and mortises. Finish top of doors in multi-story spaces. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises, unless noted otherwise.

B. Transparent Finish:

1. Grade: Custom.
2. Finish: AWI conversion varnish or catalyzed polyurethane system.
3. Staining: Match existing.
4. Effect: Filled finish.
5. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames before hanging doors.

1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

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

3.2 INSTALLATION

A. Hardware: For installation, see Section 087100 "Door Hardware."

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.

1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.

C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Re-hang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 082130 - FIBERGLASS REINFORCED POLYESTER (FRP) DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes fiberglass reinforced polyester doors with aluminum frames.

1.2 ACTION SUBMITTALS

A. Product Data: Submit door manufacturer's product data, specifications, and installation instructions for each type of door and frame.

1. Include details of core and edge construction, trim for openings and louvers, and similar components.

B. Shop Drawings: Submit shop drawings indicating location and size of each door, elevation of each kind of door, details of construction, location and extent of hardware blocking, requirements for factory finishing, and other pertinent data.

C. Samples: Two sets of manufacturer's full color selections.

1.3 WARRANTY

A. Warranty: Warrant doors and frames against failure in materials and workmanship, including excessive deflection, faulty operation, and deterioration of finish or construction in excess of normal weathering.

1. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Manufacturer: Subject to compliance with requirements, provide doors and frames by one of the following:

1. Commercial Doors Systems
2. Edgewater FRP Door
3. Special-Lite
4. Tubalite
5. Vistawall

2.2 DOOR MATERIALS AND COMPONENTS

A. Door Construction:

1. Thickness: 1-3/4-inch.
2. Stiles and Rails:

a. Aluminum extrusions made from 6063 aluminum alloys with a minimum temper of T5.
b. Minimum 2-5/16-inch deep one-piece extrusion with have integral reglets to accept face sheet on both interior and exterior side of door which secure face sheet into place and permit flush appearance.

c. Top rails must have integral legs for interlocking continuous extruded aluminum flush cap.
d. Bottom rails must have integral legs for interlocking continuous weather bar with single nylon brush weather stripping or manually adjustable door bottom with two nylon brush weather stripping.
e. Meeting stiles to include integral pocket to accept pile brush weather seal.
f. Extruded stiles and rails to have integral reglets to accept face sheet on both interior and exterior side of door which secure face sheet into place.

3. Corners: Mitered.

a. Secured with 3/8-inch diameter full-width steel tie rod through extruded splines top and bottom which are integral to standard tubular shaped rails.
b. 1-1/4 by 1-1/4 by 3/16-inch 6061 aluminum angle reinforcement at corners.

4. Core: Foamed-in-place closed-cell polyurethane foam with a minimum of 5 pounds per cu.ft. density. The door assembly shall have a minimum "R" value of 11.
5. Face Sheet: 0.120-inch minimum thickness fiberglass reinforced polyester (FRP) with a sandstone-textured finish.

a. Color: As selected by Architect from manufacturer's full range.

6. Cutouts: Manufacture doors with cutouts for required vision lites, louvers, and panels.
7. Hardware: Refer to Section 087100 "Door Hardware" for hardware requirements.

a. Pre-machine doors in accordance with templates from specified hardware manufacturers.
b. Factory install door hardware.

8. Reinforcements.

a. Aluminum extrusions made from 6061 or 6063 aluminum alloys.
b. Sheet and plate to conform to ASTM-B209.
c. Alloy and temper to be selected by manufacturer for strength, corrosion resistance, and application of required finish, and control of color.

B. Glazing: Glazing shall be factory installed. Comply with applicable requirements in Section 088000 "Glazing."

C. Louvers: Manufacturer's standard, factory supplied and installed.

2.3 ALUMINUM DOOR FRAMING SYSTEMS

A. Tubular Framing: Factory fabricated.

1. Size and Type: As indicated on the Drawings.
2. Materials: Aluminum extrusions, 6063-T5 alloy, 1/8-inch minimum wall thickness.
3. Applied Door Stops: 0.625-inch high, with screws and weatherstripping. Door stop shall incorporate pressure gasketing for weathering seal. Counterpunch fastener holes in door stop to preserve full metal thickness under fastener head.
4. Frame Members: Box type with 4 enclosed sides.
5. Caulking: Caulk joints before assembling frame members.
6. Joints:

a. Secure joints with fasteners.
b. Provide hairline butt joint appearance.

7. Applied Stops: For side, transom, and borrowed lites and panels. Applied stops shall incorporate pressure gasketing for weathering seal. Reinforce with solid bar stock fill for frame hardware attachments.

8. Hardware: Premachine and reinforce frame members for hardware in accordance with manufacturer's standards and hardware schedule.
9. Anchors:
    a. Anchors appropriate for wall conditions to anchor framing to wall materials.
    b. Door Jamb and Header Mounting Holes: Maximum of 24-inch centers.
    c. Secure head and sill members of transom, side lites, and similar conditions.
10. Finish: Clear Anodic Finish, AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 DOOR INSTALLATION

A. Inspection: Installer shall examine aluminum door frames and verify that frames are correct for proper hanging of corresponding doors. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Door Undercuts: Coordinate door undercut with specified threshold to meet accessibility requirements and provide positive seal to the threshold weatherstrip.

C. Installation:
1. Install doors in accordance with manufacturer's instructions.
2. Install doors plumb, level, square, true to line, and without warp or rack.
3. Anchor frames securely in place.
4. Separate aluminum from other metal surfaces with bituminous coatings.
5. Install exterior doors to be weathertight in closed position.

END OF SECTION 082130

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Access doors and frames for walls and ceilings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of access door and frame indicated. Include construction details, materials, individual components and profiles, and finishes.

B. Shop Drawings: Show fabrication and installation details of access doors and frames for each type of substrate. Include plans, elevations, sections, details, and attachments to other work.

C. Access Door and Frame Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of access door(s) and frame(s) through one source from a single manufacturer.

B. Size Variations: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

1.4 COORDINATION

A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in the schedule specified in "Submittals" Article.

PART 2 - PRODUCTS

2.1 STEEL MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

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. Steel Sheet: Uncoated or cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS) with A60 zinc-iron-alloy (galvannealed) coating or G60 mill-phosphatized zinc coating; stretcher-leveled standard of flatness; with minimum thickness indicated representing specified thickness according to ASTM A 924/A 924M.

D. Steel Finishes: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation for Steel Sheet: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
2. Surface Preparation for Metallic-Coated Steel Sheet: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.
    a. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
3. Factory-Primed Finish: Apply shop primer immediately after cleaning and pretreating.

2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acudor Products, Inc.
2. J. L. Industries, Inc.
3. Karp Associates, Inc.
4. Larsen's Manufacturing Company.
5. MIFAB, Inc.
6. Milcor Inc.
7. Nystrom, Inc.
8. Williams Bros. Corporation of America (The).

B. Flush Access Doors and Frames with Exposed Trim: Fabricated from steel sheet.

1. Locations: Wall and ceiling surfaces.
2. Door: Minimum 0.060-inch- thick sheet metal, set flush with exposed face flange of frame.
3. Frame: Minimum 0.060-inch- thick sheet metal with 1-inch- wide, surface-mounted trim.
4. Provide metallic coated steel sheet for high humidity applications.
5. Hinges: Continuous piano.
6. Latch: Cam latch operated by screwdriver with interior release.

2.3 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.

1. Exposed Flanges: Nominal 1 to 1-1/2 inches wide around perimeter of frame.
2. Provide mounting holes in frames for attachment of units to metal framing.
3. Provide mounting holes in frame for attachment of masonry anchors. Furnish adjustable metal masonry anchors.

D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.

C. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.2 ADJUSTING AND CLEANING

A. Adjust doors and hardware after installation for proper operation.

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083113

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior storefront framing.
2. Exterior manual-swing entrance doors and door-frame units.
3. Exterior canopy sunshades attached to storefront framing.

B. Products installed, but not furnished, under this Section include the following:

1. Door hardware furnished under Section 087100 "Door Hardware."

1.2 DEFINITIONS

A. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

1.3 PERFORMANCE REQUIREMENTS

A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:

1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
2. Dimensional tolerances of building frame and other adjacent construction.
3. Failure includes the following:

    a. Deflection exceeding specified limits.
    b. Thermal stresses transferring to building structure.
    c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
    d. Noise or vibration created by wind and by thermal and structural movements.
    e. Loosening or weakening of fasteners, attachments, and other components.
    f. Sealant failure.
    g. Failure of operating units.

B. Delegated Design: Design aluminum-framed systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1. Professional engineer shall be legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated.

C. Wind Loads: As indicated on Structural Drawings.

D. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed L/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.

2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components directly below them to less than 1/8 inchand clearance between members and operable units directly below them to less than 1/16 inch.

E. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding percent of span.
3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.

F. Story Drift: Provide aluminum-framed systems that accommodate design displacement of adjacent stories indicated.

1. Design Displacement: As indicated on Structural Drawings.
2. Test Performance: Meet criteria for passing, based on building occupancy type, when tested according to AAMA 501.4 at design displacement and 1.5 times design displacement.

G. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft.of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft.

H. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft.

I. Water Penetration under Dynamic Pressure: Provide aluminum-framed systems that do not evidence water leakage through fixed glazing and framing areas when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft.

1. Maximum Water Leakage: No uncontrolled water penetrating aluminum-framed systems or water appearing on systems' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters that is drained to exterior and water that cannot damage adjacent materials or finishes.

J. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

K. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC- certified condensation resistance rating of no less than 50 as determined according to NFRC 500.

L. Energy Performance: Certify and label energy performance per NFRC as follows:

1. Thermal Transmittance (U-factor): The following components shall provide U-factors of not more that indicate as determined per NFRC 100.

a. Fixed Glazing and Framing Areas: 0.45 Btu/sq. ft. x h x deg F.
b. Entrance Doors: 0.77 Btu/sq. ft. x h x deg F.

2. Solar Heat Gain Coefficient (SHGC): Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.25 as determined per NFRC 200
3. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 68 as determined per NFRC 500.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.

B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.

1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
2. Show sill pan.
3. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.
4. Show locations and extent of sunshades.

C. Samples for Verification:

1. For each type of exposed finish required, in manufacturer's standard sizes.
2. Sill Pan: Full-size factory fabricated unit.

D. Fabrication Sample: Of each vertical-to-horizontal intersection of aluminum-framed systems, made from 12-inch lengths of full-size components and showing details of the following:

1. Joinery, including concealed welds.
2. Anchorage.
3. Expansion provisions.
4. Glazing.
5. Flashing and drainage.

E. Delegated-Design Submittal: For aluminum-framed systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of aluminum-framed systems.
2. Detail anchorage system to substrate.
3. Include design calculations.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Thermal Conductance Certificates: Provide project-specific certificates for glazed aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.

1. Basis for Certification: AAMA-certified thermal conductance values for each glazed aluminum-framed entrance and storefront.

C. Welding certificates.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems, indicating compliance with performance requirements.

E. Field quality-control reports.

F. Warranties: Sample of special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Provide entrances and storefront produced by a single manufacturer with not less than 10 years successful experience in the fabrication of assemblies of the type and quality required.

B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

1. Installer shall have successfully completed not less than two projects of similar size, scope, and complexity as that of this Project within the last three years.

C. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.

D. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.

E. Accessible Entrances: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

F. Welding Qualifications: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code - Aluminum."

G. Mockups: Build mockups to verify selections made under sample submittals, to demonstrate aesthetic effects, to demonstrate flashing of openings, and to set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings.
2. Notify Architect and Owner’s Representative seven days in advance of dates and times when mockups will be constructed.
3. Field testing shall be performed on mockups according to requirements in "Field Quality Control" Article.
4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
5. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01. Review methods and procedures related to aluminum windows including, but not limited to, the following:

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review and discuss the finishing of aluminum storefront that is required to be coordinated with the finishing of other aluminum work for color and finish matching.
3. Review, discuss, and coordinate the interrelationship of aluminum storefront with other exterior wall components. Include provisions for structural anchorage, glazing, flashing, weeping, sealants, and protection of finishes.
4. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
5. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

1.8 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.9 COORDINATION

A. Coordinate doors, frames, door hardware, and other work for proper installation of door hardware, furnished under other Sections and installed in aluminum-framed entrance and storefront systems. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Structural failures including, but not limited to, excessive deflection.
   b. Noise or vibration caused by thermal movements.
   c. Deterioration of metals and other materials beyond normal weathering.
   d. Adhesive or cohesive sealant failures.
   e. Water leakage through fixed glazing and framing areas.
   f. Failure of operating components.

2. Warranty Period: 5 years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.

1. Warranty Period: 10 years from date of Substantial Completion.

1.11 MAINTENANCE SERVICE

A. Entrance Door Hardware:

1. 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 entrance door hardware.
2. Initial Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.
    a. Coordinate with door hardware supplier for replacement of defective items.
3. Continuing Maintenance Proposal: From Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. EFCO Corporation
2. Kawneer North America; an Alcoa Company
3. Oldcastle BuildingEnvelope
4. Tubelite
5. Wausau Window and Wall Systems
6. YKK AP America Inc.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B 209.
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Structural Profiles: ASTM B 308/B 308M.
5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.3 FRAMING SYSTEMS

A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken.
2. Glazing System: Retained mechanically with gaskets on four sides.

3. Glazing Plane: Center, unless otherwise indicated on Drawings.
4. Finish: Clear anodized finish.
5. Fabrication Method: Field-fabricated stick system.

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

D. Sill Pan: Provide high performance flashing by manufacturer. Extruded aluminum, factory fabricated to provide sealed end dams, finished to match storefront; designed to direct water away from building when installed horizontally at sill. If manufacturer offers a similar sill pan as part of aluminum-framed entrance and storefront system, submit details and product data including finishes, for consideration and approval by Architect. PVC is not acceptable.

E. Sill Extension: Extruded aluminum. Profile as indicated on Drawings.

F. Perimeter Filler: Provide perimeter filler / backer plate to close back of frame and facilitate placement of backer rod and sealant.

1. Back Plates: Furnish jamb and head framing members with manufacturer’s standard continuous back plates, unless continuous plates are integral to the design of the framing system.

G. 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.

H. Concealed Flashing: Dead-soft, 0.018-inch thick stainless steel, ASTM A 240/A 240M of type recommended by manufacturer.

I. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.

2.4 GLAZING SYSTEMS

A. Glazing: As specified in Section 088000 "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.

E. Glazing Sealants: As recommended by manufacturer for joint type and as follows:

1. Weatherseal Sealant: ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O; single-component neutral-curing formulation that is compatible with other system components with which it comes in contact; recommended by weatherseal-sealant and aluminum-framed-system manufacturers for this use.

2.5 ENTRANCE DOOR SYSTEMS

A. Aluminum Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.

1. Door Construction: 2-1/4 inches overall thickness, with minimum 0.125-inch thick, extruded-aluminum tubular rail and stile members. Mortise and tenon joinery at corner with full width 3/8-inch diameter tie rods secured with locking washers and hex nuts.

a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.

2. Door Design: Wide stile, 5-inch nominal width.

a. Accessible Doors: Smooth surfaced for width of door in area within 10 inches above floor or ground plane.

3. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.

a. Provide nonremovable glazing stops on outside of door.

2.6 ENTRANCE DOOR HARDWARE

A. General: Except for items specified in this Article, entrance door hardware to be furnished under Section 087100 "Door Hardware."

1. All hardware preparation and installation to be performed as Work of this Section.

B. Weather Stripping: Manufacturer's standard replaceable components.

1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
2. Sliding Type: AAMA 701, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

2.7 EXTERIOR SUNSHADES

A. Canopy: Fixed, extruded aluminum.

1. Orientation: Horizontal
2. Projection: As indicated on Drawings.
3. Outrigger Arm: Straight with square edges.
4. Canopy Panels: Break metal cover and soffit, 0.125-inch-thick aluminum sheet, with integral drainage well sloped to drain.
5. Fascia: Rectangular.
6. End Caps: Manufacturer's standard.

2.8 ACCESSORY MATERIALS

A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Section 079200 "Joint Sealants."

B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-milthickness per coat.

2.9 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 or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
6. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing.
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 head-and-sill-receptor system with shear blocks at intermediate horizontal members.

F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

1. At exterior doors, provide compression weather stripping at fixed stops.

G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

H. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

I. Canopy Sunshade Installation: Assemble sunshade devices in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

J. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.10 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Apply finishes to formed metal after fabrication unless otherwise indicated.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.11 ALUMINUM FINISHES

A. General: Comply with the NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.

B. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

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

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

3.2 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
6. Provide fasteners at spacing as recommended by manufacturer.
7. Seal joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Installation at Sill: Install sill pan system in accordance with manufacturer’s written instructions.

1. Set sill pan in a continuous bed of low modulus sealant or apply a nominal 6 inch wide strip of 60 mil self-adhering waterproofing membrane to the bottom of the pan and where a penetration might be required to comply with specified performance requirements.
2. Do not apply sealant between flashing pan and bottom of frame, except as required by manufacturer to comply with specified performance requirements. Set sill members in watertight sill flashing pan. Do not penetrate bottom of flashing pan and/or attach sill members to vertical leg of angle unless required by manufacturer to comply with specified performance requirements.

E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.

F. Install glazing as specified in Section 088000 "Glazing."

G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

H. Canopy Sunshades: Install sunshade devices level and plumb, securely connected to supports, free of rack, and in proper relation to adjacent construction.

I. Install weatherseal sealant according to Section 079200 "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

3.3 ERECTION TOLERANCES

A. Install aluminum-framed systems to comply with the following maximum erection tolerances:

1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.
2. Alignment:

a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.

B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch.

3.4 FIELD QUALITY CONTROL

A. Contractor/Installer Testing: Contractor/Installer shall be prepared to provide the following minimum testing as part of the Work.

1. Testing shall be in compliance with AAMA 501.2. Testing shall be performed at approximately 10 percent and 50 percent completion. A minimum of 2 test areas to be tested at each phase. Additional testing may be required if installation crew changes of if construction is suspended and resumed after an extended period of time. Coordinate with Architect’s representative for areas to be tested, testing times, and representative’s availability to monitor tests.

B. Testing Agency: Owner may engage a qualified independent testing and inspecting agency to perform field tests and inspections.

C. Testing Services: Testing and inspecting of representative areas to determine compliance of installed systems with specified requirements shall take place as follows and in successive phases as indicated on Drawings. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.

1. Air Infiltration: Areas shall be tested for air leakage of 1.5 times the rate specified for laboratory testing under "Performance Requirements" Article, but not more than 0.09 cfm/sq. ft., of fixed wall area when tested according to ASTM E 783 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft.
2. Water Penetration: Areas shall be tested according to ASTM E 1105 at a minimum uniform and cyclic static-air-pressure difference of 0.67 times the static-air-pressure difference specified for laboratory testing under Part 1 "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft., and shall not evidence water penetration.

D. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

F. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.

1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch, measured to the leading door edge.

END OF SECTION 084113

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware for:
    a. Swinging doors.
    b. Sliding doors.
    c. Gates.
2. Electronic access control system components, including:
    a. Electronic access control devices.

B. Exclusions: Unless specifically listed in hardware sets, hardware is not specified in this section for:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Section 012300 "Alternates" for alternates affecting this section.
2. Section 079200 "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
3. Division 26 sections for connections to electrical power system and for low-voltage wiring.
4. Division 28 sections for coordination with other components of electronic access control system.

1.2 REFERENCES

A. UL - Underwriters Laboratories

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Key Systems and Nomenclature

C. ANSI - American National Standards Institute

1. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties

1.3 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 requirements.
2. Highlight, encircle, or otherwise specifically identify on submittals deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.
3. Prior to forwarding submittal, comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, "EXAMINATION" article, herein.

B. Action Submittals:

1. Product Data: Product data including manufacturers' technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
    a. Wiring Diagrams: For power, signal, and control wiring and including:
        1) Details of interface of electrified door hardware and building safety and security systems.
        2) Schematic diagram of systems that interface with electrified door hardware.
        3) Point-to-point wiring.
        4) Risers.
3. Samples for Verification: If requested by Architect, submit production sample or sample installations of each type of exposed hardware unit in finish indicated, and tagged with full description for coordination with schedule.
    a. Samples will be returned to supplier in like-new condition. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.
4. Door Hardware Schedule: Submit schedule with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Indicate complete designations of each item required for each door or opening, include:
    a. Door Index; include door number, heading number, and Architects hardware set number.
    b. Opening Lock Function Spreadsheet: List locking device and function for each opening.
    c. Type, style, function, size, and finish of each hardware item.
    d. Name and manufacturer of each item.
    e. Fastenings and other pertinent information.
    f. Location of each hardware set cross-referenced to indications on Drawings.
    g. Explanation of all abbreviations, symbols, and codes contained in schedule.
    h. Mounting locations for hardware.
    i. Door and frame sizes and materials.
    j. Name and phone number for local manufacturer's representative for each product.
    k. Operational Description of openings with any electrified hardware (locks, exits, electromagnetic locks, electric strikes, automatic operators, door position switches, magnetic holders or closer/holder units, and access control components). Operational description should include how door will operate on egress, ingress, and fire and smoke alarm connection.
        1) Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work that is critical in Project construction schedule.
5. Key Schedule:
    a. After Keying Conference, provide keying schedule listing levels of keying as well as explanation of key system's function, key symbols used and door numbers controlled.

b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion.

1) Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.

f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.

6. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory prepared for door hardware installation.

C. Informational Submittals:

1. Qualification Data: For Supplier, Installer and Architectural Hardware Consultant.
2. Product Certificates for electrified door hardware, signed by manufacturer:

a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.

3. Certificates of Compliance:

a. Certificates of compliance for fire-rated hardware and installation instructions if requested by Architect or Authority Having Jurisdiction.
b. Installer Training Meeting Certification: Letter of compliance, signed by Contractor, attesting to completion of installer training meeting specified in "QUALITY ASSURANCE" article, herein.
c. Electrified Hardware Coordination Conference Certification: Letter of compliance, signed by Contractor, attesting to completion of electrified hardware coordination conference, specified in "QUALITY ASSURANCE" article, herein.

4. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by qualified testing agency, for door hardware on doors located in accessible routes.
5. Warranty: Special warranty specified in this Section.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:

a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
b. Catalog pages for each product.
c. Name, address, and phone number of local representative for each manufacturer.
d. Parts list for each product.
e. Final approved hardware schedule, edited to reflect conditions as-installed.
f. Final keying schedule
g. Copies of floor plans with keying nomenclature
h. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.
i. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

1.4 QUALITY ASSURANCE

A. Product Substitutions: Comply with product requirements stated in Division 01 and as specified herein.

1. Where specific manufacturer's product is named and accompanied by "No Substitute," including make or model number or other designation, provide product specified. (Note: Certain products have been selected for their unique characteristics and particular project suitability.)

a. Where no additional products or manufacturers are listed in product category, requirements for "No Substitute" govern product selection.

2. Where products indicate "acceptable manufacturers" or "acceptable manufacturers and products", provide product from specified manufacturers, subject to compliance with specified requirements and "Single Source Responsibility" requirements stated herein.

B. Supplier Qualifications and Responsibilities: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides certified Architectural Hardware Consultant (AHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.

1. Warehousing Facilities: In Project's vicinity.
2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
4. Coordination Responsibility: Coordinate installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.

a. Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.

C. Installer Qualifications: Qualified tradesmen, skilled in application of commercial grade hardware with record of successful in-service performance for installing door hardware similar in quantity, type, and quality to that indicated for this Project.

D. Architectural Hardware Consultant Qualifications: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:

1. For door hardware, DHI-certified, Architectural Hardware Consultant (AHC).
2. Can provide installation and technical data to Architect and other related subcontractors.
3. Can inspect and verify components are in working order upon completion of installation.
4. Capable of producing wiring diagrams.
5. Capable of coordinating installation of electrified hardware with Architect and electrical engineers.

E. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated.
2. Manufacturers that perform electrical modifications and that are listed by testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

F. Fire-Rated Door Openings: Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors

indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

G. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. at tested pressure differential of 0.3-inch wg of water.

H. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

I. Means of Egress Doors: Latches do not require more than 15 lbf to release latch. Locks do not require use of key, tool, or special knowledge for operation.

J. Accessibility Requirements: For door hardware on doors in an accessible route, comply with governing accessibility regulations cited in "REFERENCES" article, herein.

1. Provide operating devices that do not require tight grasping, pinching, or twisting of wrist and that operate with force of not more than 5 lbf.
2. Maximum opening-force requirements:

a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
b. Sliding or Folding Doors: 5 lbf applied parallel to door at latch.
c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

3. Bevel raised thresholds with slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
4. Adjust door closer sweep periods so that, from open position of 70 degrees, door will take at least 3 seconds to move to 3 inches from latch, measured to leading edge of door.

K. Keying Conference: Conduct conference at Project site to comply with requirements in Division 01.

1. Attendees: Owner, Contractor, Architect, Installer, and Supplier's Architectural Hardware Consultant.
2. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:

a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
b. Preliminary key system schematic diagram.
c. Requirements for key control system.
d. Requirements for access control.
e. Address for delivery of keys.

L. Pre-installation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Inspect and discuss preparatory work performed by other trades.
3. Inspect and discuss electrical roughing-in for electrified door hardware.
4. Review sequence of operation for each type of electrified door hardware.
5. Review required testing, inspecting, and certifying procedures.

M. Coordination Conferences:

1. Installation Coordination Conference: Prior to hardware installation, schedule and hold meeting to review questions or concerns related to proper installation and adjustment of door hardware.

a. Attendees: Door hardware supplier, door hardware installer, Contractor.
b. After meeting, provide letter of compliance to Architect, indicating when meeting was held and who was in attendance.

2. Electrified Hardware Coordination Conference: Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

a. Attendees: electrified door hardware supplier, doors and frames supplier, electrified door hardware installer, electrical subcontractor, Owner.
b. After meeting, provide letter of compliance to Architect, indicating when coordination conference was held and who was in attendance.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

1. Deliver each article of hardware in manufacturer's original packaging.

C. Project Conditions:

1. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
2. Provide secure lock-up for door hardware delivered to Project, but not yet installed. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

D. Protection and Damage:

1. Promptly replace products damaged during shipping.
2. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work.
3. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

E. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.6 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

E. Direct shipments not permitted, unless approved by Contractor.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Years from date of Substantial Completion, for durations indicated.

a. Closers:

1) Mechanical: 10 years.

b. Automatic Operators: 1 year.
c. Exit Devices:

1) Mechanical: 3 years.
2) Electrified: 1 year.

d. Locksets:

1) Mechanical: 3 years.
2) Electrified: 1 year.

e. Continuous Hinges: Lifetime warranty
f. Key Blanks: Lifetime

2. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.

1.8 MAINTENANCE

A. Extra Materials: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents as required by Owner.

B. Maintenance Tools: Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.

B. Hand of Door: Drawings show direction of slide, swing, or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.

C. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.2 MATERIALS

A. Fasteners

1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.

2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
3. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless thru-bolts are required to fasten hardware securely. Review door specification and advise Architect if thru-bolts are required.
4. Install hardware with fasteners provided by hardware manufacturer.

B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

2.3 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Ives 5BB series
2. Acceptable Manufacturers and Products: Bommer BB series, McKinney TA/T4A series.

B. Requirements:

1. Provide five-knuckle ball bearing hinges conforming to ANSI/BHMA A156.1.
2. 1-3/4 inch thick doors, up to and including 36 inches wide:

   a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches high
   b. Interior: Standard weight, steel, 4-1/2 inches high

3. 1-3/4 inch thick doors over 36 inches wide:

   a. Exterior: Heavy weight, bronze/stainless steel, 5 inches high
   b. Interior: Heavy weight, steel, 5 inches high

4. Provide three hinges per door leaf for doors 90 inches or less in height, and one additional hinge for each 30 inches of additional door height.
5. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:

   a. Steel Hinges: Steel pins
   b. Non-Ferrous Hinges: Stainless steel pins
   c. Out-Swinging Exterior Doors: Non-removable pins
   d. Out-Swinging Interior Lockable Doors: Non-removable pins
   e. Interior Non-lockable Doors: Non-rising pins

6. Width of hinges: 4-1/2 inches at 1-3/4 inch thick doors, and 5 inches at 2 inches or thicker doors. Adjust hinge width as required for door, frame, and wall conditions to allow proper degree of opening.
7. Doors 36 inches wide or less furnish hinges 4-1/2 inches high; doors greater than 36 inches wide furnish hinges 5 inches high, heavy weight or standard weight as specified.
8. Provide hinges with electrified options as scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component.
9. Provide mortar guard for each electrified hinge specified.

2.4 CONTINUOUS HINGES

A. Aluminum Geared

1. Manufacturers:

a. Scheduled Manufacturer: Ives.
b. Acceptable Manufacturers: Select, Stanley.

2. Requirements:

a. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
b. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum, with 0.25-inch diameter Teflon coated stainless steel hinge pin.
c. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
d. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
e. On fire-rated doors, provide aluminum geared continuous hinges that are classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
f. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware.
g. Install hinges with fasteners supplied by manufacturer.
h. Provide hinges 1 inch shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.5 ELECTRIC POWER TRANSFER

A. Manufacturers:

1. Scheduled Manufacturer: Von Duprin EPT-10
2. Acceptable Manufacturers: ABH PT1000, Securitron CEPT-10

B. Provide power transfer with electrified options as scheduled in the hardware sets. Provide with number and gage of wires sufficient to accommodate electric function of specified hardware.

C. Locate electric power transfer per manufacturer's template and UL requirements, unless interference with operation of door or other hardware items.

2.6 FLUSH BOLTS

A. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Burns, Rockwood

B. Requirements:

1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch steel or brass rods at doors up to 90 inches in height. For doors over 90 inches in height increase top rods by 6 inches for each additional 6 inches of door height. Provide dust-proof strikes at each bottom flush bolt.

2.7 COORDINATORS

A. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Burns, Rockwood

B. Requirements:

1. Where pairs of doors are equipped with automatic flush bolts, an astragal, or other hardware that requires synchronized closing of the doors, provide bar-type coordinating device, surface applied to underside of stop at frame head.
2. Provide filler bar of correct length for unit to span entire width of opening, and appropriate brackets for parallel arm door closers and surface vertical rod exit device strikes. Factory-prep coordinators for vertical rod devices if required.

2.8 MORTISE LOCKS

A. Manufacturers and Products:

1. Owner Preferred Manufacturer and Product: Schlage L9000 series
2. Acceptable Manufacturers and Products: Corbin-Russwin ML2000 series, Sargent 8200 series

B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1 Operational, Grade 1 Security, and manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to "KEYING" article, herein.
2. Provide locks with standard 2-3/4 inches backset with full 3/4 inch throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1 inch throw, constructed of stainless steel.
3. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
4. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide a request to exit (RX) switch that is actuated with rotation of inside lever.
5. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.
    a. Lever Design: Schlage 03A.
    b. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.

2.9 EXIT DEVICES

A. Manufacturers and Products:

1. Owner Preferred Manufacturer and Product: Von Duprin 98/35 series
2. Acceptable Manufacturers and Products: Sargent 19-43-GL-80 series, Precision Apex series

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1, and UL listed for Panic Exit or Fire Exit Hardware. Cylinders: Refer to "KEYING" article, herein.
2. Provide touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
3. Touchpad: Extend minimum of one half of door width. Match exit device finish, stainless steel for US26, US26D, US28, US32, and US32D finishes; and for all other finishes, provide compatible finish to exit device. No plastic inserts are allowed in touchpads.
4. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
5. Provide flush end caps for exit devices.
6. Provide exit devices with manufacturer's approved strikes.
7. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.

8. Mount mechanism case flush on face of doors, or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
9. Provide cylinder dogging at non-fire-rated exit devices.
10. Removable Mullions: 2 inches x 3 inches steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
11. Where lever handles are specified as outside trim for exit devices, provide heavy-duty lever trims with forged or cast escutcheon plates. Provide vandal-resistant levers that will travel to 90-degree down position when more than 35 pounds of torque are applied, and which can easily be re-set.
    a. Lever Style: Match lever style of locksets.
    b. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.
12. Provide UL labeled fire exit hardware for fire rated openings.
13. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
14. Provide electrified options as scheduled.
15. Provide devices with all control inputs – door position input, external inhibit input, fire alarm input; auxiliary locking; nuisance alarm and internal horn; and, remote signaling output self-contained in the device assembly.

2.10 POWER SUPPLIES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Schlage/ Von Duprin PS900 series
2. Acceptable Manufacturers and Products: Securitron BPS series, Security Door Controls 600 series

B. Requirements:

1. Provide power supplies, recommended and approved by manufacturer of electrified locking component, for operation of electrified locks, electrified exit devices, magnetic locks, electric strikes, and other components requiring power supply.
2. Provide appropriate quantity of power supplies necessary for proper operation of electrified locking components as recommended by manufacturer of electrified locking components with consideration for each electrified component using power supply, location of power supply, and approved wiring diagrams. Locate power supplies as directed by Architect.
3. Provide regulated and filtered 24 VDC power supply, and UL class 2 listed.
4. Options:
    a. Provide power supply, where specified, with internal capability of charging sealed backup batteries 24 VDC, in addition to operating DC load.
    b. Provide sealed batteries for battery back-up at each power supply where specified.
    c. Provide keyed power supply cabinet.
5. Provide power supply in an enclosure, complete, and requiring 120VAC to fused input.
6. Provide power supply with emergency release terminals, where specified, that allow release of all devices upon activation of fire alarm system complete with fire alarm input for initiating "no delay" exiting mode.

2.11 CYLINDERS

A. Manufacturers:

1. Owner Preferred Manufacturer: Schlage

B. Requirements:

1. Provide full size interchangeable cylinders/cores to match Owner's existing key system, compliant with ANSI/BHMA A156.5; latest revision, Section 12, Grade 1; permanent cylinders; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.
2. Replaceable Construction Cores.
    a. Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
        1) 3 construction control keys
        2) 12 construction change (day) keys.
    b. Owner or Owner's Representative will replace temporary construction cores with permanent cores.

2.12 KEYING

A. Provide a factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Provide cylinders/cores keyed into Owner's existing keying system managed by Owner's locksmith, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference. Contact:

1. Firm Name:
2. Contact Person:
3. Telephone:

C. Requirements:

1. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
    a. Master Keying system as directed by the Owner, Schlage Everest D.
2. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements shall be cause for replacement of cylinders/cores involved at no additional cost to Owner.
3. Provide keys with the following features:
    a. Material: Nickel silver; minimum thickness of .107-inch.
    b. Patent Protection: Keys and blanks protected by one or more utility patent(s).
4. Identification:
    a. Mark permanent cylinders/cores and keys with applicable blind code per DHI publication "Keying Systems and Nomenclature" for identification. Blind code marks shall not include actual key cuts.
    b. Identification stamping provisions must be approved by the Architect and Owner.
    c. Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
    d. Failure to comply with stamping requirements shall be cause for replacement of keys involved at no additional cost to Owner.
    e. Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
5. Quantity: Furnish in the following quantities.
    a. Change (Day) Keys: 3 per cylinder/core.
    b. Permanent Control Keys: 3.

c. Master Keys: 6.

2.13 DOOR CLOSERS

A. Manufacturers and Products:

1. Owner Preferred Manufacturer and Product: LCN 4010/4110 series
2. Acceptable Manufacturers and Products: Sargent 281/281P10 series factory assembled (without PRV)

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2 inch diameter, with 5/8 inch diameter double heat-treated pinion journal.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves with separate adjustment for latch speed, general speed, and backcheck.
7. Provide closers with a solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI/BHMA Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.14 ELECTRO-MECHANICAL AUTOMATIC OPERATORS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: LCN Senior Swing.
2. Acceptable Manufacturers and Products: Besam Swingmaster MP, Horton 4000LE series.

B. Requirements:

1. Provide low energy automatic operator units that are electro-mechanical design complying with ANSI/BHMA A156.19.
    a. Opening: Powered by DC motor working through reduction gears.
    b. Closing: Spring force.
    c. Manual, hydraulic, or chain drive closers: Not permitted.
    d. Operation: Motor is off when door is in closing mode. Door can be manually operated with power on or off without damage to operator. Provide variable adjustments, including opening and closing speed adjustment.
    e. Cover: Aluminum.
2. Provide units with manual off/auto/hold-open switch, push and go function to activate power operator, vestibule interface delay, electric lock delay, hold-open delay adjustable from 2 to 30 seconds, and logic terminal to interface with accessories, mats, and sensors.
3. Provide drop plates, brackets, or adapters for arms as required to suit details.

4. Provide hard-wired motion sensors and/or actuator switches for operation as specified. Provide weather-resistant actuators at exterior applications.
5. Provide key switches, with LED's, recommended and approved by manufacturer of automatic operator as required for function as described in operation description of hardware sets. Cylinders: Refer to "KEYING" article, herein.
6. Provide complete assemblies of controls, switches, power supplies, relays, and parts/material recommended and approved by manufacturer of automatic operator for each individual leaf. Actuators control both doors simultaneously at pairs. Sequence operation of exterior and vestibule doors with automatic operators to allow ingress or egress through both sets of openings as directed by Architect. Locate actuators, key switches, and other controls as directed by Architect.
7. Provide units with inputs for smoke evacuation doors, where specified, which allow doors to power open upon fire alarm activation and hold open indefinitely or until fire alarm is reset, presence detector input, which prevents closed door from opening or door that is fully opened from closing, hold open toggle input, which allows remote activation for indefinite hold open and close second time input is activated, vestibule inputs, which allow sequencing operation of two units, and SPDT relay for interfacing with latching or locking devices.

2.15 DOOR TRIM

A. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Burns, Rockwood

B. Requirements:

1. Provide push plates 4 inches wide by 16 inches high by 0.050 inch thick and beveled 4 edges. Where width of door stile prevents use of 4 inches wide plate, adjust width to fit.
2. Provide push bars of solid bar stock, diameter and length as scheduled. Provide push bars of sufficient length to span from center to center of each stile. Where required, mount back to back with pull.
3. Provide offset pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
4. Provide flush pulls as scheduled. Where required, provide back-to-back mounted model.
5. Provide pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
6. Provide pull plates 4 inches wide by 16 inches high by 0.050 inch thick, beveled 4 edges, and prepped for pull. Where width of door stile prevents use of 4 inches wide plate, adjust width to fit.
7. Provide wire pulls of solid bar stock, diameter and length as scheduled.
8. Provide decorative pulls as scheduled. Where required, mount back to back with pull.

2.16 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Burns, Rockwood

B. Requirements:

1. Provide kick plates, mop plates, and armor plates minimum of 0.050 inch thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes of plates:

    a. Kick Plates: 10 inches high by 2 inches less width of door on single doors, 1 inch less width of door on pairs

b. Mop Plates: 4 inches high by 2 inches less width of door on single doors, 1 inch less width of door on pairs
c. Armor Plates: 36 inches high by 2 inches less width of door on single doors, 1 inch less width of door on pairs

2.17 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers: Glynn-Johnson
2. Acceptable Manufacturers: Rixson, Sargent

B. Requirements:

1. Provide heavy duty concealed mounted overhead stop or holder as specified for exterior and interior vestibule single acting doors.
2. Provide heavy duty concealed mounted overhead stop or holder as specified for double acting doors.
3. Provide heavy or medium duty and concealed or surface mounted overhead stop or holder for interior doors as specified. Provide medium duty surface mounted overhead stop for interior doors and at any door that swings more than 140 degrees before striking wall, open against equipment, casework, sidelights, and where conditions do not allow wall stop or floor stop presents tripping hazard.
4. Where overhead holders are specified provide friction type at doors without closer and positive type at doors with closer.

2.18 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Burns, Rockwood

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide convex type where mortise type locks are used and concave type where cylindrical type locks are used.
2. Where a wall stop cannot be used, provide universal floor stops for low or high rise options.
3. Where wall or floor stop cannot be used, provide medium duty surface mounted overhead stop.

2.19 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Scheduled Manufacturer: Zero International
2. Acceptable Manufacturers: National Guard, Reese

B. Requirements:

1. Provide thresholds, weather-stripping (including door sweeps, seals, and astragals) and gasketing systems (including smoke, sound, and light) as specified and per architectural details. Match finish of other items.
2. Size of thresholds:

a. Saddle Thresholds: 1/2 inch high by jamb width by door width
b. Bumper Seal Thresholds: 1/2 inch high by 5 inches wide by door width

3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.

2.20 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Burns, Rockwood

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.21 MAGNETIC HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer: LCN
2. Acceptable Manufacturers: Rixson, Sargent

B. Requirements:

1. Provide wall or floor mounted electromagnetic door release as specified with minimum of 25 pounds of holding force. Coordinate projection of holder and armature with other hardware and wall conditions to ensure that door sits parallel to wall when fully open. Connect magnetic holders on fire-rated doors into the fire control panel for fail-safe operation.

2.22 DOOR POSITION SWITCHES

A. Manufacturers:

1. Scheduled Manufacturer: Schlage
2. Acceptable Manufacturers: GE-Interlogix, Sargent

B. Requirements:

1. Provide recessed or surface mounted type door position switches as specified.
2. Coordinate door and frame preparations with door and frame suppliers. If switches are being used with magnetic locking device, provide minimum of 4 inches between switch and magnetic locking device.

2.23 COAT HOOKS

A. Manufacturers:

1. Scheduled Manufacturer: Ives.
2. Acceptable Manufacturers: Burns, Rockwood

B. Provide coat hooks as specified.

2.24 FINISHES

A. Finish: BHMA 626/652 (US26D); except:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Continuous Hinges: BHMA 628 (US28)
3. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
4. Protection Plates: BHMA 630 (US32D)
5. Overhead Stops and Holders: BHMA 630 (US32D)
6. Door Closers: Powder Coat to Match
7. Wall Stops: BHMA 630 (US32D)
8. Weatherstripping: Clear Anodized Aluminum
9. Thresholds: Mill Finish Aluminum

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

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

3.2 PREPARATION

A. Where on-site modification of doors and frames is required:

1. Carefully remove existing door hardware and components being reused. Clean, protect, tag, and store in accordance with storage and handling requirements specified herein.
2. When modifications are exposed to view, use concealed fasteners, when possible.
3. Prepare hardware locations and reinstall in accordance with installation requirements for new door hardware and with:

a. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
b. Wood Doors: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.

C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

H. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as indicated in keying section.
2. Furnish permanent cores to Owner for installation.

I. Wiring: Coordinate with Division 26, Electrical sections for:

1. Conduit, junction boxes and wire pulls.
2. Connections to and from power supplies to electrified hardware.
3. Connections to fire/smoke alarm system and smoke evacuation system.
4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
5. Testing and labeling wires with Architect's opening number.

J. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

K. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Closers shall not be visible in corridors, lobbies and other public spaces unless approved by Architect.

L. Closer/Holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.

M. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.

1. Configuration: Provide least number of power supplies required to adequately serve doors with electrified door hardware.

N. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

O. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.

P. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

Q. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

R. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 FIELD QUALITY CONTROL

A. Architectural Hardware Consultant: Engage qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.

1. Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.7 DEMONSTRATION

A. Provide training for Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Section 017900 "Demonstration and Training."

3.8 DOOR HARDWARE SCHEDULE

A. Locksets, exit devices, and other hardware items are referenced in the following hardware sets for series, type and function. Refer to the above-specifications for special features, options, cylinders/keying, and other requirements.

B. Hardware Sets:

HARDWARE SET NO. 01

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112HD EPT	628	IVE	
2	EA	POWER TRANSFER	EPT10	689	VON	
1	EA	REMOVABLE MULLION	KR4954	689	VON	
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-98-EO 24 VDC	626	VON	
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-98-NL-OP-110MD 24 VDC	626	VON	
1	EA	RIM CYLINDER	20-057 ICX Trim Cylinder	626	SCH	
1	EA	MORTISE CYLINDER	20-061 ICX 36-083 Mullion Cylinder	626	SCH	
2	EA	FSIC CORE	23-030 EV D	626	SCH	
2	EA	90 DEG OFFSET PULL	8190EZHD 10" STD	630-316	IVE	
1	EA	SURFACE CLOSER	4111 STD SCUSH	689	LCN	
1	EA	SURF. AUTO OPERATOR	9542 MS AS REQ (120/240 VAC)	ANCLR	LCN	
2	EA	ACTUATOR, WALL MOUNT	8310-853T	630	LCN	
1	EA	RAIN DRIP	142AA	AA	ZER	
2	EA	MULLION SEAL	8780NBK PSA	BK	ZER	
1	SET	GASKETING	BY DOOR/FRAME MANUFACTURER			
1	EA	ASTRAGAL	BY DOOR/FRAME MANUFACTURER			
2	EA	DOOR SWEEP	39A	A	ZER	
1	EA	THRESHOLD	655A	A	ZER	
1	EA	CREDENTIAL READER	SUPPLIED BY ACCESS CONTROL PROVIDER			
2	EA	DOOR CONTACT	679-05HM	BLK	SCE	
1	EA	POWER SUPPLY	PS902 900-4RL 120/240 VAC	LGR	SCE	
1	EA	DIAGRAM	ELEVATION		DLR	
1	EA	DIAGRAM	POINT TO POINT		DLR	

COORDINATE WITH ALL RELATED TRADES. ENTRY BY CREDENTIAL OR KEY OVERRIDE. DOORS CAN BE ELECTRICALLY DOGGED.
PRESENTING VALID CREDENTIAL TO READER WILL RETRACT LATCHBOLT ON PANIC HARDWARE, ACTIVATE EXTERIOR ACTUATOR AND ALLOW ENTRY. PRESSING ACTUATOR WHEN ACTIVE WILL AUTO OPEN DOOR. INTERIOR ACTUATOR ALWAYS ACTIVE.
UPON LOSS OF POWER DOOR IS LOCKED. DOOR IS ALWAYS AVAILABLE FOR FREE EGRESS.
DOOR CONTACTS TIED TO ACCESS CONTROL SYSTEM FOR MONITORING.

HARDWARE SET NO. 01A

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112HD EPT	628	IVE
2	EA	POWER TRANSFER	EPT10	689	VON
1	EA	REMOVABLE MULLION	KR4954	689	VON
1	EA	DUMMY TRIM	AD-993DT-RHO-J 12/24 VDC For Inactive Leaf	626	SCE
2	EA	ELEC PANIC HARDWARE	CDSI-RX-LC-98-EO	626	VON
1	EA	ELEC EXIT DEVICE TRIM	AD-300-993M-70-MT-RHO-J 12/24 VDC For Active Leaf	626	SCE
1	EA	MORTISE CYLINDER	20-061 ICX 36-083 Mullion Cylinder	626	SCH
2	EA	MORTISE CYLINDER	20-061 ICX XQ11-948 36-083 Dogging Cylinder	626	SCH
3	EA	FSIC CORE	23-030 EV D	626	SCH
2	EA	SURFACE CLOSER	4111 STD SCUSH	689	LCN
1	EA	RAIN DRIP	142AA	AA	ZER
2	EA	MULLION SEAL	8780NBK PSA	BK	ZER
1	SET	GASKETING	BY DOOR/FRAME MANUFACTURER		
1	EA	ASTRAGAL	BY DOOR/FRAME MANUFACTURER		
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A	A	ZER
2	EA	DOOR CONTACT	679-05HM	BLK	SCE

COORDINATE WITH ALL RELATED TRADES.
ENTRY BY CREDENTIAL OR KEY OVERRIDE. CYLINDER DOGGING AVAILABLE.
PRESENTING VALID CREDENTIAL TO READER WILL UNLOCK PANIC HARDWARE AND ALLOW ENTRY.
DOOR IS ALWAYS AVAILABLE FOR FREE EGRESS.
DOOR CONTACTS TIED TO ACCESS CONTROL SYSTEM FOR MONITORING.

HARDWARE SET NO. 02

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112HD	628	IVE
1	EA	STOREROOM LOCK	L9080T 06A	626	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	SURFACE CLOSER	4111 STD SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A	A	ZER

HARDWARE SET NO. 03

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112HD	628	IVE
1	EA	PANIC HARDWARE	LD-98-NL	626	VON
1	EA	RIM CYLINDER	20-057 ICX Trim Cylinder	626	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	SURFACE CLOSER	4111 STD SCUSH	689	LCN
1	EA	RAIN DRIP	142AA	AA	ZER
1	SET	GASKETING	BY DOOR/FRAME MANUFACTURER		
1	EA	DOOR SWEEP	8192AA	AA	ZER
1	EA	THRESHOLD	655A	A	ZER

HARDWARE SET NO. 04

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC CLASSROOM LOCK	AD-300-MS-70-MT-RHO-J 12/24 VDC	626	SCE
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	SURFACE CLOSER	4011 STD	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	POWER SUPPLY	PS902 120/240 VAC Coordinate Power Supply Requirement with Security Provider	LGR	SCE
1	EA	DIAGRAM	ELEVATION		DLR
1	EA	DIAGRAM	POINT TO POINT		DLR

COORDINATE WITH ALL RELATED TRADES. ENTRY BY CREDENTIAL OR KEY OVERRIDE. PRESENTING VALID CREDENTIAL TO READER WILL UNLOCK LOCK AND ALLOW ENTRY. DOOR IS ALWAYS AVAILABLE FOR FREE EGRESS.
DOOR CONTACTS TIED TO ACCESS CONTROL SYSTEM FOR MONITORING.

HARDWARE SET NO. 05

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK	L9040 06A 09-544 L283-722 (ADA THUMBTURN AND VACANT/OCCUPIED INDICATOR)	626	SCH
1	EA	OH STOP	90S	630	GLY
1	EA	COAT AND HAT HOOK	572	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE SET NO. 06

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM SECURITY	L9071T 06A L283-711 Less Inside Cylinder - Install thumbturn	626	SCH
1	EA	MORTISE CYL TURN	09-900 118 XB11-720	626	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	WALL STOP	WS406/407CVX	630	IVE

HARDWARE SET NO. 07

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080T 06A	626	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE SET NO. 08

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK	L9040 06A 09-544 L283-722 (ADA THUMBTURN AND VACANT/OCCUPIED INDICATOR)	626	SCH
1	EA	SURFACE CLOSER	4111 STD SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	COAT AND HAT HOOK	572	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE SET NO. 09

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	PANIC HARDWARE	98-L-2SI-06	626	VON
1	EA	RIM CYLINDER	20-057 ICX Trim Cylinder	626	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	RIM CYL THUMBTURN	XB11-979 Interior Cylinder	626	SCH
1	EA	SURFACE CLOSER	4111 STD EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE SET NO. 10

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	L9080T 06A	626	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	SURFACE CLOSER	4111 STD SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE SET NO. 11

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080T 06A	626	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	SURFACE CLOSER	4011 STD	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

END OF SECTION 087100

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes glazing for the following:

1. Doors.
2. Storefront framing.
3. Glazed entrances.

1.2 ACTION SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Glass Samples: For each type of the following products; 12 inches square.

1. Insulating glass.

C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

D. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For glass and glazing products, from manufacturer.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for coated glass, insulating glass, glazing sealants and glazing gaskets.

1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

D. Preconstruction adhesion and compatibility test report.

E. Warranties: Sample of special warranties.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.

B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

C. Source Limitations for Glass: Obtain tinted float glass, coated float glass, and insulating glass from single source from single manufacturer for each glass type.

D. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

E. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: GANA's "Glazing Manual."
2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

F. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201 and ANSI Z97.1.

G. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

H. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

I. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Install glazing in mockups specified in Section 084113 "Aluminum-Framed Entrances and Storefronts" to match glazing systems required for Project, including glazing methods.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

1.6 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 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 E 1300 by a qualified professional engineer, using the following design criteria:

1. Design Wind Pressures: As indicated on Drawings.
2. Design Snow Loads: As indicated on Drawings.
3. 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.
4. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
5. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

C. Roller Wave Distortion: Maximum of 0.003 inch from peak to valley in the center of lite, and a maximum of 0.008 inch within 10.5 inches of the leading or trailing edge.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

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" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

1. Provide safety glazing labeling.

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 insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
3. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
4. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
5. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.3 GLASS PRODUCTS

A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2.4 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.

1. Sealing System: Dual seal, with manufacturer's standard primary and secondary.
2. Spacer: Manufacturer's standard spacer material and construction.
3. Desiccant: Molecular sieve or silica gel, or blend of both.

B. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by designations in "Insulating-Glass Types" Article.

2.5 MONOLITHIC-GLASS TYPES

A. Glass Type **TMG**: Clear fully tempered float glass, minimum 1/4 inch thick.

2.6 INSULATING-GLASS TYPES

A. Glass Type **TNG**: Low-e-coated, tinted insulating glass.

1. Overall Unit Thickness: 1 inch.
2. Thickness of Each Glass Lite: 1/4 inch.
3. Outdoor Lite: Tinted, fully tempered float glass.
    a. Manufacturers:
        1) Vitro Glass; Solarban 70XL on Solargray (Basis of Design)
        2) AGC Glass Company
        3) Guardian Industries Corp.
    b. Low-E Coating: Sputtered on second surface.
4. Interspace Content: Air or argon.
5. Indoor Lite: Clear, fully tempered float glass.
6. Performance Requirements: Provide insulated units with values within two percent of the following:
    a. Visible Light Transmittance: 34 percent minimum.

b. Winter Nighttime U-Factor: 0.28 maximum.
c. Solar Heat Gain Coefficient: 0.20 maximum.

2.7 GLAZING GASKETS

A. Compression Gaskets: Molded or extruded gaskets of type and material indicated below and of profile and hardness required to maintain watertight seal:

1. Silicone dense compression gaskets complying with ASTM C 1115.
2. Silicone soft compression gaskets complying with ASTM C 509, Type II, black.

2.8 GLAZING SEALANTS

A. General:

1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

1. Products: Subject to compliance with requirements, provide the following:

a. Dow Corning Corporation; 790
b. GE Advanced Materials - Silicones; SilPruf LM SCS2700
c. May National Associates, Inc.; Bondaflex Sil 290
d. Pecora Corporation; 890
e. Sika Corporation, Construction Products Division; SikaSil-C990
f. Tremco Incorporated; Spectrem 1

2.9 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.10 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

PART 3 - EXECUTION

3.1 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches.

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.2 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.3 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.4 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.5 LOCK-STRIP GASKET GLAZING

A. Comply with ASTM C 716 and gasket manufacturer's written instructions. Provide supplementary wet seal and weep system unless otherwise indicated.

3.6 CLEANING AND PROTECTION

A. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

B. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

END OF SECTION 088000

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes non-load-bearing steel framing members for the following applications:

1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
2. Grid suspension systems for interior gypsum ceilings and soffits.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Indicate yield strength of steel, section properties, limiting heights and spans.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For dimpled steel studs and runners and firestop tracks, from ICC-ES.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Structural Properties: Manufacturer's published data on Structural Properties are calculated based on allowable stress design conforming to AISI "Specification of the Design of Cold-Formed Steel Structural Members."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Conventional Steel Framing: Subject to compliance with requirements, provide products by one of the following:

1. Allsteel & Gypsum Products, Inc.
2. Craco Manufacturing Inc.
3. Southeastern Stud and Components
4. Steel Construction Systems
5. The Formetal Co. Inc.
6. The Steel Network
7. Steelform USA

B. Dimpled/Knurled Studs: Subject to compliance with requirements, provide products by one of the following:

1. ClarkDietrich Building Systems: ProStud 20 and ProStud 22.
2. MarinoWARE: Viper 20S.
3. Telling Industries: Viper 20S.

2.2 FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.

   a. Steel having a yield strength greater than 33 KSI is permitted.

2. Protective Coating: ASTM A 653/A 653M, G60, hot-dip galvanized, unless otherwise indicated. Equivalent coatings are not acceptable and not allowed.

B. Minimum Base-Metal Thickness: Provide minimum base metal thickness specified or greater as required by the manufacturer's published performance data based on the following criteria:

1. Yield Strength of steel.
2. Deflection Limits:

   a. Gypsum Wallboard: L/240.
   b. Ceramic Tile: L/360.

3. Limiting Heights: As indicated on Drawings.
4. Spans: As indicated on Drawings or as recommended by manufacturer.
5. Applied loads:

   a. Gypsum wallboard: 5 psf.
   b. Ceramic tile, one side: 15 psf.
   c. Ceramic tile, two sides: 30 psf.

6. Depth: As indicated on Drawings.

C. Studs and Runners: ASTM C 645. Use either conventional steel studs and runners or dimpled steel studs and runners.

1. At standard gypsum board partitions.

   a. Conventional Studs: 0.027 inch (22 ga.).
   b. Dimpled Studs: 0.0179 inch, at 70 ksi yield strength (22 ga. equivalent).
   c. Dimpled Studs: 0.0190 inch, at 50 ksi yield strength (20 ga. equivalent).

2. At tile backer panels and supporting wall-hung cabinets.

   a. Conventional Studs: 0.0312 inch (20 ga.).
   b. Dimpled Studs: 0.022 inch, at 65 ksi yield strength (20 ga. equivalent).
   c. Dimpled Studs: 0.0190 inch, at 50 ksi yield strength (20 ga. equivalent).

3. Depth: As indicated on Drawings.

D. Slip-Type Head Joints: Provide one of the following:

1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.

3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

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:

a. Fire Trak Corp.; Fire Trak System attached to studs with Fire Trak Posi Klip
b. GCP Applied Technologies; FlameSafe FlowTrak System
c. Marino/WARE; Fas Track
d. Metal-Lite, Inc.; The System

F. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: 0.033 inch.
2. Backing Plates (Contractor's Option): In lieu of flat steel straps, provide ClarkDietrich Danback fire-retardant treated flexible wood backing plates system for the attachment of cabinets, handrails, and wall fixtures. Provide fire-retardant wood in rated walls.

G. Cold-Rolled Channel Bridging: Steel, 0.053-inch minimum base-metal thickness, with minimum 1/2-inch- wide flanges.

1. Depth: 1-1/2 inches or as indicated on Drawings.
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.

H. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base-Metal Thickness: 0.033 inch.
2. Depth: As indicated on Drawings.

I. Resilient Furring Channels: 1/2-inch- deep, steel sheet members designed to reduce sound transmission.

1. Configuration: Asymmetrical or hat shaped.

J. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch- wide flanges.

1. Depth: As indicated on Drawings.
2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch.
3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.

B. Hanger Attachments to Concrete:

1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.

a. Type: Cast-in-place anchor, designed for attachment to concrete forms or Postinstalled, expansion anchor.

2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.

C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.

D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch and minimum 1/2-inch- wide flanges.

1. Depth: As indicated on Drawings.

E. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch- wide flanges, 3/4 inch deep.
2. Steel Studs and Runners: ASTM C 645.

a. Minimum Base-Metal Thickness: 0.033 inch.
b. Depth: As indicated on Drawings.

3. Dimpled Steel Studs and Runners: ASTM C 645.

a. Minimum Base-Metal Thickness: 0.025 inch.
b. Depth: As indicated on Drawings.

4. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.

a. Minimum Base-Metal Thickness: 0.033 inch.

5. Resilient Furring Channels: 1/2-inch- deep members designed to reduce sound transmission.

a. Configuration: Asymmetrical.
b. Basis of Design: RC Deluxe by ClarkDietrich.

F. Grid Suspension System for Gypsum Board Ceilings (Contractor's Option): ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Armstrong World Industries, Inc.; Drywall Grid Systems.
b. Chicago Metallic Corporation; Drywall Grid System.
c. USG Corporation; Drywall Suspension System.

2.4 AUXILIARY MATERIALS

A. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide one of the following:

1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.

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

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction. Space studs as indicated on Drawings.

D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

a. Install two studs at each jamb, unless otherwise indicated.
b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

E. Direct Furring:

1. Screw to framing.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.5 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Do not attach hangers to steel roof deck.
5. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.

7. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Exterior gypsum board for ceilings and soffits.
3. Tile backing panels.

1.2 ACTION SUBMITTALS

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

1.3 QUALITY ASSURANCE

A. Source Limitations: Provide gypsum products manufactured within the United States from materials free of sulfur, formaldehyde or other deleterious chemicals. Natural gypsum ore shall be mined in North America. Synthetic (by-product) gypsum shall be pure calcium sulfate from domestic sources.

B. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

1. Fire-Resistance-Rated Assemblies: Indicated by design designations from UL's "Fire Resistance Directory".

C. 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.

D. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Install mockups for each level of gypsum board finish indicated for use in exposed locations.
2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
3. Simulate finished lighting conditions for review of mockups.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install interior products until installation areas are enclosed and conditioned.

1. Installation of gypsum panels before areas are enclosed and conditioned is done at Contractor's own risk. Damaged panels shall be removed and new panels installed at Contractor's expense and will not be deemed cause for additional time.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PANELS, GENERAL

A. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.2 INTERIOR GYPSUM BOARD

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Gypsum.
2. Certainteed Corporation
3. Georgia-Pacific Gypsum LLC
4. Lafarge North America Inc.
5. National Gypsum Company
6. Temple-Inland Inc.
7. USG Corporation.

B. Gypsum Board, Type X: ASTM C1396/C1396M.

1. Thickness: 5/8 inch.
2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.
3. Location: Vertical surfaces, unless otherwise indicated.

C. Gypsum Ceiling Board: ASTM C1396/C1396M.

1. Thickness: 5/8 inch.
2. Long Edges: Tapered.

2.3 EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS

A. Exterior Gypsum Soffit Board: ASTM C1396/C1396M, with manufacturer's standard edges.

1. Core: Type X, 5/8 inch.

2.4 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or 1325, with manufacturer's standard edges.

1. Products: Subject to compliance with requirements, provide one of the following:

a. C-Cure; C-Cure Board 990
b. CertainTeed Corp.; FiberCement BackerBoard
c. Custom Building Products; Wonderboard
d. FinPan, Inc.; Util-A-Crete Concrete Backer Board
e. James Hardie Building Products, Inc.; Hardiebacker
f. National Gypsum Company, Permabase Cement Board
g. USG Corporation; DUROCK Cement Board

2. Thickness: 5/8 inch.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.5 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:

a. Cornerbead: Use at outside corners, unless otherwise indicated.
b. Bullnose Bead: Use where indicated.
c. LC-Bead: J-shaped; exposed long flange receives joint compound.
d. L-Bead: L-shaped; exposed long leg receives joint compound; use at exposed terminations of gypsum board panels.
e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
f. Expansion (Control) Joint: Galvanized or aluminum-coated steel sheet or rolled zinc control joint with 1/2 inch to 3/4 inch grounds for drywall finishes. Staple or screw grounds to panel face.

B. Exterior Trim: ASTM C1047.

1. Material: Hot-dip galvanized-steel sheet, plastic, or rolled zinc.
2. Shapes:

a. Cornerbead.
b. LC-Bead: J-shaped; exposed long flange receives joint compound.
c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

2.6 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.
2. Exterior Gypsum Soffit Board: Paper.
3. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use joint setting compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use joint setting compound.
3. Fill Coat: For second coat, use joint setting compound.
4. Finish Coat: For third coat, use drying-type compound.

D. Joint Compound for Exterior Applications:

1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.

E. Joint Compound for Tile Backing Panels: As recommended by backing panel manufacturer.

F. Spot Grout: ASTM C 475, setting-type joint compound recommended for spot-grouting hollow metal door frames.

2.7 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.

D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
2. Provide sound attenuation blankets free of formaldehyde.

E. Acoustical Sealant: As specified in Section 079200 "Joint Sealants."

F. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.

B. Examine weathertight building enclosure, with Installer present, and verify that delivery, storage, and installation of gypsum panel products will not be affected by exposure to moisture beyond limits recommended by manufacturer.

C. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

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

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.

C. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

D. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

E. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

F. Form control and expansion joints with space between edges of adjoining gypsum panels.

G. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch wide joints to install sealant.

H. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

I. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

J. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

K. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.

1. Space screws a maximum of 12 inches o.c. for vertical applications.

L. Space fasteners in panels that are tile substrates a maximum of 8 inches o.c.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
    a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

B. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints 1 framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

C. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.4 APPLYING EXTERIOR GYPSUM PANELS FOR CEILINGS AND SOFFITS

A. Apply panels perpendicular to supports, with end joints staggered and located over supports.

1. Install with 1/4-inch open space where panels abut other construction or structural penetrations.
2. Fasten with corrosion-resistant screws.

3.5 APPLYING TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile.

B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.6 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints at locations indicated on Drawings, or, if not shown, according to ASTM C 840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners, unless otherwise indicated.
2. LC-Bead: Use at exposed panel edges.
3. L-Bead: Use where indicated.

4. U-Bead: Use at exposed panel edges.

D. Exterior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners.
2. LC-Bead: Use at exposed panel edges.

3.7 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:

1. Level 0: This level of finish shall be used in temporary construction only. No taping, finishing, or accessories required unless indicated or specified as in dust proof partitions.
2. Level 1: This level shall be used in ceiling plenum areas and concealed areas unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies. Embed tape at joints.
3. Level 2: This level of finish shall be used where water resistant gypsum backing board is used as a substrate for tile. Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges where indicated.
4. Level 3: This level of finish shall be used in areas to receive heavy textured, thick (1/8 inch or greater) wall coverings and where indicated. Embed tape and apply separate first and finish coats of joint compound to tape, fasteners, and trim flanges.
5. Level 4: This level of finish shall be used for areas to receive smooth paint finish. Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces.

    a. Tape joints require joint compound and feathering of joint to a minimum of 12 inches each side of joint.
    b. Tape joints that are visible through finished walls are not acceptable.

E. Cementitious Backing Panels: Finish according to manufacturer's written instructions.

3.8 FIELD QUALITY CONTROL

A. Above-Ceiling Observation: Before Contractor installs gypsum board ceilings, Architect will conduct an above-ceiling observation and report deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.

1. Notify Architect seven days in advance of date and time when Project, or part of Project, will be ready for above-ceiling observation.
2. Before notifying Architect, complete the following in areas to receive gypsum board ceilings:

    a. Installation of 80 percent of lighting fixtures, powered for operation.
    b. Installation, insulation, and leak and pressure testing of water piping systems.
    c. Installation of air-duct systems.
    d. Installation of air devices.
    e. Installation of mechanical system control-air tubing.

f. Installation of ceiling support framing.
g. Installation of through-penetration firestopping and fire-resistant joint sealants, with identification labels.

3.9 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 093000 - TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Porcelain floor tile.
2. Ceramic wall tile.
3. Stone thresholds.
4. Crack isolation membrane.

1.2 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. ANSI A108 Series which are contained in "American National Standard Specifications for Installation of Ceramic Tile."

1.3 ACTION SUBMITTALS

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

B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

C. Samples: For each type of tile and grout indicated. Include Samples of accessories involving color selection.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Certificates: For each type of product, signed by product manufacturer.

C. Material Test Reports: For each tile-setting and -grouting product.

1.5 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain tile of each type and color or finish from one source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.

C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of each type of floor and wall tile installation.
2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

D. Preinstallation Conference: Conduct conference at Project site.

1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

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

D. Store liquid materials in unopened containers and protected from freezing.

E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.8 EXTRA MATERIALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 2 percent of amount installed for each type, composition, color, pattern, and size indicated.
2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard grade requirements unless otherwise indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

2.2 TILE PRODUCTS

A. Manufacturers: Subject to compliance with requirements, provide basis of design indicated or Architect approved comparable product by one of the following:

1. American Olean; Division of Dal-Tile International Inc.
2. Crossville Tile
3. Daltile; Division of Dal-Tile International Inc.
4. Florida Tile Industries, Inc.

B. Tile, General:

1. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile.
2. Porcelain tile shall be through-body.
3. All edges shall be rectified.
4. Dynamic Coefficient of Friction: Provide a minimum of 0.42 DCOF for floor tile in wet areas.

C. Porcelain Paver Tile: Unglazed porcelain paver tile.

1. Basis of Design: Daltile; Porcealto Graniti.
2. Composition: Through-body porcelain.
3. Face Size: 8 by 8 inches.
4. Face: Plain with cushion edges.
5. Tile Color: As selected by Architect from manufacturer's full range, equal to Group 1 Graniti.
6. Grout Color: As selected by Architect from manufacturer's full range.
7. Number of Colors: 2
8. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile.
    a. Base: 6 by 8 inches, coved base.
    b. Corners: For coved base use angle pieces designed to fit with stretcher shapes.

D. Ceramic Wall Tile: Glazed ceramic wall tile.

1. Basis of Design: Daltile; Semi-Gloss
2. Face Size: 6 by 6 inches.
3. Face: Plain with cushion edges.
4. Finish: Gloss.
5. Tile Color: As selected by Architect from manufacturer's full range.
6. Grout Color: As selected by Architect from manufacturer's full range.
7. Trim: Bullnose wainscot cap.

2.3 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.

B. Thresholds:

1. Marble ASTM C 503, with a minimum abrasion resistance of 10 per ASTM C 1353 or ASTM C 241 and with honed finish.
2. Finish: Honed.
3. Description: Uniform, fine- to medium-grained stone.
4. Color: As selected by Architect.

2.4 CRACK ISOLATION MEMBRANE

A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.12 for standard performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and fabric reinforcement.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Bonsal American; an Oldcastle company; B 6000 Waterproof Membrane with Glass Fabric
b. Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane
c. Laticrete International, Inc.; Laticrete Blue 92 Anti-Fracture Membrane
d. MAPEI Corporation; Mapelastic HPG with MAPEI Fiberglass Mesh

2.5 SETTING MATERIALS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bonsal American; an Oldcastle company
2. Custom Building Products
3. Laticrete International, Inc.
4. MAPEI Corporation
5. Southern Grouts & Mortars, Inc.
6. Summitville Tiles, Inc.
7. TEC; a subsidiary of H. B. Fuller Company

B. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.

1. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

2.6 GROUT MATERIALS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bonsal American; an Oldcastle company
2. Custom Building Products
3. Laticrete International, Inc.
4. MAPEI Corporation
5. Southern Grouts & Mortars, Inc.
6. Summitville Tiles, Inc.
7. TEC; a subsidiary of H. B. Fuller Company

B. Polymer-Modified Tile Grout: ANSI A118.7.

1. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.

2.7 ELASTOMERIC SEALANTS

A. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the following requirements and with the applicable requirements in Section 079200 "Joint Sealants."

1. Use primers, backer rods, and sealant accessories recommended by sealant manufacturer.

B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.

2.8 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Temporary Protective Coating: Either product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.

1. Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 120 to 140 deg F per ASTM D 87.
2. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.

C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

D. Grout Sealer: Manufacturer's standard product for sealing grout joints that is acceptable to manufacturer of grout and that does not change color or appearance of grout.

2.9 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap,

wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.

2. Verify that concrete substrates for tile floors installed with thin-set mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
    a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

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

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

D. Field-Applied Temporary Protective Coating: When recommended by manufacturer to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 TILE INSTALLATION

A. Comply with TCNA's "Handbook for Ceramic Tile Installation" for TCNA installation methods applicable for field condition. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods applicable for field condition, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 Series of tile installation standards for providing 95 percent mortar coverage:
    a. Tile floors in wet areas.
    b. Tile floors composed of tiles 8 by 8 inches or larger.
    c. Tile floors composed of rib-backed tiles.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

1. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
2. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

E. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

1. Paver Tile: 3/16 inch.
2. Wall Tile: 1/8 inch.

F. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, in accordance with ANSI and TCNA recommendations. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

G. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.

1. Do not extend cleavage membrane or crack isolation membrane under thresholds set in dry-set portland cement or latex-portland cement mortar. Fill joints between such thresholds and adjoining tile with elastomeric sealant.

H. Grout Sealer: Apply grout sealer to cementitious grout joints in tile floors according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 CRACK ISOLATION MEMBRANE INSTALLATION

A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.

B. Do not install tile or setting materials over crack isolation membrane until membrane has cured.

3.5 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove latex-portland cement grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.

B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.6 INTERIOR TILE INSTALLATION SCHEDULE

A. Paver Tile Installation F113: Thin-set mortar.

1. Tile Type: Porcelain paver tile.
2. Thin-Set Mortar: Latex- portland cement mortar.
3. Grout: Polymer-modified sanded grout.

B. Wall Tile Installations, Metal Studs or Furring W244: Thin-set mortar on cementitious backer board.

1. Tile Type: Ceramic wall tile.
2. Thin-Set Mortar: Latex- portland cement mortar.
3. Grout: Polymer-modified unsanded grout.

END OF SECTION 093000

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes acoustical panels and exposed suspension systems for interior ceilings.

B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified, 6 inches in size.

C. Delegated-Design Submittal: For seismic restraints for ceiling systems.

1. Include design calculations for seismic restraints including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension-system members.
2. Structural members to which suspension systems will be attached.
3. Method of attaching hangers to building structure.
    a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
5. Size and location of initial access modules for acoustical panels.
6. Items penetrating finished ceiling and ceiling-mounted items including the following:
    a. Lighting fixtures.
    b. Diffusers.
    c. Grilles.
    d. Speakers.
    e. Sprinklers.
    f. Access panels.
    g. Perimeter moldings.
7. Minimum Drawing Scale: 1/8 inch = 1 foot.

B. Evaluation Reports: For seismic wall angles and seismic separation clips.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Units: Full-size panels equal to 5 percent of quantity installed.
2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.
3. Hold-Down Clips: Equal to 2 percent of quantity installed.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong World Industries, Inc
2. CertainTeed Corporation
3. USG Interiors, Inc.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:

1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
    a. Identify materials with appropriate markings of applicable testing and inspecting agency.
2. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:
    a. Flame-Spread Index: 25 or less.
    b. Smoke-Developed Index: 50 or less.

B. Delegated Design: Engage a qualified professional engineer to design seismic restraints for ceiling systems.

C. Seismic Performance: Suspended ceilings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7 and CISCA's Guidelines for Systems Requiring Seismic Restraint: Comply with CISCA's "Guidelines for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies--Seismic Zones 0-2."

2.3 ACOUSTICAL PANELS, GENERAL

A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.

B. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273, ASTM D 3274, or ASTM G 21 and evaluated according to ASTM D 3274 or ASTM G 21.

2.4 ACOUSTICAL PANELS

A. Acoustical Panel **(ACT-1)**:

1. Basis of Design: Armstrong; Zone Fine Fissured, 1717.
2. Classification: Provide panels as follows:
    a. Type and Form: Type III, mineral base with painted finish; Form 2, water felted.
    b. Pattern: CE (perforated, small holes and lightly textured).
3. Color: White.
4. Light Reflectance (LR): Not less than 0.85.
5. Ceiling Attenuation Class (CAC): Not less 40.
6. Noise Reduction Coefficient (NRC): Not less than 0.70.
7. Edge/Joint Detail: Angled tegular.
8. Thickness: 3/4 inch.
9. Modular Size: 24 by 24 inches.

B. Acoustical Panel **(VFP-1)**:

1. Basis of Design: Armstrong; Pebble 2988
2. Classification: Provide panels as follows:
    a. Type and Form: Type XII, glass-fiber base with membrane-faced overlay; Form 1, vinyl.
    b. Pattern: E (Lightly Textured).

3. Color: White.
4. Light Reflectance (LR): Not less than 0.89.
5. Noise Reduction Coefficient (NRC): Not less than 0.80.
6. Edge/Joint Detail: Square lay-in.
7. Thickness: 1 inch.
8. Modular Size: 24 by 24 inches.

2.5 METAL SUSPENSION SYSTEM

A. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C 635/C 635M and designated by type, structural classification, and finish indicated.

1. High-Humidity Finish: Where indicated, provide coating tested and classified for "severe environment performance" according to ASTM C 635/C 635M.

B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation; with prefinished 15/16-inch-wide metal caps on flanges.

1. Basis of Design: Armstrong; Prelude XL
2. Structural Classification: Intermediate-duty system.
3. End Condition of Cross Runners: Override (stepped) type.
4. Face Design: Flat, flush.
5. Cap Material: Cold-rolled steel.
6. Cap Finish: Painted white.
7. Provide fire-rated grid where required.

2.6 ACCESSORIES

A. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

B. Wire Hangers, Braces, and Ties: Provide wires as follows:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
2. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch-diameter wire.

C. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches o.c. on all cross tees.

D. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical panels in place during a seismic event.

E. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.

F. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

G. Seismic Separation Joints: Provide manufacturer’s approved seismic joint clips for main and cross beams. Provide one of the following:

1. Armstrong; SJMR, SJCG, and SJCSI.
2. Certainteed; CTSTJ transition clip system.

3. USG; Seismic Separation Joint Clips.

H. Single Tee Adapter Clip: Manufacturer's standard. Provide with running bond ceilings.

2.7 METAL EDGE MOLDINGS AND TRIM

A. Provide edge moldings and trim from the manufacturer of suspension system.

B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

1. Edge moldings shall fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration with 3/8-inch clearance.
4. For sprinkler heads and other penetrations, provide 2-inch oversized ring or sleeve through the ceiling to allow for free movement of at least 1 inch in all horizontal directions.
5. Wall Angle: 7/8-inch wide, approved for use in seismic areas.
    a. Armstrong Seismic RX with BERC2 Clips.
    b. Certainteed; CTSPC clips system
    c. USG; DX main and cross runners with ACM7 clips.

2.8 AUXILIARY MATERIALS

A. Acoustical Sealant: As specified in Section 079200 "Joint Sealants."

B. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

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

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.

B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION

A. Install acoustical panel ceilings according to ASTM C 636/C 636M, seismic design requirements, and manufacturer's written instructions.

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
6. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
7. Do not attach hangers to steel deck tabs.
8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
9. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
10. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
11. Install hanger wire as specified above within 6 inches of each corner of the grid at every light, air diffuser, air return grill, and other equipment items which are installed within or penetrate the ceiling system.

C. Where area of ceiling exceeds 2500 square feet provide seismic separation joints as indicated, or, if not indicated, as directed by Architect.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
4. Install seismic edge molding in accordance with manufacturer’s written recommendations with all accessories necessary to comply with ICC evaluation report.

E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.

1. Arrange directionally patterned acoustical panels in a basket-weave pattern.
2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
3. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
4. For reveal-edged panels on suspension system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension system surfaces and panel faces flush with bottom face of runners.
5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
6. Install hold-down clips at entrances and in areas required by authorities having jurisdiction; space as recommended by panel manufacturer's written instructions, unless otherwise indicated.
7. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.
8. Install seismic clips as required.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Periodic inspection during the installation of suspended ceiling grids according to ASCE/SEI 7.

B. Acoustical panel ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.

3.5 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Resilient base.
2. Resilient molding accessories.

1.2 ACTION SUBMITTALS

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

B. Samples: For each type of product indicated, in manufacturer's standard-size Samples, of each resilient product color, texture, and pattern required.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.5 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong World Industries, Inc.

2. Johnsonite.
3. Mannington Commercial
4. Roppe
5. VPI, LLC; Floor Products Division.

2.2 RESILIENT BASE

A. Resilient Base Standard: ASTM F 1861.

1. Material Requirement: Type TS (vulcanized thermoset rubber) or Type TP (rubber, thermoplastic).
2. Manufacturing Method: Group I (solid, homogenous).
3. Style: Cove (base with toe).
4. Minimum Thickness: 0.125 inch.
5. Height: 4 inches, unless otherwise indicated.
6. Lengths: Coils in manufacturer's standard length, but not less than 96 feet.
7. Outside and Inside Corners: Preformed.
8. Colors: As selected by Architect from manufacturer's full range.

2.3 RESILIENT MOLDING ACCESSORIES

A. Description:

1. Reducer strips.
2. Transition strips.

B. Material: Rubber or vinyl.

C. Profile and Dimensions: As selected by Architect.

D. Colors and Patterns: As selected by Architect from full range of industry colors.

2.4 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

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

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates for Resilient Accessories: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.
4. Moisture Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient products until they are same temperature as the space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of resilient floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

B. Perform the following operations immediately after completing resilient product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products until Substantial Completion.

END OF SECTION 096513

SECTION 096520 - RESILIENT PLANK FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Luxury vinyl floor planks.

1.2 ACTION SUBMITTALS

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

B. Shop Drawings: Include floor plank layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

C. Samples: Full-size units of each color and pattern required.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer to perform work of this Section who has specialized in installing resilient products similar to those required for this Project and with a record of successful in-service performance.

B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.6 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer in spaces to receive flooring.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer.

C. Close spaces to traffic during flooring installation and for 48 hours after flooring installation.

D. Install flooring after other finishing operations, including painting, have been completed.

E. Do not install flooring over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive, as determined by flooring manufacturer's recommended bond and moisture test.

PART 2 - PRODUCTS

2.1 LUXURY VINYL FLOOR PLANKS

A. Luxury Vinyl Planks: Products complying with ASTM F 1700, Class III - printed film vinyl, Type B - embossed surface.

1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:

   a. Armstrong
   b. Bolyu
   c. Mannington Commercial
   d. Shaw Contract
   e. Tandus Centiva
   f. Tarkett

2. Color: As selected by Architect from manufacturer's full range.
3. Size: 7.25 by 48 inches.
4. Wear Layer Thickness: 20 mil.

2.2 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit flooring and substrate conditions indicated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
4. Moisture Testing: Perform tests recommended by floor covering manufacturer. Proceed with installation only after substrates pass testing.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor planks until they are same temperature as space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.2 FLOOR INSTALLATION

A. Comply with manufacturer's written instructions for installing floor planks.

B. Apply leveling compound at transitions from tile to resilient flooring and feather out over two feet.

C. Lay out floor planks from center marks established with principal walls, discounting minor offsets, so planks at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half plank at perimeter.

1. Lay planks square with room axis.

D. Match floor planks for color and pattern by selecting planks from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed planks.

1. Lay planks with grain running in one direction.

E. Scribe, cut, and fit floor planks to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

F. Extend floor planks into toe spaces, door reveals, closets, and similar openings. Extend floor planks to center of door openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor planks as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

H. Adhere floor planks to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

I. Hand roll resilient flooring according to manufacturer's written instructions.

J. Cleaning and Protection: Comply with manufacturer's written instructions for cleaning and protection of flooring.

END OF SECTION 096520

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following substrates:

1. Galvanized metal.
2. Steel.
3. Wood.
4. Gypsum board.
5. Concrete.

1.2 ACTION SUBMITTALS

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

B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

C. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.

1.3 CLOSEOUT SUBMITTALS

A. Mix Formula: For each color provided.

1.4 QUALITY ASSURANCE

A. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.

a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft.
b. Other Items: Architect will designate items or areas required.

2. Apply benchmark samples after permanent lighting and other environmental services have been activated.
3. Final approval of color selections will be based on benchmark samples.

a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1.6 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.

1. Quantity: Furnish an additional 2 percent, but not less than 1 gal. of each material and color applied.

PART 2 - PRODUCTS

2.1 PAINT, GENERAL

A. Painting Schedule: Refer to end of Part 2 of this Section for listing of applications for each product.

B. Products, General: Refer to Part 2 for specific products. Subject to compliance with requirements, provide the products indicated or comparable products from one of the listed manufacturers for each substrate.

C. Colors: As selected by Architect from manufacturer's full range.

D. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

2.2 PRIMERS/SEALERS

A. Interior, Institutional Low Odor/VOC Primer/Sealer:

1. Benjamin Moore; Ultra Spec Zero VOC Primer, 534
2. PPG; Speedhide Interior Zero VOC Latex Sealer, 6-4900XI
3. Sherwin-Williams; ProMar 200 Zero Interior Latex Primer, B28W02600

2.3 METAL PRIMERS

A. Waterborne Galvanized-Metal Primer:

1. Benjamin Moore; Super Spec HP Acrylic Metal Primer, P04
2. PPG; Pitt-Tech Plus Int/Ext DTM Industrial Primer, 90-912
3. Sherwin-Williams; Pro Industrial Pro-Cryl Universal Primer, B66W310

B. Rust-Inhibitive Primer (Water Based):

1. Benjamin Moore; Acrylic Metal Primer, M04
2. PPG; Pitt-Tech Plus Int/Ext DTM Industrial Primer, 90-912
3. Sherwin-Williams; Pro-Industrial Pro-Cryl Universal Primer, B66W310

2.4 WOOD PRIMERS

A. Wood-Knot Sealer: White shellac or other sealer recommended in writing by manufacturer for this purpose.

B. Interior Latex-Based Wood Primer:

1. Benjamin Moore; Seal Lock Plus Primer/Sealer, IL-6800
2. PPG; Seal Grip Int/Ext Stain Blocking Primer, 17-921
3. Sherwin-Williams; Synthetic Shellac, B49W60

2.5 LATEX PAINTS

A. Institutional Low-Odor/VOC Latex (Flat - Gloss Level 1):

1. Benjamin Moore; Ultra Spec Zero VOC Flat, 536
2. PPG; Speedhide Zero Interior Zero-VOC Latex Flat 6-4110XI
3. Sherwin-Williams; ProMar 200 Zero VOC Flat, B30W2600 Series

B. Institutional Low-Odor/VOC Latex (Low-Sheen/Eggshell - Gloss Level 3).

1. Benjamin Moore; Ultra Spec Zero VOC Low Sheen, 537
2. PPG; Speedhide Zero Interior Zero-VOC Latex Eggshell 6-4310XI
3. Sherwin-Williams; ProMar 200 Eg-Shel Latex, B20W2600 Series

C. Institutional Low-Odor/VOC Latex (Semi-Gloss - Gloss Level 5):

1. Benjamin Moore; Ultra Spec Zero VOC Semi-Gloss, 539
2. PPG; Speedhide Zero Interior Zero-VOC Latex Semi-Gloss 6-4510XI
3. Sherwin-Williams; ProMar 200 Zero VOC Interior Latex Semi-Gloss, B31W2600 Series

2.6 EPOXY PAINTS

A. Interior Pre-Catalyzed Epoxy, (Eggshell):

1. Benjamin Moore; Pre Catalyzed Epoxy Eggshell, V342.
2. PPG; Pitt-Glaze WB1 Pre-Catalyzed Epoxy Eggshell, 16-310C
3. Sherwin-Williams; Pro Industrial Pre-Catalyzed Epoxy Eg-Shel, K45-151 Series

B. Interior Pre-Catalyzed Epoxy, (Semi-gloss):

1. Benjamin Moore; Pre Catalyzed Epoxy Semi-Gloss, V341.
2. PPG; Pitt-Glaze WB1 Pre-Catalyzed Epoxy Semi-Gloss, 16-510

3. Sherwin-Williams; Pro Industrial Pre-Catalyzed Epoxy Semi-Gloss, K46-151 Series

2.7 FLOOR COATINGS

A. Interior/Exterior Clear Concrete Floor Sealer (Water Based):

1. Benjamin Moore; Concrete Waterproofing Sealer, 075
2. PPG; Porter Plex-Seal W.B. Sealer 3215
3. Sherwin-Williams; H & C Concrete & Masonry Waterproofing Sealer 50.043054

2.8 INTERIOR PAINTING SCHEDULE

A. Galvanized-Metal Substrates:

1. Pre-Catalyzed Epoxy System:

a. Prime Coat: Shop-applied primer or waterborne galvanized-metal primer.
b. Intermediate Coat: Interior pre-catalyzed epoxy matching topcoat.
c. Topcoat: Interior pre-catalyzed epoxy, (semigloss).

B. Steel Substrates:

1. Pre-Catalyzed Epoxy System:

a. Prime Coat: Shop-applied primer or rust-inhibitive primer (water based).
b. Intermediate Coat: Interior pre-catalyzed epoxy matching topcoat.
c. Topcoat: Interior pre-catalyzed epoxy, (semigloss).

C. Wood Substrates: Including painted plywood.

1. Institutional Low-Odor/VOC Latex System:

a. Prime Coat: Interior latex-based wood primer.
b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
c. Topcoat: Institutional low-odor/VOC interior latex (semigloss).

D. Gypsum Board Substrates:

1. Institutional Low-Odor/VOC Latex System:

a. Prime Coat: Institutional low-odor/VOC interior latex primer/sealer.
b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
c. Topcoat for Ceilings: Institutional low-odor/VOC interior latex (flat).
d. Topcoat for Other Locations: Institutional low-odor/VOC interior latex (eggshell).

2. Pre-Catalyzed Epoxy System:

a. Prime Coat: Institutional low-odor/VOC interior latex primer/sealer.
b. Topcoat for Toilets and High Traffic Areas: Interior pre-catalyzed epoxy, (eggshell).

E. Concrete Substrates, Traffic Surfaces:

1. Water-Based Clear Sealer System:

a. First Coat: Interior/exterior clear concrete floor sealer (water based).
b. Topcoat: Interior/exterior clear concrete floor sealer (water based).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Wood: 15 percent.
2. Gypsum Board: 12 percent.
3. Concrete: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Application of coating constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions applicable to substrates indicated.

B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

D. Apply field primer to unfinished shop primed surfaces.

E. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

1. Galvanized-metal substrates should not be chromate passivated (commercially known as "bonderized") if primers are field applied. If galvanized metal is chromate passivated, consult manufacturers for appropriate primers.

F. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.

G. Shop Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

I. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

J. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Back Rolling: Back roll all spray applications on walls and ceilings to allow for touch up.

F. Apply primers and finish coats in accordance with manufacturer's recommended dry-film thickness, square foot per gallon, and mil thickness per coat. Do not add solvent or thinner to paint and coating products.

G. Allow adequate curing time before handling and before applying subsequent coats.

H. Painting Mechanical and Electrical Work: Paint same color as the adjoining substrate items exposed in equipment rooms and occupied spaces including, but not limited to, the following:

1. Mechanical Work:

a. Uninsulated metal and plastic piping.
b. Pipe hangers and supports.
c. Tanks that do not have factory-applied final finishes. Should be prefinished.

d. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
e. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
f. Mechanical equipment that is indicated to have a factory-primed finish for field painting.

2. Electrical Work:

a. Switchgear.
b. Panelboards.
c. Electrical equipment that is indicated to have a factory-primed finish for field painting.

3.4 MARKING AND IDENTIFICATION

A. Fire walls, fire barriers, fire partitions, smoke barriers and smoke partitions or any other wall required to have protected openings or penetrations shall be effectively and permanently indentified with signs or stenciling. Such identification shall:

1. Be located in accessible concealed floor, floor-ceiling or attic spaces; and
2. Be repeated at intervals not exceeding 20 feet measured horizontally along both sides of the wall or partition; and
3. Include red lettering not less than 2 inches in height, incorporating the suggested wording: "_X HOUR FIRE AND/OR SMOKE BARRIER-PROTECT ALL OPENINGS," or other wording approved or required by Authority Having Jurisdiction (AHJ). Replace “X” with the appropriate designated hourly rating.
4. Apply a minimum one-inch wide bright red horizontal line, both sides of wall, interrupted for approved text, at the required interval.
5. Refer to the Drawings for locations of walls and for applicable types and ratings.

3.5 CLEANING AND PROTECTION

A. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

END OF SECTION 099123

SECTION 099600 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of high-performance coating systems on the following substrates:

1. Exterior galvanized steel.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. Samples for Verification: For each type of coating system and each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

C. Product List: Cross-reference to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.3 Informational Submittals

A. Steel Primer Certification: Written confirmation from fabricators of structural steel and miscellaneous metals certifying that surface preparation procedures for fabricated steel items comply with Specifications and that applied primers are compatible with specified finish coat materials.

1.4 CLOSEOUT SUBMITTALS

A. Mix Formula: For each color provided.

1.5 QUALITY ASSURANCE

A. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Final approval of color selections will be based on mockups.
    a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 HIGH-PERFORMANCE COATINGS, GENERAL

A. Painting Schedule: Refer to end of Part 2 of this Section for listing of applications for each product.

B. Products, General: Refer to Part 2 for specific products. Subject to compliance with requirements, provide the products indicated or comparable products from one of the listed manufacturers for each substrate.

C. Material Compatibility:

1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a coating system, provide products recommended in writing by manufacturers of topcoat for use in coating system and on substrate indicated.
3. Provide products of same manufacturer for each coat in a coating system.

D. Colors: As selected by Architect from manufacturer's full range.

2.2 METAL PRIMERS

A. Galvanized Metal Primer:

1. Benjamin Moore; Super Spec HP Epoxy Mastic Coating, P45
2. PPG; Amercoat Amerlock 400 High Solids Epoxy Coating
3. Sherwin-Williams; Industrial & Marine Duraplate 235 Multi-Purpose Epoxy, B67W235

2.3 EPOXY COATINGS

A. Epoxy, Gloss:

1. Benjamin Moore; Polyamide Epoxy Coating, M36/M37
2. PPG; Aquapon 35 Polyamide Epoxy Gloss, 95-1/95-98
3. Sherwin-Williams, Protective & Marine, Tile-Clad HS Epoxy, B62WZ111/B60VZ70

2.4 POLYURETHANE COATINGS

A. Polyurethane, Two-Component, Pigmented, Gloss (Gloss Level 6):

1. Benjamin Moore; Corotech Aliphatic Acrylic Urethane Gloss, V500
2. PPG; Pitthane Ultra Urethane Aliphatic Pigmented Gloss, 95-812
3. Sherwin-Williams; Acrolon 218 HS Polyurethane Gloss, B65W611/B65V60

2.5 HIGH-PERFORMANCE COATING SCHEDULE

A. Galvanized Steel Substrates: Exterior, exposed galvanized steel components.

1. Pigmented Polyurethane over Galvanized Steel Primer System:

a. Prime Coat: Galvanized metal primer.
b. Intermediate Coat: Epoxy, gloss.
c. Topcoat: Polyurethane, 2-component, pigmented, gloss (Gloss Level 6).

PART 3 - EXECUTION

3.1 PREPARATION

A. Comply with manufacturer's written instructions applicable to substrates and coating systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

D. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.

3.2 APPLICATION

A. Apply high-performance coatings according to manufacturer's written instructions.

1. Use applicators and techniques suited for coating and substrate indicated.
2. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

END OF SECTION 099600

SECTION 101100 - VISUAL DISPLAY SURFACES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Markerboards.
2. Tackboards.
3. Visual display rails.

1.2 DEFINITIONS

A. Tackboard: Framed or unframed, tackable, visual display board assembly.

B. Visual Display Board Assembly: Visual display surface that is factory fabricated into composite panel form, either with or without a perimeter frame; includes markerboards and tackboards.

C. Visual Display Surface: Surfaces that are used to convey information visually, including surfaces of markerboards, tackboards, and surfacing materials that are not fabricated into composite panel form but are applied directly to walls.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for visual display surfaces.

B. Shop Drawings: For visual display surfaces.

1. Include dimensioned elevations. Show location of joints between individual panels where unit dimensions exceed maximum panel length.
2. Include sections of typical trim members.
3. Show anchors, grounds, reinforcement, accessories, layout, and installation details.

C. Samples: For each type of visual display surface with factory-applied color finishes.

1. Visual Display Surface: Not less than 8-1/2 by 11 inches, mounted on substrate indicated for final Work. Include one panel for each type, color, and texture required.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for surface-burning characteristics of fabrics.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain visual display surfaces from single source from single manufacturer.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.

2. Smoke-Developed Index: 450 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver factory-built visual display surfaces, including factory-applied trim, completely assembled in one piece without joints, where possible. If dimensions exceed maximum manufactured panel size, provide two or more pieces of equal length as acceptable to Architect. When overall dimensions require delivery in separate units, prefit components at the factory, disassemble for delivery, and make final joints at the site.

B. Store visual display surfaces vertically with packing materials between each unit.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install visual display surfaces until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Field Measurements: Verify actual dimensions of construction contiguous with visual display surfaces by field measurements before fabrication.

1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

1.8 WARRANTY

A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer's standard form in which manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Surfaces lose original writing and erasing qualities.
b. Surfaces exhibit crazing, cracking, or flaking.

2. Warranty Period: 50 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Porcelain-Enamel Face Sheet: Manufacturer's standard steel sheet with porcelain-enamel coating fused to steel; uncoated thickness indicated.

1. Gloss Finish: Gloss as indicated; dry-erase markers wipe clean with dry cloth or standard eraser.

B. Plastic-Impregnated Cork Sheet: Seamless, homogeneous, self-sealing sheet consisting of granulated cork, linseed oil, resin binders, and dry pigments that are mixed and calendared onto fabric backing; with washable vinyl finish and integral color throughout with surface-burning characteristics indicated.

C. Particleboard: ANSI A208.1, Grade M-1, made with binder containing no urea formaldehyde.

D. Extruded Aluminum: ASTM B 221, Alloy 6063.

2.2 MARKERBOARD AND TACKBOARD ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AARCO Products, Inc.
2. ABC School Equipment, a division of Platinum Visual Systems.
3. ADP Lemco
4. American Visual Display Products
5. Best-Rite Manufacturing
6. Claridge Products and Equipment, Inc.
7. Ghent Manufacturing, Inc.
8. Newline Products Inc.
9. Platinum Visual Systems
10. PolyVision Corporation
11. Tri-Best Visual Display Products

B. Markerboard Assemblies: Porcelain enamel, balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction consisting of backing sheet, core material, and porcelain-enamel face sheet with low-gloss finish.

1. Fiberboard Core: 1/2-inch thick, industrial grade with aluminum backing sheet.
2. Coatings:
    a. Deposition coat of 2.0 to 2.5 mils on front of steel.
    b. Deposition coat of 1.5 to 2.0 mils on back of steel.
    c. Porcelain enamel steel writing and erasing coat system, totalling 3.5 to 4.5 mils over front surface.
    d. Reflectance factor shall be no more than 20% or less than 15%,
    e. Writing surface shall be no less than 6.5 MOH’s scale.
3. Laminating Adhesive: Manufacturer's standard, moisture-resistant thermoplastic type.
4. Color: White, glossy.
5. Corners: Square.
6. Dimensions: As indicated on Drawings.
7. Edges: Concealed by factory-applied aluminum trim.

C. Tackboard Assemblies: Plastic-impregnated cork, 1/4-inch thick, plastic-impregnated cork sheet factory laminated to 1/4-inch thick hardboard backing.

1. Color: As selected by Architect from manufacturer's full range of colors.
2. Corners: Square.
3. Dimensions: As indicated on Drawings.
4. Edges: Concealed by factory-applied aluminum trim.

D. Visual Display Rails:

1. Tack Strip: 1/4-inch thick plastic-impregnated cork sheet.
2. Width: 1-inch at markerboards and 2-inches at other locations.
3. Edges: Concealed by factory-applied aluminum trim.

E. Accessories:

1. Aluminum frames, minimum 0.062-inch thick.
2. Trim: Factory-applied aluminum.
3. Marker Tray: Box type, extruded aluminum with slanted front, grooved tray, and cast-aluminum end closures.
4. Map Rail: 1 to 2-inch wide display rail with end stops, two map hooks, and two flag holders.

2.3 FABRICATION

A. Porcelain-Enamel Visual Display Assemblies: Laminate porcelain-enamel face sheet and backing sheet to core material under heat and pressure with manufacturer's standard flexible, waterproof adhesive.

B. Assembly: Provide factory-assembled markerboard and tackboard units, unless field-assembled units are required.

C. Factory-Assembled Visual Display Units: Coordinate factory-assembled units with trim and accessories indicated. Join parts with a neat, precision fit.

1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to Architect.
2. Provide manufacturer's standard vertical-joint system between abutting sections of markerboards.
3. Provide manufacturer's standard mullion trim at joints between markerboards and tackboards of combination units.
4. Where size of visual display boards or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated or as selected by Architect from manufacturer's standard structural support accessories to suit conditions indicated.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 ALUMINUM FINISHES

A. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 607.1.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine walls and partitions for proper preparation and backing for visual display surfaces.

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

3.2 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of substances that could impair the performance of and affect the smooth, finished surfaces of visual display boards, including dirt, mold, and mildew.

C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display surfaces and wall surfaces.

1. Prime wall surfaces indicated to receive tackable wall covering panels and as recommended in writing by primer/sealer manufacturer and wall covering manufacturer.

3.3 INSTALLATION, GENERAL

A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

3.4 INSTALLATION OF VISUAL DISPLAY BOARDS AND ASSEMBLIES

A. Visual Display Boards: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display boards with fasteners at not more than 16 inches o.c. Secure both top and bottom of boards to walls.

1. Aluminum Trim: Attach trim over edges of visual display boards and conceal grounds and clips. Attach trim to boards with fasteners at not more than 24 inches o.c.

a. Attach marker trays to boards with fasteners at not more than 12 inches o.c.

3.5 CLEANING AND PROTECTION

A. Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room.

B. Touch up factory-applied finishes to restore damaged or soiled areas.

C. Cover and protect visual display surfaces after installation and cleaning.

END OF SECTION 101100

SECTION 101423 - ROOM-IDENTIFICATION SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Room-identification signs.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For room-identification signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign.

C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design," the ABA standards of the Federal agency having jurisdiction, and ICC A117.1.

2.2 ROOM-IDENTIFICATION SIGNS

A. Manufacturers of Panel Signs: Subject to compliance with requirements, provide products by one of the following:

1. APCO Graphics, Inc.

2. ASI Sign Systems, Inc.
3. Avalis Wayfinding Solutions Inc.
4. Best Manufacturing Company
5. Gemini Incorporated
6. Innerface Sign Systems, Inc.
7. InPro Corporation
8. Mohawk Sign Systems
9. Poblocki Sign Company
10. Supersine Company

B. General: Provide signs for each door or as indicated on Drawings.

1. Provide graphics and Braille as required by code.
2. Fabricate panel signs to comply with the requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes and details of construction. Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed condition within a tolerance of plus or minus 1/16 inch measured diagonally.

C. Unframed Panel Signs: Fabricate unframed panel signs with edges mechanically and smoothly finished to conform with the following requirements:

1. Edge Condition: Beveled.
2. Corner Condition: Match existing.
3. Signs: Nominal 3/16 inch thick, plastic or phenolic, with the following:
    a. Raised characters, 1/32 inch minimum, at least 5/8 inch high but not higher than 2 inches;
    b. Raised numbers, 1/32 inch minimum, at least 1 inch high numbers;
    c. Raised Braille, 1/32 inch minimum, Grade 2;
    d. Signs shall be etched and have raised integral symbols and letters. Applied symbols and letters are not acceptable.
    e. Each room sign shall list the room number and a room identification name in both Braille and in the characters and numbers described above.
4. Character Font: Match existing.
5. Size: Match existing.
6. Exterior Signs: Provide fiberglass units for exterior applications.
7. Signs Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to conceal back of sign.
    a. Color: Color matching sign or black. Confirm final color selection with Architect.
8. Copy: As indicated on Room Signage Schedule.
9. Handicapped Symbols: Provide one combination handicapped symbol, male and female caricatures, and room identification sign for every room where handicapped facilities are provided, such as toilet rooms.
10. Changeable Message Inserts: Fabricate signs to allow insertion of changeable messages in the form of transparent covers with paper inserts printed by Owner.
    a. Furnish insert material and software for creating text and symbols for Owner production of paper inserts.
    b. Furnish insert material cut-to-size for changeable message insert.
11. Color: Color for background and letter colors as required to match existing.
12. Mounting Height Above Floor: 48 inches minimum above floor measure to baseline of lowest raised character and 60 inches maximum above floor measured to baseline of highest raised character.

2.3 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:

1. For exterior exposure, furnish stainless-steel devices unless otherwise indicated.
2. Exposed Metal-Fastener Components, General:

a. Fabricated from same basic metal and finish of fastened sign unless otherwise indicated.

3. Sign Mounting Fasteners:

a. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, and installed in predrilled holes.

B. Adhesive: As recommended by sign manufacturer.

C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.

B. Wall-Mounted Panel Signs: Attach panel signs to wall surfaces using the methods indicated below:

1. Interior Signage: Manufacturer's standard two-face tape and silicone-adhesive mounting, unless otherwise indicated.

a. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
b. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

2. Exterior Signage: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
3. Install signage in accordance with approved shop drawings, ADA requirements, and at locations indicated on the Drawings and in conformance with manufacturer’s instructions using only approved materials and methods.

END OF SECTION 101423

SECTION 102113 - PLASTIC TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-plastic toilet compartments configured as toilet enclosures and urinal screens.

a. Toilet-Enclosure Style: Floor anchored, overhead braced.
b. Urinal Screen Style: Floor anchored.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.

1. Show locations of cutouts for compartment-mounted toilet accessories.
2. Show locations of reinforcements for compartment-mounted grab bars.
3. Show locations of centerlines of toilet fixtures.
4. Show overhead support or bracing locations.

C. Samples: For each type of unit indicated.

D. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of toilet compartment, from manufacturer.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of toilet compartments and accessories from single source and single manufacturer.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for toilet compartments designated as accessible.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Accurate Partitions Corporation.
2. Ampco, Inc.
3. Bradley Corporation; Mills Partitions
4. Comtec Industries/Capitol Partitions
5. General Partitions Mfg. Corp.
6. Global Partitions
7. Hadrian Manufacturing Inc.
8. Hiny Hiders; Division of Scranton Products
9. Metpar Corp.
10. Partition Systems Incorporated of South Carolina
11. Rockville Partitions Incorporated.
12. Santana Products, Inc.
13. Weis-Robart Partitions, Inc.

2.3 SOLID-PLASTIC TOILET COMPARTMENTS

A. Door, Panel, Screen, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.

1. Heat-Sink Strip: Manufacturer's standard continuous, stainless-steel strip fastened to exposed bottom edges of solid-polymer components to prevent burning.
2. Color and Pattern: As selected by Architect from manufacturer's full range.

B. Pilaster Shoes: Stainless-steel sheet, not less than 0.031-inch nominal thickness and 3 inches high, finished to match hardware.

C. Urinal-Screen Post: Manufacturer's standard post design of material matching the thickness and construction of pilasters; with shoe matching that on the pilaster.

D. Brackets (Fittings): Stirrup Type, U-brackets; stainless steel.

2.4 HARDWARE AND ACCESSORIES

A. Hardware and Accessories: Manufacturer's heavy-duty operating hardware and accessories.

1. Material: Stainless steel.

2. Hinges: Manufacturer's premium grade paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees.
3. Latch and Keeper: Manufacturer's premium grade surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
4. Coat Hook: Manufacturer's premium grade combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
5. Door Bumper: Manufacturer's premium grade rubber-tipped bumper at out-swinging doors.
6. Door Pull: Manufacturer's premium grade unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.

B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

2.5 MATERIALS

A. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.

B. Stainless-Steel Castings: ASTM A 743/A 743M.

C. Aluminum Extrusions: ASTM B 221.

2.6 FABRICATION

A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.

B. Floor-Anchored, Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

C. Urinal-Screen Posts: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at bottoms of posts. Provide shoes at posts to conceal anchorage.

D. Door Size and Swings:

1. Standard Compartments: Provide 24-inch clear opening with door swing as indicated on Drawings.
2. Wheelchair and Ambulatory Accessible Compartments: Provide 32-inch clear opening with door swing as indicated on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.

1. Confirm location and adequacy of blocking and supports required for installation.

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

3.2 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

a. Pilasters and Panels: 1/2 inch.
b. Panels and Walls: 1 inch.

2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than three brackets attached at midpoint and near top and bottom of panel.

a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
b. Align brackets at pilasters with brackets at walls.

B. Floor-Anchored, Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.3 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113

SECTION 102800 - TOILET ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Custodial accessories.

B. Related Sections:

1. Division 22 for underlavatory guards.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.
2. Identify accessories using designations indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For accessories to include in maintenance manuals.

1.5 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.6 WARRANTY

A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Subject to compliance with requirements, provide basis of design indicated or comparable products by one of the following:

1. A & J Washroom Accessories, Inc.
2. American Specialties, Inc.
3. Bobrick Washroom Equipment, Inc.
4. Bradley Corporation

B. Source Limitations: Obtain toilet accessories from single source from single manufacturer.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

A. Toilet Tissue (Roll) Dispenser: Owner-furnished, Contractor-installed.

B. Paper Towel Dispenser: Owner-furnished, Contractor-installed.

C. Waste Receptacle: Owner-furnished, Contractor-installed.

D. Liquid-Soap Dispenser: Owner-furnished, Contractor-installed.

E. Grab Bar:

1. Basis of Design: Bobrick; B-5806.99
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch thick.
    a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.
4. Outside Diameter: 1-1/4 inches.
5. Configuration and Length: As indicated on Drawings.

F. Sanitary-Napkin Disposal Unit:

1. Basis of Design: Bobrick; B-254
2. Mounting: Surface mounted.
3. Door or Cover: Self-closing, disposal-opening cover and hinged face panel with tumbler lockset.
4. Receptacle: Removable.
5. Material and Finish: Stainless steel, No. 4 finish (satin).

G. Mirror Unit:

1. Basis of Design: Bobrick; B-290
2. Frame: Stainless-steel channel.
    a. Corners: Welded and ground smooth.
3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
    a. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
4. Size: As indicated on Drawings.

2.3 CUSTODIAL ACCESSORIES

A. Mop and Broom Holder with Utility Shelf: Provide one unit in each Custodial/Janitor room.

1. Basis of Design: Bobrick # B-224 x 36.
2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
3. Length: 36 inches.
4. Hooks: Three.
5. Mop/Broom Holders: Four, spring-loaded, rubber hat, cam type.
6. Material and Finish: Stainless steel, No. 4 finish (satin).

a. Shelf: Not less than nominal 0.05-inch thick stainless steel.
b. Rod: Approximately 1/4-inch diameter stainless steel.

2.4 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.

B. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.

C. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

D. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

E. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.5 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written instructions.

END OF SECTION 102800

SECTION 104400 - FIRE-PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Portable fire extinguishers.
2. Fire protection cabinets for portable fire extinguishers.
3. Wall mounting brackets for fire extinguishers.

1.2 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection specialties.

1. Fire Extinguishers: Include rating and classification.
2. Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Standard for Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide fire extinguishers approved, listed, and labeled by FMG.

C. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

1.5 COORDINATION

A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire protection cabinets with wall depths.

C. Provide fire rated cabinets where indicated to be installed in fire rated walls.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of hydrostatic test according to NFPA 10.
b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amerex Corporation.
2. Ansul Incorporated; Tyco International Ltd.
3. Badger Fire Protection; a Kidde company.
4. J.L. Industries, Inc.
5. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
6. Larsen's Manufacturing Company.
7. Potter-Roemer; Div. of Smith Industries, Inc.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

B. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.

2.3 PORTABLE FIRE EXTINGUISHERS

A. General: Provide fire extinguishers of type, size, and capacity for each cabinet and other locations indicated.

B. Multipurpose Dry-Chemical Type: UL-rated 4-A:60-B:C, 10-lb nominal capacity, in enameled-steel container.

2.4 FIRE PROTECTION CABINET

A. Cabinet Type: Suitable for fire extinguisher.

B. Cabinet Construction: Nonrated and fire rated.

1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.0428-inch thick, cold-rolled steel sheet lined with minimum 5/8-inch thick, fire-barrier material. Provide factory-drilled mounting holes.

C. Cabinet Material: Steel sheet.

1. Shelf: Same metal and finish as cabinet.

D. Semirecessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.

1. Rolled-Edge Trim: 2-1/2-inch backbend depth.

E. Cabinet Trim Material: Steel sheet.

F. Door Material: Steel sheet.

G. Door Style: Vertical duo panel with frame.

H. Door Glazing: Acrylic sheet, clear transparent.

I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide projecting lever handle with cam-action latch.
2. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
3. Provide manufacturer's standard hinge permitting door to open 180 degrees.

J. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.
    a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."
        1) Location: Applied to cabinet door.
        2) Application Process: Decals or Pressure-sensitive vinyl letters.
        3) Lettering Color: Red.
        4) Orientation: Vertical.

K. Finishes: Manufacturer's standard baked enamel or powder coat finish.

L. Fabrication:

1. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
    a. Weld joints and grind smooth.
    b. Provide factory-drilled mounting holes.
2. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
    a. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
    b. Miter and weld perimeter door frames.
3. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 WALL MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

2.6 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 STEEL FINISHES

A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning".

B. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.

1. Color: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets are to be installed.

B. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged units.

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

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing fire-protection specialties.

B. Install in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

1. Prepare recesses for cabinets as required by type and size of cabinet and trim style.
2. Fasten mounting brackets to structure and cabinets, square and plumb.

3. Fasten cabinets to structure, square and plumb.

3.3 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust cabinet doors that do not swing or operate freely.

B. Refinish or replace cabinets and doors damaged during installation.

C. Provide final protection and maintain conditions that ensure that cabinets and doors are without damage or deterioration at the time of Substantial Completion.

D. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104400

SECTION 107326 - MANUFACTURED CANOPY SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Post-and-beam supported canopies.

1.2 SYSTEM DESCRIPTION

A. General: Provide a complete, integrated set of canopy manufacturer's standard mutually dependent components and assemblies that form a canopy system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior. Include primary and secondary framing, metal roof panels, and accessories complying with requirements indicated.

1. Provide canopy system of size and with spacings, slopes, and spans indicated.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show fabrication and installation details for canopies.

1. Include plans, elevations, and at least 3/4-inch scale sections of typical members and other components. Show anchors, reinforcement, accessories, layout, and installation details.

C. Samples for Verification: For each type of product indicated, of size below:

1. Aluminum: For each form, finish, and color, on 6-inch- long sections of extrusions and squares of sheet at least 4 by 4 inches.

D. Delegated-Design Submittal: For manufactured canopy indicated to comply with performance requirements, including analysis data and calculations signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative of canopy manufacturer for installation of units required for this Project.

B. Source Limitations: Obtain canopy components through one source from a single manufacturer.

C. Preinstallation Conference: Conduct conference at Project site.

D. Special Inspections: Comply with Section 033000 "Cast-In-Place Concrete" special inspection requirements for concrete footings for manufactured canopies.

1.6 DELIVERY AND HANDLING

A. Deliver canopies in protective covering and crating to protect components and surfaces against damage.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of construction contiguous with canopies by field measurements and indicate on Shop Drawings.

1.8 COORDINATION

A. Coordinate installation of anchorages for canopies. Furnish setting drawings, templates, and directions for installing anchorages and other items that are to be embedded in concrete. Deliver such items to Project site in time for installation.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair finish or replace canopies that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

B. Special Warranty on Aluminum Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal wall panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design manufactured canopy, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Provide canopies capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Design Loads: As indicated on Structural Drawings.
2. Live Loads: Include vertical loads induced by maintenance workers, materials, and equipment for roof live loads.
3. Roof Snow Loads: As indicated on Structural Drawings.
4. Deflection Limits: Engineer assemblies to withstand design loads with deflections no greater than the following:

a. Purlins and Rafters: Vertical deflection of 1/240 of the span.
b. Metal Roof Panels: Vertical deflection of 1/240 of the span.

C. Thermal Movements: Provide canopies 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.

2.2 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:

1. Peachtree Protective Covers
2. Dittmer Architectural Aluminum
3. East Coast TVM, LLC
4. Mapes Industries, Inc.
5. Tennessee Valley Metals, Inc.

2.3 MATERIALS

A. Aluminum Sheet and Plate: ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with at least the strength and durability properties of alloy 5005-H15.

B. Aluminum Extrusions: Extruded post, roof deck, cap, and fascia, alloy 6061-T6, 6063-T5, and 6063-T6 as called for by profile and design.

1. Thickness: As required by design, complying with minimum thickness requirement specified.

C. Aluminum Sheet: For miscellaneous trim only: Alloy 3105-H28 or 3004-H34; Minimum yield: 30 ksi; Minimum thickness 0.040 inch.

2.4 POST SUPPORTED CANOPIES

A. Deck: Extruded aluminum, minimum 0.040 inch thick.

1. Depth: 3-1/2 inches, unless otherwise indicated on Drawings.
2. Interlocking, self-flashing sections.

a. Provide flush flat pan appearance from exposed underside.

B. Fascia: Extruded aluminum, minimum 0.125 inch thick.

1. Depth: 8 inches, unless otherwise indicated on Drawings.
2. Style: As indicated on Drawings.

C. Beams: Extruded aluminum, minimum .156 inch thick.

D. Support Posts: Extruded aluminum, minimum .125 inch thick.

E. Concealed Drainage: Integral gutter beams draining into designated hollow support posts.

2.5 STRUCTURE

A. Base: Provide canopies with integral base consisting of channels, angles, plates, or other fittings. Drill holes in members for anchor-bolt connection.

1. Provide anchor bolts of size required for connecting base to concrete foundations.

2.6 ACCESSORIES

A. Fasteners: Use concealed fasteners fabricated from metals that are noncorrosive to canopy systems material and mounting surface.

1. Material: Plated non-corrosive Type 18-8 stainless steel, sealed with neoprene "O" rings beneath flat washers.

B. Anchors and Inserts: Use stainless steel or hot-dip galvanized anchors and inserts. Use torque-controlled expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete.

C. Concrete for Foundations: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.

2.7 FABRICATION, GENERAL

A. General: Provide canopy systems consisting of extruded aluminum canopy supported on aluminum structural framing system as indicated.

1. Welded Connections: Comply with AWS standards for recommended practices in shop welding. Provide welds behind finished surfaces without distortion or discoloration of exposed side.
2. Mill joints to a tight, hairline fit. Form joints exposed to weather to exclude water penetration.
3. Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.

2.8 ALUMINUM FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

C. High-Performance Organic Finish: 2-coat fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify all dimensions existing and provided.

B. Make reasonable adjustments in fabrication and erection to provide an acceptable finished canopy.

3.2 INSTALLATION

A. General: Install canopies in strict accordance with manufacturer's written recommendations and approved Shop Drawings.

B. Excavation: In firm, undisturbed or compacted soil, excavate canopy system foundation to dimensions indicated.

C. Set anchor bolts and other embedded items required for installation of canopy systems. Use templates furnished by suppliers of items to be attached.

D. Install canopy systems level, plumb, and at height and slope indicated, with surfaces free from distortion or other defects in appearance.

1. Beams:

a. If mechanically fastened system, place beams in column notches and secure with proper number of fasteners as specified by size of beam and engineering. Ensure contact bearing in bottom of column notches; insert aluminum shim plates as necessary.
b. Level tops of beams to receive roof panels; roof panels shall drain rainwater into beams as indicated.
c. Minor connections and incidental details shall be as shown on the drawings.
d. Ensure that end caps are welded or mechanically fastened securely into place.

2. Roof Panels:

a. Fabricate roof panels to required lengths.
b. Install level and square to beams to avoid "out of square" conditions at beam ends.
c. Secure each contact point with a minimum of three stainless steel fasteners with 3/4 inch flat neoprene washers.

3. Joints Sealants and Flashing:

a. Seal fabrication joints and seams away from view where required.
b. Seal all other points where water penetration might be expected.
c. Flash connection to walls where canopy units contact surface of building. Do not use sealant.

3.3 CLEANING

A. At completion of installation, clean soiled surfaces of canopy systems according to manufacturer's written instructions.

1. Remove protective film from members. Clean canopy of dirt, grease, handprints, and other blemishes. Leave area in a neat, clean, and acceptable condition.

B. Protect canopy from damage from other construction operations. Provide temporary barricades where necessary.

END OF SECTION 107326

SECTION 122413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Manually-operated roller shades with single rollers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

C. Samples: For each exposed product and for each color and texture specified

1. Shadeband Material: Not less than 10 inches square. Mark inside face of material if applicable.

1.4 INFORMATIONAL SUBMITTALS

A. Roller-Shade Schedule: Use same designations indicated on Drawings.

B. Product Certificates: For each type of shadeband material, signed by product manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roller shades to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain roller shades from single source from single manufacturer.

B. Fire-Test-Response Characteristics: Provide products passing flame-resistance testing according to NFPA 701 by a testing agency acceptable to authorities having jurisdiction.

C. Product Standard: Provide roller shades complying with WCMA A 100.1.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide product by one of the following:

1. Draper Inc.
2. Lutron Shading Solutions
3. MechoShade Systems, Inc.
4. Hunter Douglas Contract

2.2 MANUALLY-OPERATED, SINGLE-ROLLER SHADES

A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

1. Bead Chains: Nickel-plated metal.

a. Loop Length: Full length of roller shade.
b. Limit Stops: Provide upper and lower ball stops.
c. Chain-Retainer Type: Chain tensioner, jamb mounted.

2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller-shade weight and lifting heavy roller shades.

a. Provide for shadebands that weigh more than 10 lb or for shades as recommended by manufacturer, whichever criteria are more stringent.

B. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Roller Drive-End Location: As standard with manufacturer to suit installation.
2. Direction of Shadeband Roll: Regular, from back of roller.
3. Shadeband-to-Roller Attachment: Removable spline fitting integral channel in tube.

C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

D. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.

E. Shadebands: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

F. Shade Band Material: PVC-coated polyester.

1. Bottom Hem: Straight, sealed hem bar.
2. Material Openness Factor: 5 percent.
3. Material Color: As selected by Architect from manufacturer's full range.

G. Installation Accessories:

1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.

a. Shape: L-shaped.
b. Height: Manufacturer's standard height required to conceal roller and shadeband when shade is fully open, but not less than 3 inches.

2. Endcap Covers: To cover exposed endcaps.
3. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.3 ROLLER-SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:

1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.

C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible except as follows:

1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
2. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance of the Work.

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

3.2 ROLLER-SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller-shade surfaces after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 122413

SECTION 123216 - MANUFACTURED PLASTIC-LAMINATE-FACED CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-faced cabinets of stock design.
2. Plastic-laminate cubbies.

1.2 DEFINITIONS

A. Definitions in the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" apply to the work of this Section.

B. MDF: Medium-density fiberboard.

C. Hardwood Plywood: A panel product composed of layers or plies of veneer, or of veneers in combination with lumber core, hardboard core, MDF core, or particleboard core, joined with adhesive, and faced both front and back with hardwood veneers.

D. Exposed Portions of Cabinets: Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than 48 inches above floor, and surfaces visible in open cabinets.

E. Semiexposed Portions of Cabinets: Surfaces behind opaque doors, such as interiors of cabinets, shelves, dividers, interiors and sides of drawers, and interior faces of doors. Tops of cases 78 inches or more above floor are defined as semiexposed.

F. Concealed Portions of Cabinets: Surfaces not usually visible after installation, including sleepers, web frames, dust panels, and ends and backs that are placed directly against walls or other cabinets.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

B. Keying Conference: Conduct conference at Project site. Incorporate keying conference decisions into final keying requirements.

1.4 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that casework can be supported and installed as indicated.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Show fabrication details, including types and locations of hardware. Show installation details, including field joints and filler panels. Indicate manufacturer's catalog numbers for casework.

C. Keying Schedule: Include schematic keying diagram and index each key set to unique designations that are coordinated with the Contract Documents.

D. Samples: For cabinet finishes.

E. Samples for Verification: 8-by-10-inch Samples for each type of finish and the following:

1. One full-size finished base cabinet complete with hardware, doors, and drawers.
2. One full-size finished wall cabinet complete with hardware, doors, and adjustable shelves.
3. Maintain full-size Samples at Project site during construction in an undisturbed condition as a standard for judging the completed Work. Unless otherwise indicated, approved sample units may become part of the completed Work if in undisturbed condition at time of Substantial Completion. Notify Architect of their exact locations.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranty: For special warranty.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: AWI certified, with minimum of five years continuous experience in performing work of similar quality and scope.

B. Installer Qualifications: Fabricator of products.

C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. 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.
2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

D. Preinstallation conference.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver casework only after painting, utility roughing-in, and similar operations that could damage, soil, or deteriorate casework have been completed in installation areas. If casework must be stored in other than installation areas, store only in areas where environmental conditions meet requirements specified in "Project Conditions" Article.

B. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install casework until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Established Dimensions: Where casework is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

C. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before being enclosed, and indicate measurements on Shop Drawings.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of casework that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Delamination of components or other failures of glue bond.
b. Warping of components.
c. Failure of operating hardware.
d. Deterioration of finishes.

2. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CASEWORK, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" for grades of casework indicated for construction, finishes, installation, and other requirements.

2.2 CASEWORK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cabinets by Design, Duluth, GA
2. Cleora Sterling
3. Interior Wood Specialties
4. Pridgen Millwork
5. Stephenson Millwork
6. Stevens Industries, Inc.
7. TMI Systems

B. Grade: Custom.

C. Design: Flush overlay.

D. Exposed Materials:

1. Plastic Laminate: Grade VGS.
2. Unless otherwise indicated, provide 3 mm PVC edgebanding on all exposed edges.

E. Semiexposed Materials:

1. Plastic Laminate: Grade VGS plastic laminate for interior faces of doors and drawer fronts.
2. Thermoset Decorative Panels: Provide thermoset decorative panels for semiexposed surfaces unless otherwise indicated.
3. Unless otherwise indicated, provide 3 mm PVC edgebanding on all semiexposed edges.

F. Concealed Materials: Grade BKL plastic laminate.

2.3 MATERIALS

A. Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood.

B. Hardwood Plywood: HPVA HP-1, particleboard core except where veneer core is indicated.

C. Softwood Plywood: DOC PS 1.

D. Particleboard: ANSI A208.1, Grade M-2.

E. MDF: ANSI A208.2, Grade 130.

F. Hardboard: ANSI A135.4, Class 1 Tempered.

G. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Wilsonart
b. Formica Corporation
c. Nevamar; a Panolam Industries International, Inc. brand
d. Pionite; a Panolam Industries International, Inc. brand

2. Colors: As selected by Architect from manufacturer's full range.

H. Edgebanding for Plastic Laminate: Rigid PVC extrusions, through color with satin finish, 3 mm thick at doors and drawer fronts, 1 mm thick elsewhere.

1. Color: As selected by Architect from manufacturer's full range.

I. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.

1. Color: As selected by Architect from manufacturer's full range.

J. Edgebanding for Thermoset Decorative Panels: PVC or polyester edgebanding matching thermoset decorative panels.

2.4 FABRICATION

A. Plastic-Laminate-Faced Cabinet Construction: As required by referenced quality standard, but not less than the following:

1. Bottoms and Ends of Cabinets, and Tops of Wall Cabinets and Tall Cabinets: 3/4-inch particleboard, plastic-laminate faced on exposed surfaces, thermoset decorative panels on semiexposed surfaces.
2. Cabinet Joinery: Fixed body members shall be joined using dowels and assembled using glue and pressure.
3. Shelves: 1 inch thick particleboard, plastic-laminate faced.
4. Backs of Cabinets: 1/2-inch particleboard, plastic-laminate faced on exposed surfaces, thermoset decorative panels on semiexposed surfaces.
5. Drawer Fronts: 3/4-inch particleboard, plastic-laminate faced.

6. Drawer Sides and Backs: 1/2-inch thermoset decorative panels, with glued dovetail or multiple-dowel joints.
7. Drawer Bottoms: 1/4-inch hardwood plywood glued and dadoed into front, back, and sides of drawers. Use 1/2-inch material for drawers more than 24 inches wide.
8. Doors: 3/4-inch particleboard, plastic-laminate faced.

B. Plastic-Laminate-Faced Cubbies: As required by referenced quality standard, but not less than the following:

1. Bottoms and Ends of Cubbies: 3/4-inch particleboard, plastic-laminate faced on exposed surfaces, thermoset decorative panels on semiexposed surfaces.
2. Shelves: 3/4-inch particleboard, plastic-laminate faced.
3. Backs of Cubbies: 1/2-inch particleboard, plastic-laminate faced on exposed surfaces, thermoset decorative panels on semiexposed surfaces.

C. Filler Strips: Provide as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets.

D. Leg Shoes: Vinyl or rubber, black, open-bottom type.

2.5 CASEWORK HARDWARE AND ACCESSORIES

A. Hardware, General: Unless otherwise indicated, provide manufacturer's standard satin-finish, commercial-quality, heavy-duty hardware.

1. Use threaded metal or plastic inserts with machine screws for fastening to particleboard except where hardware is through-bolted from back side.

B. Butt Hinges: Chrome-plated, semiconcealed, five-knuckle hinges complying with BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Provide two hinges for doors less than 48 inches high, and provide three hinges for doors more than 48 inches high.

C. Pulls: Solid chrome-plated wire pulls, fastened from back with two screws. Provide two pulls for drawers more than 24 inches wide.

D. Door Catches: Manufacturer's standard magnet catch.

E. Drawer Slides: BHMA A156.9, Type B05091.

1. Regular, Kneespace, Keyboard and Pencil: 100-pound load rated epoxy coated steel, bottom corner mounted with smooth and quiet ball-bearing slides. Positive stop both directions with soft-closing feature. Provide continuous mounting condition for keyboard slides beneath countertops.
2. File: Full extension, no less than 125-pound load rated epoxy coated steel, bottom corner mounted with smooth and quiet ball-bearing slides. Positive stop both directions with self-closing feature.

F. Label Holders: Chrome plated, sized to receive standard label cards approximately 1 by 2 inches, attached with screws or brads.

1. Provide label holders where indicated.

G. Drawer and Hinged Door Locks: Cylindrical (cam) type, five-pin tumbler, brass with chrome-plated finish, and complying with BHMA A156.11, Grade 1.

1. Provide a minimum of two keys per lock and six master keys.
2. Provide locks on all doors and drawers.

H. Adjustable Shelf Supports: Injection molded transparent polycarbonate friction fit into cabinet end panels and vertical dividers, adjustable on 32mm centers. Each shelf support has 2 integral support pins, 5mm diameter, to interface pre-drilled holes, and to prevent accidental rotation of support. The support automatically adapts to 3/4 inch or 1 inch shelving and provides non-tip feature for shelving. Structural load to 1200 pounds (300 pounds per support) without failure.

I. Cubbie Hooks: Belwith P27305 or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

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

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

3.2 CASEWORK INSTALLATION

A. Grade: Install cabinets to comply with same grade as item to be installed.

B. Install casework level, plumb, and true; shim as required, using concealed shims. Where casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.

C. Base Cabinets: Set cabinets straight, level, and plumb. Adjust subtops within 1/16 inch of a single plane. Align similar adjoining doors and drawers to a tolerance of 1/16 inch. Bolt adjacent cabinets together with joints flush, tight, and uniform.

D. Wall Cabinets: Hang cabinets straight, level, and plumb. Adjust fronts and bottoms within 1/16 inch of a single plane. Fasten to hanging strips, masonry, framing, wood blocking, or reinforcements in walls and partitions. Align similar adjoining doors to a tolerance of 1/16 inch.

E. Fasten cabinets to adjacent cabinets and to masonry, framing, wood blocking, or reinforcements in walls and partitions to comply with the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards."

F. Install hardware uniformly and precisely. Set hinges snug and flat in mortises unless otherwise indicated. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.

G. Adjust casework and hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.3 CLEANING

A. Repair or remove and replace defective work as directed on completion of installation.

B. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

END OF SECTION 123216

SECTION 123623 - PLASTIC-LAMINATE-CLAD COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes plastic-laminate countertops.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product, including panel products, high-pressure decorative laminate, and adhesive for bonding plastic laminate.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show locations and sizes of cutouts and holes for plumbing fixtures, electrical switches and outlets, trash bins, and other items installed in plastic-laminate countertops.

C. Samples:

1. Plastic laminates.
2. Edge banding.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Fabricator.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.

B. Installer Qualifications: Fabricator of products.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver countertops until painting and similar operations that could damage countertops have been completed in installation areas. If countertops must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install countertops until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where countertops are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE COUNTERTOPS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades indicated for construction, installation, and other requirements.

B. Grade: Custom.

C. High-Pressure Decorative Laminate: NEMA LD 3, Grade HGS.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Formica Corporation.
b. Nevamar; a Panolam Industries International, Inc. brand
c. Pionite; a Panolam Industries International, Inc. brand.
d. Wilsonart.

D. Color and Pattern: As selected by Architect from manufacturer's full range.

E. Edge Treatment: 3-mm PVC edging.

F. Core Material: Particleboard or medium-density fiberboard.

G. Core Material at Sinks: Medium-density fiberboard made with exterior glue.

H. Core Thickness: 3/4 inch.

I. Backer Sheet: Provide plastic-laminate backer sheet, NEMA LD 3, Grade BKL, on underside of countertop substrate.

2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard unless otherwise indicated.

1. Wood Moisture Content: 8 to 13 percent.

B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated. Provide wood composite products with no added formaldehyde.

1. Medium-Density Fiberboard: ANSI A208.2, Grade 130.
2. Particleboard: ANSI A208.1, Grade M-2 and Grade M-2-Exterior Glue.
3. Softwood Plywood: DOC PS 1.

2.3 ACCESSORIES

A. Grommets for Cable Passage through Countertops: 2-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage; color as selected from manufacturer’s full range.

B. Countertop Brackets: Countertop support brackets, under-counter support frames, legs and miscellaneous metal parts shall be aluminum, welded, degreased, cleaned, treated and powder-coated.

2.4 MISCELLANEOUS MATERIALS

A. Adhesive for Bonding Plastic Laminate: Contact cement.

1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

B. Multipurpose Construction Adhesive: Formulation complying with ASTM D 3498 that is recommended for indicated use by adhesive manufacturer.

2.5 FABRICATION

A. Fabricate countertops to dimensions, profiles, and details indicated. Provide front and end overhang of 1 inch over base cabinets. Ease edges to radius indicated for the following:

B. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

C. Shop cut openings to maximum extent possible to receive appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

1. Seal edges of openings in countertops with a coat of varnish.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.

B. Before installing countertops, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Grade: Install countertops to comply with same grade as item to be installed.

B. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.

1. Provide cutouts for appliances, plumbing fixtures, electrical work, and similar items.
2. Seal edges of cutouts by saturating with varnish.

C. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.

1. Secure field joints in plastic-laminate countertops with concealed clamping devices located within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.

D. Install countertops level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

E. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

F. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c. and to walls with adhesive.
3. Seal junctures of tops, splashes, and walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective countertops, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean countertops on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 123623

SECTION 123661 - SOLID SURFACING WINDOW STOOLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid surface material window stools.

1.2 ACTION SUBMITTALS

A. Product Data: For solid surfacing materials.

B. Shop Drawings: For window stools. Show materials, finishes, and profiles.

C. Samples for Verification: Solid surface material, 6 inches square.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For solid surface materials to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of window stools.

C. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.

1. Build mockup of typical window stool as shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of window stools by field measurements before fabrication is complete.

PART 2 - PRODUCTS

2.1 SOLID SURFACE MATERIALS

A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.

1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
    a. Aristech Surfaces; Avonite
    b. E. I. du Pont de Nemours and Company; Corian
    c. Hanwha Surfaces.
    d. LG Hausys; Hi-Macs
    e. LivingStone Surfaces
    f. Samsung Chemical USA, Inc.
    g. Wilsonart
2. Type: Provide Standard type unless Special Purpose type is indicated.
3. Color: As selected by Architect from manufacturer's full range.

2.2 WINDOW STOOL FABRICATION

A. Fabricate window stools according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Grade: Custom.
2. Configuration: Straight, slightly eased edges.
3. Thickness: 1/2 inch.

B. Fabricate window stools in one piece.

C. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.

1. Adhesive color shall match solid-surfacing material.

2.3 INSTALLATION MATERIALS

A. Adhesive: Product recommended by solid surface material manufacturer.

B. Sealant: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install window stools level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.

B. Secure window stools to substrate with adhesive according to solid surface material manufacturer's written instructions. Carefully remove surface scratches and clean entire surface.

C. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION 123661

SECTION 210000 - FIRE PROTECTION

210001 GENERAL

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

B. Fire Protection work shall be performed as outlined in "Information for Bidders".

C. These specifications and the accompanying fire protection drawings are intended to provide for all labor, materials and equipment necessary for the installation of a complete

1. Wet-pipe sprinkler system

and accessories including necessary apparatus, valves and fittings hereinafter described or called for on the fire protection drawings accompanying these specifications.

D. All fire protection work shall be installed in accordance with the following Codes and all Local Ordinances. Codes shall be latest editions approved by the NC Building Code Council with North Carolina amendments. Materials, equipment and workmanship shall be as hereinafter specified.

1. North Carolina State Building Code
2. North Carolina State Fire Prevention Code
3. NFPA 70
4. NFPA 13

E. All products used as part of the installation of the fire sprinkler system shall be Underwriter's Laboratories (UL) or Factory Mutual (F.M.) approved as required by NFPA 13.

F. This contractor shall secure all required permits and inspection fees necessary for this work. Permits may be secured from the Building Inspections Department.

G. The accompanying drawings are schematic only and are not intended to show all fittings, couplings, hangers, offsets, etc., unless specifically dimensioned. The layout shown on the drawings is a conceptual layout only. This contractor shall provide complete installation drawings for the sprinkler systems defined herein, per the Contract Drawings and these specifications. Provide all adjustments as necessary to conform to the structural conditions, machinery, equipment, work of other contractors and the intent of the drawings, without additional cost to the Owner. Fire protection consultant drawings should not be scaled. Secure dimensions from Architectural drawings. Refer to drawings of other trades and coordinate with other contractors. All equipment shall be installed in accordance with the manufacturer's published installation instructions and diagrams.

H. The Contractor shall coordinate the exact location of incoming sprinkler riser rough-in with Division 33 and all other trades.

210002 SCOPE OF WORK

A. The Contractor shall be required to perform all the following work, in general and provide a complete fire sprinkler system(s) as shown on the plans. This Contractor's scope of work begins at the sprinkler riser rough-in(s) provided by others, approximately one foot above the finished floor. The items in general are to be as follows:

1. Furnish and install complete wet-pipe sprinkler system as shown on the fire protection drawings and here-in specified.
2. Sprinkler Contractor is responsible for acquiring flow test data, less than one year old, from the local Fire Department, local Water Department, or by performing a flow test. Contractor shall

coordinate with and get approval of date, time, and location of flow test from the local Fire Department.

210003 LIST OF MATERIALS, FIXTURES AND EQUIPMENT

A. Sprinkler system design submittal, including shop drawings, hydraulic calculations, and materials, shall be performed by a Professional Engineer registered in the State of North Carolina, or an individual who has Level III or IV certification from the National Institute for Certification in Engineering Technologies (NICET) in Fire Protection Engineering Technology: Water-Based Systems Layout in accordance with NICET 1014.

B. The Sprinkler Contractor shall obtain written approval from the Engineer/Architect for the use of substitute materials claimed as equal to those specified. Such approvals must be obtained as soon after contract awards as possible and before any materials are ordered. Applications for approvals shall be made by the Sprinkler Contractor and not by subcontractors or manufacturer's representative. The Sprinkler Contractor shall submit within ten days following award of contract and written notice to begin the work a complete list of materials proposed for the job. All like items shall be by the same manufacturer. When this list is approved, no further substitutions will be permitted except in unusual or extenuating circumstances. If no list is submitted, the Sprinkler Contractor shall supply materials specified. The Sprinkler Contractor shall review and stamp the submittals as being in accordance with his or her bid and these specifications.

C. The Sprinkler Contractor shall submit a set of installation plan drawings to the Architect before any materials, and equipment to be incorporated in the work has been ordered. **FAXED COPIES WILL NOT BE ACCEPTABLE**. Installation plan drawings shall include:

1. Hydraulic design data, including remote area designation(s), and locations of nodes.
2. Flow test data.
3. All piping, included mains, cross mains, branches, and armovers with sizes indicated.
4. Locations of couplings on grooved piping.
5. Location of Riser(s).
6. Riser Details.
7. Hanger Details.
8. Locations of sprinkler heads.
9. Sprinkler head legend, indicating the manufacturer and model number of each type of sprinkler head.
10. Location of backflow preventer.
11. Location of fire department connection and associated check valve.
12. Location of backflow preventer test header.
13. Location of inspector's test connection.
14. Location of auxiliary drains.
15. Locations of seismic bracing, as well as seismic bracing details, as applicable.
16. Site diagram indicating water supply piping location, sizes, and hydraulic calculation nodes.
17. Preparer's NICET Certification ID or Professional Engineer Seal.

D. The Sprinkler Contractor shall submit seismic bracing calculations.

E. The Sprinkler Contractor shall submit a set of hydraulic calculations to the Architect before any materials, and equipment to be incorporated in the work has been ordered. Hydraulic Calculations shall be performed using computer-based software, such as HydraCALC or HASS. **FAXED COPIES WILL NOT BE ACCEPTABLE**. Hydraulic Calculations shall include:

1. Required water density and size of remote area(s), in accordance with NFPA and the Authority Having Jurisdiction.

2. Pressure and flow required for the system(s) to operate properly (after hose allowance has been added).
3. Flow test data. Sprinkler Contractor shall reduce the static pressure, residual pressure, and flow as required by the AHJ when performing hydraulic calculations.
4. Node by node analysis of required pressure, required flow, friction losses, and elevation.
5. Flow vs. pressure curves, indicating that sprinkler system curve(s) are sufficiently below flow test curve.

F. The Sprinkler Contractor shall submit a set of manufacturer's submittal data to the Architect before any materials, and equipment to be incorporated in the work has been ordered. **All sprinkler system components shall be UL listed and/or FM approved as required by NFPA 13.** Shop drawings shall include the name and address of the manufacturer and their catalog numbers and trade names clearly marked. All items shall be referenced to the specifications by **specification paragraph number on an index tab**. One complete set of submittal data shall be manufacturer's original published material. **FAXED COPIES WILL NOT BE ACCEPTABLE**. Approval of materials will be based upon the manufacturer's published ratings. Submit shop drawings and/or catalog data for the following material and equipment:

1. Sprinkler Heads
2. Piping, Fittings, and Couplings
3. Valves
4. Gauges
5. Hangers
6. Seismic Bracing
7. Riser Check Valve
8. Flow Switch
9. Backflow Preventer
10. Backflow Preventer Test Header
11. Fire Department Connection

G. Approval of shop drawings and/or submittal data shall not relieve the Sprinkler Contractor of the responsibility to comply with the requirements and intent of the plans and specifications with regard to dimensions, capacities, quality, quantity, performance characteristics, etc. If data submitted deviates from the contract documents, the Sprinkler Contractor shall point out such deviations in writing and also state reasons for same. All similar items shall insofar as possible be one make and manufacturer. **MANUFACTURER'S MODEL NUMBERS LISTED WITHIN DIVISION 21 SPECIFICATIONS ARE PROVIDED FOR GENERAL INFORMATION ONLY**. Description of product shall take precedence over model numbers.

H. Prior to submitting equipment information, the Contractor shall field verify all necessary dimensions to ensure that all equipment will fit within designated rooms and/or spaces with proper clearances.

I. Failure to submit materials, equipment, etc., the Architect shall assume that all items shall be installed as specified.

210004 WORKMANSHIP

A. Layout:

1. Furnish and install all necessary sleeves, inserts, etc., for walls and partitions. Failure to install such items in time to avoid delaying the general contractor shall result in the Contractor doing all cutting and repairing at his or her own expense.
2. Conceal piping above ceilings. Where piping is installed in areas without ceilings, coordinate with all other exposed items.
3. Provide sprinkler protection below all obstructions 4'-0" and wider per NFPA 13.

4. The General Contractor shall paint exposed piping per Division 9 to match surroundings. Sprinkler heads shall not be painted. Any sprinkler head that is painted shall be removed and replaced.
5. All equipment shall be installed in accordance with manufacturer's installation written instructions.
6. All equipment shall be installed such that components do not provide a safety hazard to occupants who come within a close proximity.

B. All equipment and components located on site shall be protected from the weather and damage from construction equipment.

C. Wet-pipe sprinkler system piping:

1. Piping shall be installed level, without slope, unless otherwise indicated on Contract Drawings.
    a. Exception: Piping installed immediately below sloped roofs shall match the slope of the roof.
    b. If sloped piping causes water to be trapped from draining in quantities exceeding 5 gallons, an auxiliary drain shall be provided in an accessible location.
2. Run all piping as directly as possible, avoiding unnecessary bends and turns so as not to interfere with proper installation of work of other contractors.
3. All piping shall be routed with a minimum clearance of ten (10) feet from any electrical switchboards, panel boards or telephone backboards.
4. Piping shall be concealed in walls, or above ceilings, unless otherwise indicated on Contract Drawings.
    a. No sprinkler piping shall be covered or concealed until inspected by the Authority Having Jurisdiction, and tested and approved by the Architect.
5. Piping shall not be installed underground.
6. Sprinkler heads shall be installed in the center of ceiling tiles.
7. Sprinkler heads shall be installed on armovers to allow their locations to be adjusted to the center of ceiling tiles.
8. Sprinkler mains, cross mains, and branches shall be at least 1-1/4" in diameter and armovers shall be at least 1" in diameter.
9. Support horizontal black steel pipe with hangers located every 12 feet for piping 1-1/4" or smaller and every 15 feet for all piping 1-1/2" or larger.
10. Armovers longer than 24" shall be supported by hangers per NFPA 13.

210005 CUTTING, PATCHING AND CHASING

A. All cutting and patching shall be in accordance with the "General Conditions" of these specifications.

210006 SEISMIC RESTRAINTS

A. The Contractor shall be responsible for providing restraints to resist the earthquake effects on the sprinkler system(s), per NFPA, local codes, and the Authority Having Jurisdiction. Restraints shall be per Seismic Design Category C.

B. The Contractor shall retain the services of a Professional Engineer registered in the State of North Carolina, or an individual who has Level III or IV certification from the National Institute for Certification in Engineering Technologies (NICET), to design seismic restraint elements required for this project. The engineer's (or NICET-certified individual's) computations, bearing his or her professional seal or NICET Certification Number, shall accompany shop drawings that show Code compliance.

Computations and shop drawings shall be submitted for review prior to the purchasing of materials, equipment, systems and assemblies.

C. The Professional Engineer (or NICET-certified individual) retained by the Contractor for seismic restraint calculations, shall visit the job site upon completion of the seismic restraint installation. This engineer (or NICET-certified individual) shall provide in writing verification of compliance with the approved seismic submittal. This verification shall bear the Engineer's (or NICET-certified individual's) professional seal or NICET Certification Number. Job site inspections by other than this engineer (or NICET-certified individual) is not acceptable.

D. Review of the seismic design and shop drawings by the Engineer/Architect or their agent shall not relieve the Contractor of his or her responsibility to comply with the seismic or any other requirements of the North Carolina State Building Code.

210007 WET-PIPE SPRINKLER SYSTEMS

A. Piping:

1. Sprinkler piping 2" and smaller (minimum 1") shall be Schedule 40 threaded black steel, conforming to ASTM A 795 and ANSI/ASTM A 53.
2. Sprinkler piping 2-1/2" and larger shall be Schedule 10 roll grooved black steel, conforming to ASTM A 795 and ANSI/ASTM A 53.

B. Fittings:

1. Fittings for threaded black steel piping shall be cast iron threaded fittings.
2. Fittings for grooved black steel piping shall be ductile iron grooved fittings conforming to ASTM A 536. Fittings shall be joined with rigid ductile iron couplings.

C. Riser:

1. Riser check valve shall have grooved connections and be rated for 250 psi, with upstream and downstream pressure gauges, and main drain valve piped to exterior of the building.
2. Electric vane-type water flow alarm switch shall consist of a U bolt and saddle with non-corrosive insert for mounting to the pipe, a non-corrosive vane and trip stem assembly for detecting waterflow and a retard time delayed switch to prevent false alarms from water surges. Waterflow switch enclosures shall be NEMA 4 rated and shall be held captive by tamper resistant screws. It shall be possible to install an optional cover tamper switch to detect removal of the enclosure. The device shall be listed for pressures up to 450 psi, maximum water surges of 18 fps and alarm activation by 10gpm. Activation shall be accomplished by the continuous flow of water against a non-corrosive paddle attached to a non-corrosive stem operating a field replaceable instantly recycling adjustable retard with a 0-90 second range and visual indication of activation. Expiration of the retard time shall result in the simultaneous operation of two sets of single pole double throw (SPDT) switch contacts rated at 10A, 125VAC and 2A, 30VDC. Each switch contact shall have a separate wiring chamber and separate conduit entrance to comply with the separation of power limited and non-power limited conductors without the need for special wire or wire methods.
3. Control Valves shall be ductile iron butterfly valves with grooved ends.
4. Alarm bell shall have under dome strikers and operating mechanisms. Gong shall have an operating voltage of 24VDC. Bell shall be surface mounted on exterior of building and have weatherproofed electrical box.

210008 HANGERS

A. Hangers for vertical piping shall be the Riser Clamp design.

B. Hangers for horizontal piping shall be hanger rings attached to top beam clamps using 3/8" threaded rod. Top beam clamps shall only be attached to the top portion of structural members. All hangers shall permit adequate adjustment after erection while still supporting the load.

C. Trapeze hangers are allowed only where it is necessary due to the required piping layout and structure.

D. Trapeze hangers shall attach to the structure using top beam clamps located on both sides of trapeze hanger. Top beam clamps shall only be attached to the top portion of structural members.

E. Hangers **SHALL NOT** be fastened to joist bridging or roof deck.

210009 BACKFLOW PREVENTER

A. Provide stainless steel reduced pressure zone ("RPZ") backflow preventer installed horizontally immediately downstream of sprinkler water entrance to building, complete with two independent link check modules, differential pressure relief valve between the two modules, two shut-off valves with tamper switches, and required test cocks. Relief valve drain shall be piped to exterior of the building using an air gap fitting by the same manufacturer as the backflow preventer.

B. Test header for backflow preventer shall be as indicated on Contract Drawings.

210010 VALVES

A. Valves not specified elsewhere in Division 21 shall be UL listed and/or FM approved as required by NFPA 13, and shall be listed specifically for fire protection service.

210011 PIPE SLEEVES, PLATES, ESCUTCHEONS, ETC.

A. Pipe sleeves shall be standard weight schedule 40 black steel. All sleeves shall be equal to construction thickness except that pipe sleeves passing through floors above grade, shall extend 3/4" above the finished floor. Pipe sleeve sizes shall be sized two pipe sizes larger than piping passing thru the sleeve.

B. Piping thru non-fire rated walls, floors above slab on grade or ceilings shall have sleeves installed concentric and centered on pipe. Ream all sleeves to prevent cutting of piping. The Contractor shall furnish shop drawings to the general contractor and the Architect showing location, dimensions, and sizes of holes required.

C. Install escutcheons snug against room finish on all exposed pipe passing through walls, floors above slab on grade or ceilings. Use cup type escutcheons at floors where sleeves extend above finished floors. Escutcheons shall be chrome plated steel with spring clip as by Keeny, Connecticut Stamping and Bending Company of Dearborne.

D. Core drill openings for all floor openings may be utilized in lieu of sleeved openings. All openings shall be sized two pipe sizes larger than pipe passing thru the opening. All cored openings shall be fireproofed as required and shall be made water tight.

E. All penetrations in rated floors, firewalls and any other rated separations shall be protected using a through-penetration firestopping method with an "F" rating equivalent to the rating of the membrane being penetrated for particular piping materials used and membrane construction type. Floor penetrations shall additionally have a "T" rating equivalent to the rating of the floor being penetrated. Through–penetration firestop systems shall be installed and tested in accordance with ASTM E814 or UL 1479 with a minimum positive pressure differential 0.01 inch w.g. All openings through horizontal fire

separations shall be protected by Metacaulk U.L. Systems or approved U.L. listed system by other manufacturers.

F. All openings through floors and vertical fire separations shall be protected by combination water seal and fire stops as manufactured by Presealed Systems or approved equal by Proset, or approved equal by Metacaulk or 3M.

210012 SPRINKLER SYSTEM IDENTIFICATION:

A. Each individual riser shall be marked with a metal hydraulic placard containing the following data:

1. Location of area protected by riser.
2. Total number of sprinkler heads connected to riser.
3. Design density and design area, as approved.
4. Required flow rate and pressure at the base of the riser, as approved.

210013 SPRINKLER HEADS

A. Sprinkler head types shall be as indicated on the Contract Drawings, and shall be listed for the proposed application.

B. All sprinkler heads shall be quick response type, unless otherwise indicated on the Contract Drawings.

C. All sprinkler heads shall be glass bulb type.

D. Sprinkler heads shall have ordinary temperature classification, unless otherwise indicated on the Contract Drawings, or required by NFPA 13.

E. K-Factor of sprinkler heads shall be 5.6 or 8.0.

F. Provide spare sprinkler head cabinet with a spare sprinkler heads of each type installed within the building, as required by NFPA 13. Provide at least one wrench of each type required.

210014 PROTECTION OF WORK AND EQUIPMENT

A. The Contractor shall be responsible for all work damaged by him or her. Any fire sprinkler system work damaged by any other contractor shall be replaced by the Contractor and placed in perfect working condition without extra cost to the Owner. All sprinkler heads, valves, pipe, fittings, and equipment shall be adequately protected before, during and after installation.

B. The Contractor shall be responsible for all sprinkler heads, valves, pipe, fittings, and equipment at time of final inspection. Any broken items will be replaced by the Contractor at no cost to the owner regardless of by whom the item was broken.

210015 TESTING

A. The Contractor shall notify the Engineer forty-eight (48) hours in advance of all tests. The Contractor shall make all necessary preliminary tests to ensure a functional system, which shall include flushing, testing, and inspection of sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.

B. All tests shall be applied before any work is concealed or covered in any manner.

C. All tests shall be conducted with regard to safety of all personnel on site.

D. The Authority Having Jurisdiction shall be alerted to and invited to witness all Division 21 tests.

E. Preliminary Tests:

1. All sprinkler piping shall be made tight under a hydrostatic test pressure of 50 psi greater than the required design pressure, or 200 psi, whichever is greater. Hydrostatic test pressure shall be maintained without pressure loss for a minimum of two (2) hours. No caulking of joints will be permitted. Test pressure shall be read from a gauge located at the low elevation point of the system that is under test pressure. Any joint found to leak under this test shall be broken, remade and a new test applied.
2. Waterflow detecting devices, including associated alarm circuits, shall be flow tested using the inspector's test connection. Alarm bell must be audible on premises within five (5) minutes of fully opening inspector's test connection. Each water-operated alarm device shall be tested to verify proper operation.
3. Each tamper switch shall be tested by operating the associated valve.
4. Following flushing of the underground piping, a main drain test shall be made to verify the adequacy of the water supply. Static and residual pressures shall be recorded and submitted. In addition, a main drain test shall be conducted each time after a main control valve is shut and opened.
5. Energize circuits to electrical equipment and devices.
6. Verify that equipment hose threads are same as local fire department equipment.
7. Main drain valves shall be opened until the system pressure stabilizes.
8. All control valves shall be fully opened and closed under system water pressure to ensure proper operation.
9. All backflow preventers shall be tested and certified by an approved and licensed backflow prevention company.
10. All alarms, supervisory signals, and trouble signals that are related to the sprinkler system shall be activated and verified.

F. A final acceptance test shall be conducted, only after all above tests have been successfully conducted and reports have been submitted and approved, in which a technician employed by the installing Sprinkler Contractor shall provide a complete demonstration of the operation of the system. This demonstration shall include operation of control valves and flowing of inspector's test connections to verify operation of associated waterflow alarm switches, as well as a subsequent main drain test to verify that the control valves are in the open position. The technician shall have a copy of all "as-built" drawings, as well as certificates of previously conducted tests listed above. The sprinkler system installation shall not be considered accepted until as identified problems have been corrected, and the system is successfully retested. It is also required that the test documentation is properly completed and received prior to system acceptance.

G. Prior to making a request of Beneficial Occupancy the Sprinkler Contractor shall submit written test reports and certificates as required by NFPA 13 and 24. Submittals shall include system acceptance forms copyrighted by NFPA which shall bear the NFPA copyright symbol. No other forms shall be considered.

H. Sprinkler piping system will be considered defective if it does not pass tests and inspections. Replace damaged and malfunctioning controls and equipment, and retest as necessary.

I. The Contractor shall furnish all necessary equipment, materials and labor to perform the above-specified tests. All equipment and materials shall be in excellent condition.

210016 PLACING IN SERVICE

A. The Contractor shall furnish Owner's representative with Contractor's Material and Test Certificate, per NFPA.

B. The Contractor shall place the entire system in a satisfactory operating condition and shall furnish all assistance and instructions required by the Owner's representative during initial operating period.

210017 ELECTRICAL WIRING

A. Equipment connections to alarm systems shall be provided by Fire Alarm Contractor.

210018 OPERATING AND MAINTENANCE MANUAL

A. Four (4) complete sets of all operation and maintenance manuals **shall** be delivered by the Contractor to the Owner thru the Architect. The manuals **shall** be installed in 3-ring hard cover heavy duty notebooks with the name of the project and the words "**Operation and Maintenance Manual**" permanently affixed to the **cover** and **spine**. All items for the project shall be separated by identification tabs correlated to the index. The manuals **shall** contain the following items as a minimum:

1. Index and page number.
2. Certificate of substantial completion.
3. A summary sheet of warranties with dates noted and a copy of all warranties.
4. List of subcontractors and suppliers with names, addresses, and phone numbers.
5. Backflow preventer certificate of operation.
6. All documented results of preliminary and system acceptance testing.
7. Complete start-up, operation, and shutdown procedures for each system including sequence of events, locations of switches, emergency procedures, and any other critical items
8. Lubrication schedules and types of lubricants.
9. Complete set of Sprinkler Contractor's record drawings and hydraulic calculations.
10. Equipment summary showing all capacities and ratings (HP, KW, etc.).
11. Operation manuals, installation manuals, and parts list for all installed equipment.
12. All submittal data indexed with tabs.
13. Copy of NFPA 25, edition to match that which is currently enforced by the Authority Having Jurisdiction.

B. One copy shall be manufacturers original published literature with manufacturers name on all items. **FAXED COPIES WILL NOT BE ACCEPTABLE**.

C. Contractor shall provide a typed copy of condensed instructions for the operation and testing of the fire pump, as well as wiring and control diagrams framed under glass mounted on the wall near the fire pump.

D. Contractor shall provide training for the Owner's maintenance personnel covering the operation and maintenance of the sprinkler system.

210019 AS BUILT DRAWINGS

A. The General Contractor and Sprinkler Contractor shall maintain "during the course of the work" a set of drawings marked up to show the work as installed. Both Contractors shall initial and date all changes to the contract drawings. The Architectural Observer may check this set of documents monthly for compliance. Upon completion of the work, Sprinkler Contractor shall use these as-built drawings to create a set of record drawings which shall be delivered to the Architect.

B. A printed set of record drawings, along with hydraulic calculations updated as necessary due to field changes, shall be placed within a white PVC tube marked "Fire Sprinkler Shop Drawings" and securely fixed in the first sprinkler riser room.

C. A second set of printed record drawings shall be provided to the Owner, as well as electronic copies of the record drawings and updated hydraulic calculations in PDF form.

210020 GUARANTEE

A. Guarantee: The Contractor shall guarantee the entire fire sprinkler system subject to the General Conditions of these specifications.

210021 BIDDING PROCEDURE

A. The Contractor shall provide bidding for Alternate Bids in accordance with Division 1. Contractor shall refer to Division 1 for any required unit prices and allowances.

END OF SECTION 210000

SECTION 220000 - PLUMBING

220001 GENERAL

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

B. Contractor shall provide coordination drawings per Division 1.

C. Plumbing work shall be performed as outlined in "Information for Bidders".

D. These specifications and the accompanying plumbing drawings are intended to provide for all labor, materials and equipment necessary for the installation complete of all

1. Plumbing Fixtures
2. Equipment
3. Rough-Ins
4. Waste and Vent System
5. Condensate Drainage System
6. Roof Drainage System
7. Overflow Roof Drainage System
8. Cold Water System
9. Hot Water System

and accessories including necessary apparatus, valves and fittings hereinafter described or called for on the plumbing drawings accompanying these specifications.

E. All plumbing work shall be installed in accordance with the following Codes and all Local Ordinances. Materials, equipment and workmanship shall be as hereinafter specified.

1. North Carolina State Plumbing Code
2. North Carolina State Fire Prevention Code
3. National Electrical Code
4. ICC A117.1
5. NSF Standard # 61

F. This contractor shall secure all required permits and inspection fees necessary for this work. Permits may be secured from the Building Inspections Department.

G. The accompanying drawings are schematic only and are not intended to show all fittings, bolts, connections, offsets, etc., unless specifically dimensioned. Follow drawings as closely as possible, provide all adjustments as necessary to conform to the structural conditions, machinery, equipment, work of other contractors and the intent of the drawings, without additional cost to the Owner. Plumbing drawings should not be scaled. Secure dimensions from Architectural drawings. Refer to drawings of other trades and coordinate with other contractors. All items of equipment shall be installed in accordance with the manufacturer's published installation instructions and diagrams.

H. The Contractor shall coordinate water and sewer taps and pay all fees in conjunction to provide services as required, for this project.

220002 SCOPE OF WORK

A. The Contractor shall be required to perform all the following work, in general and provide a complete plumbing system as shown on the plans. The items in general are to be as follows:

1. Furnish and install complete waste and vent system with connections to services as shown on the plumbing drawings and here-in specified.
2. Furnish and install cold water system complete with connections to point as shown on the plumbing drawings and here-in specified.
3. Furnish and install hot water system complete with connections to equipment as shown on the plumbing drawings and here-in specified.
4. Furnish and install condensate drainage system as shown on the plumbing drawings and here-in specified.
5. Furnish and install roof drainage leader system as shown on the plumbing drawings and here-in specified.
6. Furnish and install overflow roof drainage system as shown on the plumbing drawings and here-in specified.
7. Provide connections to equipment furnished and installed by General Contractor or Owner as shown on the plumbing drawings and here-in specified.

220003 LIST OF MATERIALS, FIXTURES AND EQUIPMENT

A. The Plumbing Contractor shall obtain written approval from the Engineer/Architect for the use of substitute materials claimed as equal to those specified. Such approvals must be obtained as soon after contract awards as possible and before any materials are ordered. Applications for approvals shall be made by the Plumbing Contractor and not by subcontractors or manufacturer's representative. The Plumbing Contractor shall submit within ten days following award of contract and written notice to begin the work a complete list of materials proposed for the job. All like items shall be by the same manufacturer. When this list is approved, no further substitutions will be permitted except in unusual or extenuating circumstances. If no list is submitted, the Contractor shall supply materials specified. *Contractor should note that all items specified in section 220000 shall be submitted independently of other 220000 series sections.* The Plumbing Contractor shall review and stamp the submittals as being in accordance with his bid and these specifications. **Private labeled materials are not acceptable.**

B. The Plumbing Contractor shall submit shop drawings to the Architect after award of the contract, and before any materials, fixtures, and equipment to be incorporated in the work has been ordered. Shop drawings shall include the name and address of the manufacturer and their catalog numbers and trade names clearly marked. All items shall be referenced to the plans and specifications by **fixture designation or specification paragraph number on an index tab**. One complete set of submittal data shall be manufacturer's original published material. **FAXED COPIES WILL NOT BE ACCEPTABLE**. Approval of materials will be based upon the manufacturer's published ratings. Submit shop drawings and/or catalog data for the following material and equipment:

1. Waste Piping, Fittings and Couplings
2. Condensate Piping, Fittings and Couplings
3. Roof Drainage Piping, Fittings and Couplings
4. Overflow Roof Drainage Piping, Fittings and Couplings
5. Water Piping, Fittings and Equipment
6. Booster Pump System
7. Cleanouts and Access Doors
8. Valves
9. Insulation
10. Hangers
11. U. L. penetration systems
12. Pipe Markers
13. Fixtures
14. Coordination Drawings per Division 1.

C. Approval of shop drawings and/or submittal data shall not relieve the Plumbing Contractor of the responsibility to comply with the requirements and intent of the plans and specifications with regard to

dimensions, capacities, quality, quantity, performance characteristics, etc. If data submitted deviates from the contract documents, the Plumbing Contractor shall point out such deviations in writing and also state reasons for same. All similar items shall insofar as possible be one make and manufacturer.

D. Where any special make, fixture or materials are specified by plate number, trademark or name, deliver to the building with original labels or other identification marks placed thereon by the manufacturer and do not remove until inspected and approved by the Architect. Similar and equal materials and equipment by other manufacturers will be acceptable, subject to approval.

E. Failure to submit materials, equipment, fixtures, etc., in the time period specified above, the Architect shall assume that all items shall be installed as specified.

220004 WORKMANSHIP

A. Layout:

1. Drawings indicate general locations of fixtures. Secure exact location from Architectural plans before proceeding with work.
2. Furnish and install all necessary sleeves, inserts, bolts, etc., for concrete floor slabs, roof, walls, and partitions. Failure to install such items in time to avoid delaying the general contractor shall result in the Contractor doing all cutting and repairing at his own expense.
3. Sleeves as here-in-after specified shall be installed on all through the floor piping above slab on grade except water closet rough-ins. Water closet rough-ins shall be cast in place. Core drilling of slabs shall be sealed with approved fire retardant caulking and sealed watertight.
4. All equipment shall be installed in accordance with manufacturer's written installation instructions.

B. Drainage, Waste and Vent Piping:

1. Grade all sanitary waste lines as indicated on contract drawings.
2. Grade all condensate drain lines 1/8" per foot.
3. All underground piping shall be graded by the use of a laser beam alignment system.
4. All floor drains shall be set ½ inch below the room finished floor perimeter and the entire floor sloped to the floor drain.
5. Run all piping as directly as possible, avoiding unnecessary bends and turns so as not to interfere with proper installation of work of other contractors.
6. All PVC-DWV piping shall be protected by a cast iron sleeve under the following condition with a sleeve as follows:

    a. Piping passing thru foundation walls: Sleeve shall extend 6 inches beyond wall footing on both sides.
    b. Piping passing below a footing: Per Contract Drawings.

7. Provide removable caps for cleanouts with at least six threads engaged. Provide cleanouts at foot of waste and drainage stacks, all changes in direction of horizontal lines more than 135 degrees, in straight lines at intervals not exceeding 100-feet and anywhere additionally noted on the drawings.
8. Run all horizontal and vertical piping true and plumb to building structure and connect all piping with 'Y' branches and 1/8 or 1/16 bends.
9. Tapped tees and crosses will not be permitted. Tapped sanitary tees and crosses shall be used.
10. No soil, waste, or vent piping shall be covered or concealed, until tested and approved by the Architect.
11. Conceal all soil and vent piping. Vents shall be tied together as shown with minimum number of vents extending through roof. All vents extended through the roof shall be a minimum of 12" above roof level.
12. All PVC-DWV and PVC drainage lines shall be bedded per the manufacturer's recommendations and shall be maintained under a continuous head of 10-feet until after all concrete slabs are poured

and/or all heavy equipment has been removed from the site. Contractor shall be responsible for the protection of the piping system at all times including freezing weather.

C. Water System:

1. Conceal water supply piping in walls, below floor or above ceiling except where exposed for connections to fixtures. Install and secure all piping as walls are built. Wedging of piping will not be permitted. All piping shall be isolated from mortar.
2. All water piping shall be routed with a minimum clearance of ten (10) feet from any electrical switchboards, panel boards or telephone backboards.
3. Arrange all pipes to freely drain through a ball valve when water is cut off. All branch valves shall be installed adjacent to the water piping main.
4. All supplies to fixtures shall have individual stop valves.
5. Provide water hammer shock arrestors as required to prevent water hammer. Arresters shall be A.S.S.E. Standards Number 1010 certified. Arresters shall be installed in accordance with manufacturer's published recommendations. Air chambers are not acceptable. Water hammer shock arrestors shall be as manufactured by Precision Plumbing Products, Inc. or approved equal by Zurn, Josam, J.R. Smith, or Sioux Chief.
6. All exposed piping to fixtures shall be chrome plated installed true and plumb.
7. Insulate all water piping inside the building as hereinafter specified.
8. All tees shall be installed such that the flow shall be straight thru the tee and/or out the side. Tees **shall not** be installed where the flow is into the side and out of both ends of the tee (bullhead tee). Bullhead tees installations are not acceptable and shall not be used.
9. Extend water lines to water mains where shown on the plans.
10. Terminate cold water line 5-feet outside building. Connection at this point will be by the General Contractor.

D. Roof Drainage Piping:

1. Roof drains shall be provided by the Plumbing Contractor and installed where shown on the architectural roof plan by the General Contractor. The Plumbing Contractor shall connect to these roof drains and install the collector and leader system as shown on the plans.
2. Grade all horizontal leaders with slopes as shown on the drawings.
3. All PVC-DWV and PVC drainage lines shall be maintained under a continuous head of 10 foot until after all concrete slabs are poured and/or all heavy equipment has been removed from the site.

E. Overflow Roof Drainage System:

1. Overflow roof drains shall be provided by the Plumbing Contractor and installed where shown on the architectural roof plan by the General Contractor. The Plumbing Contractor shall connect to these roof drains and install the collector and leader system as shown on the plans.
2. Grade all horizontal piping with slopes as shown on the drawings.
3. Terminate piping discharge where shown on the drawings.

F. Insulation:

1. All pipe insulation joints shall be sealed to maintain integrity of the vapor jacket and shall pass thru all sleeves unbroken except for fire stops.
2. Pipe insulation at all fire separations shall be butted tightly to the firewall or to the floor after fire stop material has been installed.

220005 CUTTING, PATCHING AND CHASING

A. All cutting and patching shall be in accordance with the "General Conditions" of these specifications.

220006 EXCAVATION, TRENCHING AND BACKFILLING

A. All excavation, trenching and backfilling shall be in accordance with Division 31 of these specifications.

220007 SEISMIC RESTRAINTS

A. The Contractor shall be responsible for providing restraints to resist the earthquake effects on the plumbing system. The requirements for these restraints are found in Section 1613 of the North Carolina Building Code. All tables and references shall conform to the building's location. Restraints shall be per Seismic Design Category C.

B. The Contractor shall refer to the latest edition of the "Seismic Restraints Manual Guidelines for Mechanical Systems" published by SMACNA for guidelines to determine the correct restraints for piping and conduit, etc. This manual refers to Seismic Hazard Level (SHL).

C. The anchorage of the equipment and machinery for this project shall be an integral part of the design and specification of such equipment and machinery. Manufacturers of all equipment including pumps, hot water heaters, tanks, etc. shall provide anchorage details, isolators, seismic mounts and restraints, etc. necessary to comply with Section 1613 to the Contractor for installation. It shall be the Contractor's responsibility to provide and install the equipment, machinery, systems, and assemblies, etc. For this project that satisfies these requirements.

D. Where seismic restraints are required, the Contractor shall provide restraints per details and instructions included in SMACNA's Seismic Restraints Manual. Contractor shall include shop drawings of the specific methods of seismic restraint to be used for this project before installation of piping and equipment.

E. The Contractor shall retain the services of a Professional Engineer registered in the State of North Carolina to design seismic restraint elements required for this project. The engineer's computations, bearing his professional seal, shall accompany shop drawings that show Code compliance. Computations and shop drawings shall be submitted for review prior to the purchasing of materials, equipment, systems and assemblies.

F. Internal seismic restraint elements of manufactured equipment shall be certified by a Professional Engineer retained by the manufacturer. Such certificate applies only to internal elements of the equipment. All equipment anchorage requirements shall be coordinated with the building structure and shall be compatible thereto. All such anchorage shall be reviewed by the project's structural engineer.

G. The Professional Engineer retained by the Contractor for seismic restraint calculations, shall visit the job site upon completion of the seismic restraint installation. This engineer shall provide in writing verification of compliance with the approved seismic submittal. This verification shall bear the Engineer's professional seal. Job site inspections by other than this engineer are not acceptable.

H. Review of the seismic design and shop drawings by the Engineer/Architect or his agent shall not relieve the Contractor of his responsibility to comply with the seismic or any other requirements of the North Carolina State Building Code.

220008 WASTE AND VENT SYSTEMS

A. Piping: Waste, and vent piping shall be schedule 40 PVC-DWV solid wall piping conforming to ASTM D-2665-68 and C.S. 272-65 with NSF seal.

B. Fittings: Fittings for PVC-DWV piping shall be PVC-DWV fittings conforming to piping specifications.

C. Joints:

1. Joints for PVC-DWV piping shall be made using the piping manufacturer's approved solvent cement.
2. Flashing of plumbing vents will be provided by the General Contractor.

220009 CONDENSATE DRAINAGE

A. Piping: Condensate piping shall be Schedule 40 PVC-DWV solid wall, conforming to ASTM D-2665 and C.S. 272.

B. Fittings: Fittings for PVC-DWV piping shall be PVC-DWV fittings conforming to piping specifications.

C. Joints: Joints for PVC-DWV piping shall be made using manufacturer's approved solvent cement.

220010 HOT AND COLD WATER SYSTEMS

A. Water Piping: Water piping 2-1/2" and smaller, below grade, shall be type 'K' soft copper conforming to ASTM B-88.

B. Fittings:

1. Fittings for copper piping shall be wrought copper, solder joint fittings conforming to ANSI B 16.22.
2. Fittings for copper piping may be press fittings conforming to ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117.

C. Joints:

1. All copper piping joints, 1-1/4" and smaller shall be made using lead free solder with a minimum melting point of 410 degrees Fahrenheit.
2. All copper piping joints, 1-1/2" and larger shall be made using Phos-copper silver alloy material with a minimum melting point of 1000 degrees Fahrenheit.
3. Press fitting joints shall be made using the press fitting manufacturer's tools and per manufacturer's instructions. Upon completion of the project, the press fitting manufacturer's tools used for installation shall be turned over to the Owner.

D. Backflow Preventer:

1. Double Check: Backflow preventer shall be lead-free double check valve design, high hazard, with strainer, test valves, gate valve on inlet and discharge, inlet and outlet pressure gauges, designed to meet AWWA C-510, ASSE 1015. Unit shall be size as shown on the drawings and be manufactured by Watts LF007S or approved equal by Wilkins, Febco, or Conbraco.
2. RPZ: Backflow preventer shall be lead-free reduced pressure design with test valves, strainer, gate valve on inlet and discharge, inlet and outlet pressure gauges, discharge drain funnel, designed to meet AWWA C-511, ASSE 1013, and IAMPO performance specifications. Unit shall be size as shown on the drawings and be manufactured by Watts LF909S or approved equal by Wilkins, Febco, or Conbraco. Funnel drain shall be piped to over floor drain or thru wall.

E. Expansion Tank: Expansion tank shall be diaphragm design constructed of welded steel and shall bear the ASME and National Board Stamp for 150 pounds working pressure and 200° F. operating temperature. Fittings shall include test cocks, hose bibb drain and air control fitting. Tank and fittings shall be as manufactured by Amtrol, Bell and Gossett, Thrush or Taco.

F. Thermometers and Gauges:

1. Thermometers shall be metallic element type with 3" dial, Type 304 stainless steel case, accuracy range of 1%, black markings on white face, and designed for variable angle mounting. Thermometers range shall be such that the operating temperature shall be in the middle range for

the dial. Thermometers shall be installed in a thermometer well and shall be Weiss Model 3VBM Series or approved equal by Omega or Tel-Tru Mfg. Co.

2. Pressure gauges shall be non-filled with 4" face, 1/4" NPT lower connection with operating range in middle portion of the dial, accuracy range of 1%, and black markings on white face. Pressure gauges shall be installed with lever handle gauge cocks. Pressure gauges shall be Weiss Model 4PG-1 or approve equal by Omega or Tel-Tru Mfg. Co.

220011 ROOF DRAINAGE SYSTEM

A. Piping:

1. Roof drain leaders above grade shall be hubless cast iron piping conforming to C.I.S.P.I. Standards 301 and shall carry country of origin, manufacturer's name or manufacturer's registered trade-mark.
2. Roof drain leaders below grade or slab on grade shall be Schedule 40 PVC-DWV solid wall, conforming to ASTM D-2665.

B. Fittings:

1. Fittings for cast iron roof drain leaders shall be sanitary drainage pattern cast iron conforming to ASTM A-74 and shall be marked with the Cast Iron Soil Pipe Institute symbol cast into the fitting.
2. Fittings for PVC roof drain leaders shall be Schedule 40 PVC-DWV conforming to ASTM D-2665.

C. Joints:

1. Joints for hubless cast iron piping shall be made using neoprene gasket and cast iron clamping band with stainless steel bolts torqued to manufacturer's specifications. Clamps shall be as manufactured by MG Piping Products Company or approved equal.
2. Joints for PVC-DWV piping shall be made using manufacturer's approved solvent cement.

D. Drains:

1. Combination primary and overflow roof drains shall be two (2) large sump body coated cast iron drains with galvanized cast iron domes, adjustable extension, combination flashing device/gravel guard, static extension and top set deck plate. Overflow drain shall include internal water dam to provide not in excess of 4" height over main roof drain. Drains shall be Zurn ZC-163-E or approved equal by Josam, J. R Smith, Wade or Watts. Height of static extension shall be as shown on architectural drawings. No hub outlet shall be sized as shown on the drawings.
2. Canopy drains shall be large sump body coated cast iron drains with galvanized cast iron domes, adjustable extension, combination flashing device/gravel guard, static extension and top set deck plate. Drains shall be Zurn ZC-100-DP-E or approved equal by Josam, J. R Smith, Wade or Watts. Height of static extension shall be as shown on architectural drawings. No hub outlet shall be sized as shown on the drawings.

220012 OVERFLOW ROOF DRAINAGE SYSTEM

A. Piping: Overflow roof drain leaders above grade shall be No hub cast iron piping conforming to C.I.S.P.I. Standards 301 and shall carry country of origin, manufacturer's name or manufacturer's registered trade-mark.

B. Fittings: Fittings for cast iron overflow roof drain leaders shall be the sanitary drainage pattern conforming to ASTM A-74 and shall be marked with the Cast Iron Soil Pipe Institute symbol cast into the fitting.

C. Joints: Joints for hubless cast iron piping shall be made using neoprene gasket and cast iron clamping band with stainless steel bolts torqued to manufacturer's specifications. Clamps shall be as manufactured by MG Piping Products Company or approved equal.

D. Termination: Overflow roof drains shall terminate with a nickel bronze downspout nozzle. Downspout nozzle shall be provided with manufacturer's stainless steel screen. Screen shall be secured in place. Downspout nozzle shall be Zurn ZANB-SS series or approve equal by Josam, Wade or J. R. Smith.

E. Drains: Combination primary and overflow roof drains shall be as specified in "Roof Drainage System" section of this specification.

220013 BOOSTER PUMP SYSTEMS

A. Furnish and install prefabricated (triplex) (duplex) variable speed water pressure booster systems as manufactured by HYFAB, or approved equal by SyncroFlo, Inc. or B&G. System shall be capable of providing a controlled system pressure of 60-psig with flow rates from 0 to 95.5-GPM when suction pressure is 14-psig minimum, using 480 Volt, 3 phase, 60 hertz power. Each pump shall deliver 95.5-GPM @ 138.6' TDH with 5-hp 3500-RPM ODP motors. The system control panel, pumps, suction and discharge headers shall be mounted on a single structural mounting frame.

B. All packaged equipment shall be independently Third Party labeled as a system suitable for the intended use by a nationally Recognized Testing Laboratory in accordance with OSHA Federal Regulations, and NFPA Pamphlet 70, National Electric Code Article 90-7.

C. Pump system manufacturer must have no less than 20 years experience as a designer and manufacturer of domestic water pumping systems for commercial buildings. Manufacturer must have designed, built, and supported not less than 10,000 pump systems and been under continuous management for not less than twenty years. Manufacturer's testing instrumentation must be traceable to NIST standards. Include current certifications with substitution request. Manufacturer must be ISO 9000 certified.

D. Pumps shall be single stage end-suction design with stainless steel volute and stainless-fitted construction, equipped with sleeve-mounted mechanical shaft seals and a high efficiency motor with class F insulation. Pump designs that do not have shaft sleeves shall not be acceptable. Pumps shall be fitted with single inside mechanical seal with carbon vs. ceramic faces, stainless steel spring and hardware and Buna-N elastomers. Pumps shall be selected closest to the best efficiency point. Motors shall be non-overloading at duty point.

E. To protect the pump against overheating, provide a mechanical over-temperature protection device on the pump discharge that will divert flow to drain when water temperature exceeds 140 degrees F.

F. To protect the domestic water system against excessive pressure, provide a pressure relief valve on the pump discharge that will divert flow to drain when water pressure exceeds 80 psi.

G. Provide isolation valves on the suction and discharge of each pump. Valves shall be lug style butterfly valves with hand lever operator rated for a minimum 200 psig W.P. Valves shall be certified to NSF 61 drinking water standards. Gate valves shall not be acceptable.

H. Provide a wafer style check valve to prevent back flow of water on each pump discharge. Check valve shall be manufactured from gray iron and shall be rated for a minimum of 200psig W.P. All contact surfaces shall be suitable for potable water service.

I. The booster pump system shall employ logic that adjusts the set point of the pumps to simulate the operation of a remote sensor at the critical fixtures that determine the pressure required per ASHRAE 90.1-2010.

J. The controller shall optimize power consumption based on flow, VFD speed, and power consumption. As a backup, a factory set pressure switch shall sequence pumps when system pressure falls below the setpoint. Automatic sequencing shall include the following features:

1. Flow sequencing.
2. Power sequencing, programmable in horsepower, not Watts.
3. Pressure sequencing.
4. End-of-curve protection, based on pump differential, with 2% accuracy.
5. VFD speed sequencing.
6. Lead pump shutdown feature that can be enabled or disabled by the operator.
7. Low-flow test feature testing pressure, power, VFD speed, and flow to reduce pump short-cycling, pressure swings, power surges, and motor wear.
8. Tank pressurization sequence to increase the energy stored in the tank prior to shutdown.
9. Time clock to disable lead-pump shutdown during building occupancy.
10. Sequence shifting that adjusts the pump sequence when any pump is disabled.
11. Successive and 24-hour alternation of equal capacity pumps.
12. Pump overlap during 24-hour alternation.
13. Lag pump exerciser function.
14. Special sequencing to reduce surges during power restoration.
15. Sequential sequencing of lag pumps.
16. Minimum run and stop delay timer for each pump.
17. Field adjustable time delay for lag pump pressure start signals.
18. Field adjustable low suction pressure alarm.
19. Field adjustable selection to enable/disable limited auto reset of low suction and high system pressure alarms.

K. Provide a factory pre-charged, ASME code and NB stamped, 52-gallon HydroCumulator tank. Tank shall include a replaceable FDA approved Butyl rubber flexible membrane to separate air and water. No water shall come in contact with the walls of the tank. The HydroCumulator tank shall be shipped pre-charged to the proper design conditions. The tank shall be located as indicated on the plans. Contractor shall install the tank and provide floor drain as required by the manufacturer for adequate serviceability.

L. Furnish a power and control panel in NEMA 1 enclosure complete with programmable controller, epoxy-coated backpan, operator interface, and 120V control circuit transformer. The complete assembly shall have the UL listing mark for industrial control panels and have a single-point power connection. Provide circuit-breaker protection, not fuses that require replacement. The primary control power circuit breaker shall comply with UL file code 489 and the secondary circuit breaker with UL file code 1077. All components must conform to the IP10 finger safe design to protect against accidental contact. All internal power wiring must be 90 degrees C rated per UL508A. Size power wire in accordance with UL508A Table 28.1. Control panel must meet 65,000 SCCR Rating.

M. The touchscreen interface shall be flush mounted in the door of the control panel. The touchscreen shall have the following features:

1. 320 x 240 resolution, 256 color, 3MB memory, 5.7" screen size, 520 characters per screen, 300 touchpoints per screen.
2. Serial port (for PLC communication), USB port (for programming), and Campact Flash port (for troubleshooting and field-loading program changes).
3. The HMI shall be capable of direct communication with the VFD, in the event of a PLC failure.

The following data shall be accessible through the operator interface:

1. System status including flow rate (GPM), current system pressure and setpoint, pump run status, the current speed of the pumps (%), and the method of speed control. Display system status on all user screens.
2. Usage history shall record the maximum instantaneous flow, along with the date and time. Overall and current day totalized flow, pump starts, and pump run hours are also recorded. Usage history may be reset.
3. A Set Points Menu system for adjusting setpoint. Display and adjust flow, pressure, differential pressure, VFD speed, power, minimum speed, lead pump shutdown mode, and tank pressurizer set

points and time delays. Restore to either factory defaults or the last saved field defaults. Protect adjustable settings with a password.

4. Alarm History of the past 200 alarms. Each log shall include individual pump run status, system pressure and run setpoint, alarm type and the date and time. Alarm Type shall be in plain English, not codes requiring a reference list.
5. Alarm List of all possible alarms and their current status. Display any current alarms on all user screens.
6. Startup instructions and checklist.

The HMI shall include a method for transferring data.

1. System information shall automatically copy to an installed compact flash drive every minute, plus an additional entry for each alarm condition.
2. Include fault codes from the PLC and the VFD.
3. Copy usage data to the drive daily.
4. Data shall be stored in a text file, readable by non-proprietary software.
5. HMI Software shall allow for program changes to the HMI and PLC to be transferred via the compact flash drive.

N. The PLC shall be installed on the control panel base pan, not the door, to protect it from damage. The PLC manufacturer shall be clearly marked on the controller, and non-proprietary. The PLC shall continue to function even if the touchscreen is non-functional. The PLC shall have the following features: 32,000 steps of built-in program memory, 7680 auxiliary relays, 320 timers, 235 counters, 8000 data registers, 24,000 extension registers, and 24,000 extension file registers.

O. Each pump shall have its own variable frequency drive factory-wired with the following features:

1. Voltage source, GTR or IBGT power transistor based inverter - PWM Type
2. Use a high carrier frequency to reduce drive and motor noise
3. Shall be capable of operating in an ambient temperature between 15 degrees F and 100 degrees F and a line voltage variation of less than 10 percent.
4. Self protection features shall include: under voltage and over voltage protection, current overload protection, short circuit protection, power failure protection, ground fault protection, and over-temperature protection.
5. Include a four-digit LED readout to indicate the following: drive enabled, output frequency, and all VFD fault conditions.
6. The drive shall automatically restart after any of the following: overload over-voltage, converter over-current, inverter over-current, or power failure.
7. The following drive parameters shall be user adjustable: acceleration speed (1 to 300 seconds), deceleration speed (1 to 300 seconds), minimum speed, and maximum speed.
8. The drive shall have a front mounted "HAND-OFF-AUTO" selector switch and a potentiometer for adjusting drive speed in the "HAND" position.
9. Minimum 1000,000 SCCR
10. The VFD shall use the following energy saving techniques

    a. Slows down the motor
    b. Reduce current
    c. Reduces voltage
    d. Evaluates 6 motor characteristics to further increase efficiency

11. The VFD shall communicate with the PLC with a DIGITAL connection, with the following capabilities:

    a. Able to modify 300 different VFD parameters through the PLC and HMI
    b. Read all VFD data and communicate it to the PLC, HMI, and write to the compact flash drive.

P. Install variable frequency drives smaller than 40-HP inside a NEMA 1 control panel, or provide dust protection to and externally-mounted drive. Provide fans to cool control panels with internally-mounted VFD's. Fans shall produce positive cabinet pressure to prevent dust infiltration. Filter all incoming air.

Q. Mount the pressure transmitters inside the control panel. Digital pressure transmitters shall be connected to both the suction and discharge headers. The transmitters shall have 1.0% accuracy, stainless steel wetted parts and a waterproof enclosure. Transmitters shall be IP67 rated, and capable of withstanding over pressurization of double its range. The transmitter shall use a digital 1-6 kHz pulse output that can be directly sent to the programmable logic controller (PLC) without requiring an additional analog module for measuring current. The transmitter zero set point must be capable of field-calibration.

R. Each system shall have pressure gauges for indicating suction and system discharge pressures, and a control power light. All pump or header-mounted pressure gauges shall be 4½" glycerin filled gauges. All panel-mounted gauges shall be 2½" glycerin filled gauges. Gauges shall have a stainless steel case and crimp ring, copper alloy movement with the case connection sealed with EPDM "O"-ring. Gauges shall be according to ASME B40.100, Grade A and shall have an accuracy of 1% of span.

S. Provide thermometers at each pump discharge and at inlet. Thermometers shall be metallic element type with 3" dial, type 304 stainless steel case, accuracy range of 1%, black markings on white face, and designed for variable angle mounting. Thermometers range shall be such that the operating temperature shall be in the middle range for the dial. Thermometers shall be installed in a thermometer well and shall be Weiss Model 3vbm series or approved equal by Omega or Tel-Tru Mfg. Co.

T. Furnish temperature relief valves at each pump, low suction and low system pressure alarms, indication of first activated alarm, pulsing alarm horn with silence function, and individual alarm auxiliary contacts, time delays, and indicating lights. Provide backup sequencing and controls to provide temporary operation when the touchscreen or PLC is inoperable or removed.

U. The system shall be factory prefabricated. Furnish flanged schedule 40 suction and discharge headers, which can be reversed in the field. All branch and header wetted parts shall be minimum 304 stainless steel. To minimize leak points, all branch and header connections shall be flanged or welded with the only threads located at the pump discharge. Secure all piping with adequate bracing and supports. The only field connections required will be to piping to system headers, tank, over-temperature drain tube, and one incoming power connection at the control panel. All skid members must be properly designed structural steel, to adequately support the weight of the entire system, including piping and motors, and resist bending during transportation.

V. The booster system and its component parts shall undergo a complete operational flow test from zero to 100% design flow rate under the specified suction and net system pressure conditions. This flow test shall be performed by supplying the control panel with the specified incoming voltage. Each pump's performance shall be tested over its full range of flow. All adjustments shall be set and all functions verified. Components shall be tested for hydraulic shock, vibration, or excessive noise. Any parts found to be defective must be replaced prior to shipment. Full documentation shall be maintained by the manufacturer showing flow rates, pressures, and amp draws for future service and troubleshooting reference. In the Operation and Maintenance Manuals, include an X-Y graph of system pressure-flow performance.

W. The contractor shall install the system adjacent to a floor drain sized in accordance with local code. This drain is to prevent building damage in the event of seal failure and to receive over-temperature protection discharge. The contractor shall pipe the temperature relief valve discharge line to the drain.

X. To reduce the possibility of damaging vibration, the contractor shall install the pump system on a housekeeping pad, bolted and grouted in place. The pump system shall be piped with a bypass and isolation valves, and with flexible connectors at the header connections.

Y. The complete pumping system shall be guaranteed in writing by the manufacturer for a period of one year from date of startup or eighteen months from shipment, whichever comes first, against defects in materials and workmanship. Warranties and guarantees by the suppliers of various components in lieu of single-source responsibility by the manufacturer will not be accepted. The PLC, Touchscreen HMI, and VFD's shall also be warranted for 5-years by a single third-party. The manufacturer's warranty shall cover any and all parts and components, while labor remains the responsibility of the installing contractor's warranty contract with the building owner.

Z. Startup shall be by manufacturer's authorized representative.

220014 CLEANOUTS AND ACCESS DOORS

A. Cleanouts shall be the same diameter as the pipe they are connected to. If the pipe is greater than 4" in diameter, the cleanout shall be 4".

B. The Contractor shall provide access doors in accordance with Division 08. Access doors shall be provided for all valves and shock arrestors located behind hard ceilings and in walls to provide access. Ceiling access doors shall be a minimum of 24" x 24".

C. Cleanouts installed in walls or pipe chases shall be installed using PVC-DWV cleanout tee with slotted plug, stainless steel cover with vandalproof securing screw. Cleanouts shall be Zurn ZS-1468, Josam 58600-PLG, or J. R. Smith 4472.

D. Cleanouts installed in floors and walks shall have adjustable cast iron body with cast brass plug, lead seal and round nickel bronze top with watertight gasketed cover. Cleanouts shall be Zurn ZN-1400, or approved equal by Josam or J. R. Smith.

E. Cleanouts installed outside the building and flush with grade shall be installed flush with 24" x 24" x 6" thick concrete pad. Cleanouts plugs shall be PVC with recessed head. Cleanouts shall be Zurn Z-1474, or approved equal by Josam, J. R. Smith.

220015 VALVES

A. Valves shall be installed at all points noted on the plans by standard symbols or as required by best general practice for proper control and operation of the system. All valves shall be identified with 1" diameter, 19 gauge, polished brass identification tags with a number and valve service indicated. Provide a valve chart listing all valves with size and service framed and mounted under glass in the main mechanical room. Provide a self-sticking 1/2" diameter dot on lay-in ceiling grid at all valve locations. Red dot for domestic hot water supply and return, Blue for cold water.

B. Check valves 2 inch and small shall be Class 125, lead free design cast bronze body with threaded ends.

C. Check valves 2-1/2 inch and larger shall be Class 125, cast iron body with flanged ends.

D. Domestic cold and hot water system valves 1-1/4 inch and smaller shall be lead free design cast bronze body, full ported, soldered end ball valves rated for Class 150, 200 WOG service.

E. Domestic cold and hot water system valves 1-1/2 inch and 2 inch shall be lead free design cast bronze body, full ported, threaded end ball valves rated for Class 150, 200 WOG service. Valves shall be provided with stem extensions for insulation thickness specified.

F. Domestic cold and hot water system valves 2-1/2 inch and larger shall be flanged end, iron body ball valves rated for Class 150, 200 WOG service. Valves shall be provided with stem extensions for insulation thickness specified.

220016 PIPE INSULATION

A. All plumbing pipe insulation systems shall be installed as a subcontract to the Plumbing contract. All plumbing pipe insulation systems, including jacketing, coverings, adhesives when used, shall have a flame spread rating not exceeding twenty-five (25) and a smoke development rating not exceeding fifty (50) when the insulation assembly is tested as a composite. Fibrous glass pipe insulation shall be pre-molded with a thermal conductivity of 0.24BTU/in/hr/ft^2 at 100°F.

1. Insulate all cold water piping above grade with 1" thick pre-molded fibrous glass pipe insulation with self-sealing fire retardant vapor barrier jacket.
2. Insulate all hot water piping, 1-1/2" and smaller, above grade with 1" thick pre-molded fibrous glass pipe insulation with self-sealing fire retardant jacket.
3. Insulate all copper water piping below grade or slab on grade with 1/2" thick pre-molded closed cellular plastic foam pipe insulation.
4. All roof drain leaders, horizontal and vertical, above slab on grade shall be insulated with 1" thick pre-molded fibrous glass pipe insulation with self-sealing fire retardant vapor barrier jacket.
5. All overflow roof drain leaders, horizontal and vertical, above slab on grade shall be insulated with 1" thick pre-molded fibrous glass pipe insulation with self-sealing fire retardant vapor barrier jacket.
6. Rigid pipe insulation inserts shall be provided for all insulated piping 2" and larger.
7. All condensate drainage piping, horizontal and vertical, above slab on grade serving air conditioning condensate shall be insulated with 1" thick pre-molded fibrous glass pipe insulation with self-sealing fire retardant vapor barrier. Condensate P-traps shall be insulated with 1" thick insulating cement insulation.

B. Exposed pre-molded pipe insulation in finished areas and mechanical rooms shall be finished with factory jacket neatly pasted in place and left ready for painting as specified hereinafter.

C. All pipe insulation for pipe fittings shall be pre-molded to fit fittings and shall be enclosed under pre-molded PVC fitting jacket.

D. Plumbing piping located in CMU walls shall be insulated with closed cellular foam insulation with thicknesses as specified above. Foam insulation thermal properties shall match or exceed the specified thermal insulation properties for the intended usage. Insulation shall be secured with insulation manufacturer's approved tape.

E. Contractor **may request** that closed cellular foam insulation be used on insulated piping when the building structure is not "dried in" to protect fibrous glass insulation from getting wet. Foam insulation thermal properties shall match or exceed the specified thermal insulation properties for the intended usage. Insulation shall be secured with 16 gauge copper wire at 16 inch centers.

220017 HANGERS

A. Hangers for vertical piping shall be the Riser Clamp design and shall conform to MSS SP-58, Types 1 through 58.

B. Hangers for horizontal piping shall be the Clevis type and shall conform to MSS SP-58, Types 1 through 58.

C. **Hangers for insulated piping shall extend around the insulation.** Provide 16 gage galvanized steel insulation protection saddles 12" long at each hanger on all insulated lines. At the contractor's option, hangers for insulated piping may be Michigan Hangers Model 4031 or 4041. Insulation Shields shall cover lower 180 degrees of pipe in the case of clevis hangers, and entire circumference of pipe in the case of trapeze hangers or clamps.

D. Hangers shall be spaced per the NC State Plumbing Code in accordance with the piping material.

E. A hanger shall be provided within one (1) foot of each bend in horizontal piping. Vertical piping shall be supported at each floor or at intervals not exceeding ten (10) feet. Support cast iron soil pipe to each joint.

F. For piping 4" in diameter and larger, rigid support sway bracing shall be provided at changes in direction greater than 45 degrees.

G. Hangers shall be fastened by means of threaded rods to steel beam clamps, center of bar joist, center of trusses, etc. All hangers shall permit adequate adjustment after erection while still supporting the load. All hanger rods attached to bar joist and trusses shall be install between bottom or top cords of the structural member. Structural members to span from building structure to structure shall be provided by the Contractor.

H. Hangers SHALL NOT be fastened to joist bridging or roof deck.

I. Hangers shall only be hung with drilling into the slab with "drop-in" hangers with the approval of the Structural Engineer of record and the Mechanical Engineer of record with complete dead and operating load information provided for each location. Loading information shall be provided by the Plumbing Contractor.

J. Piping supported on a trapeze hanger shall be secured to the trapeze hanger by means of a pipe clamp around the pipe insulation and insulation saddle. Bare piping shall be secured by a pipe clamp and isolated by an isolation cushion.

K. Piping supported from the floor shall be supported using a base plate securely anchored to the floor and be equipped with a pipe riser. Riser shall be a minimum size of one inch. Horizontal piping above the floor shall be anchored and rest on a manufactured saddle. Piping shall be secured to each saddle as approved by the Engineer.

220018 PIPE SLEEVES, PLATES, ESCUTCHEONS, ETC.

A. Pipe sleeves shall be standard weight schedule 40 black steel above slab on grade or cast iron below slab on grade. All sleeves shall be equal to construction thickness except that pipe sleeves passing through floors, other than slab on grade, shall extend 3/4" above the finished floor. Pipe sleeve sizes shall be sized two pipe sizes larger than piping passing thru the sleeve.

B. Piping thru non-fire rated walls, floors above slab on grade or ceilings, piping passing through foundation walls, and piping installed below structural footings shall have sleeves installed concentric and centered on pipe. Ream all sleeves to prevent cutting of piping. The Contractor shall furnish shop drawings to the general contractor and the Architect showing location, dimensions, and sizes of holes required. Sleeves on piping passing through foundation walls shall extend 6" beyond wall footing on both sides. Sleeves on piping installed below structural footings shall extend beyond footing as indicated on contract drawings.

C. Install escutcheons snug against room finish on all exposed pipe passing through walls, floors above slab on grade or ceilings. Use cup type escutcheons at floors where sleeves extend above finished floors. Escutcheons shall be chrome plated steel with spring clip.

D. Sleeves for insulated piping shall be large enough to allow the insulation to pass thru sleeve unbroken.

E. Core drill openings for all floor openings may be utilized in lieu of sleeved openings. All openings shall be sized two pipe sizes larger than pipe passing thru the opening. All cored openings shall be fireproofed as required and shall be made water tight.

F. All penetrations in rated floors, firewalls and any other rated separations shall be protected using a through-penetration firestopping method with an "F" rating equivalent to the rating of the membrane being

penetrated for particular piping materials used and membrane construction type. Floor penetrations shall additionally have a "T" rating equivalent to the rating of the floor being penetrated. Through–penetration firestop systems shall be installed and tested in accordance with ASTM E814 or UL 1479 with a minimum positive pressure differential 0.01 inch w.g. All openings through horizontal fire separations shall be protected by Metacaulk U.L. Systems or approved U.L. listed system by other manufacturers.

G. All openings through floors and vertical fire separations shall be protected by combination water seal and fire stops as manufactured by HoldRite, or approved equal by Proset, Metacaulk, or 3M.

220019 PLUMBING SYSTEM IDENTIFICATION

A. All piping in the building shall be identified by snap-on pipe markers or secured with two zip ties. Markers shall have ANSI colored letters at ANSI height on ANSI colored background with flow arrows and shall be located at 10' on center along pipeline, at each tee branch and at each floor/wall penetration, both sides. A pipe marker shall be located adjacent to each valve. Pipe identification markers shall comply with ANSI A13.1 and be Custom MS-790 as manufactured by Marketing Service Incorporated or approved equal Steton, Emed or DuraLabel. Stenciling of piping and/or insulation is not acceptable. Wording on markers shall be as follows where more stringent than ANSI Standards:

1. Cold Water
2. Hot Water
3. Roof drain
4. Overflow roof drain

B. Engraved plastic laminate signs for listed plumbing equipment shall be 1/16 inch thick and be secured with self-tapping stainless steel screws. Plastic laminate face color shall be red for all emergency applications and black for all other uses. Background color shall be white. Signage for all equipment, etc., shall show equipment or service identification, capacity, final date of acceptance for equipment item and warranty information. Signage shall be provided for the following items:

1. Water Heaters
2. Booster pump
3. Hydrocumulator tank

220020 PROTECTION OF WORK AND EQUIPMENT

A. It is imperative that waste and vent lines not be filled with concrete, concrete grindings, sand, gravel, or other foreign matter. Under no circumstances shall any line be left open while the Contractor's workers are not on the job site.

B. Plug each opening of waste and vent lines the same day it is installed with test plug securely held in place.

C. All floor drains and hub drains shall be covered immediately after installation.

D. The Contractor shall be responsible for all work damaged by him/her. Any plumbing work damaged by any other contractor shall be replaced by the Contractor and placed in perfect working condition without extra cost to the Owner. All fixtures and fittings shall be adequately protected before, during and after installation.

E. The Contractor shall be responsible for all plumbing fixtures at time of final inspection. Any broken fixtures will be replaced by the Contractor at no cost to the owner regardless of by whom the fixture was broken.

220021 TESTING

A. The Contractor shall notify the Engineer forty-eight (48) hours in advance of all tests. The Contractor shall make all necessary preliminary tests to insure a tight system. Any joint found to leak under test shall be broken, cleaned and remade.

B. All tests shall be applied before any work is concealed or covered in any manner.

C. All sanitary waste, vent and condensate drainage piping shall be tested in the following manner: Plug all openings and fill entire waste and vent system to overflow with water and sustain a constant level for a minimum period of three hours. All portions of the each floor system shall be tested under a minimum of a 10-foot head including roof vent terminal.

D. All water piping, hot and cold shall be made tight under a hydrostatic test pressure of 150-lbs. per square inch and maintained without pressure loss for a minimum of four (4) hours. No caulking of joints will be permitted. Any joint found to leak under this test shall be broken, remade and a new test applied.

E. The roof drain piping system shall be tested in the following manner: Plug pipe outlet and fill entire under floor system with water under a 10-foot head above finished floor and sustain a constant level for a minimum period of three (3) hours. All piping above the lowest floor level shall be tested from a test tee installed at that level with the entire system filled with water into drain body and sustain the constant level for a period of three (3) hours.

F. The overflow roof drainage piping system shall be tested in the following manner: Each joint in piping system shall be tested under a minimum of a 10-foot water column for a one hour period without loss of water.

G. All backflow preventers shall be tested and certified by an approved and licensed backflow prevention company.

H. The Contractor shall furnish all necessary equipment, materials and labor to perform the above-specified tests.

220022 STERILIZATION

A. All new water piping shall be charged with a chlorine solution containing not less than 50-ppm available chlorine. The solution shall remain in the piping for a minimum period of 6 hours, during which time valves shall be opened and closed to permit a small flow of the solution. At the end of the six (6) hours, the solution shall be tested and must contain a residual of at least 5 to 10 ppm chlorine. The system shall then be drained and flushed to provide satisfactory potable water before final connection is made to the existing distribution system.

B. The Contractor shall contract with an independent Testing Laboratory for a certification letter that the system sterilization meets or exceed standards for potable water.

220023 PLACING IN SERVICE

A. Upon completion of the entire system installation, the entire system and all equipment shall be tested by actual operation to provide that it will function as intended.

B. The Contractor shall flush all waste piping prior to final connection to existing system, to ensure that no foreign materials are in these lines, and that a continuous flow of water and waste can be affected.

C. The Contractor shall flush all water piping prior to the connection of flush valves, mixing valves, and faucet aerators to provide a clean and operational water system.

D. The Contractor shall place the entire system in a satisfactory operating condition and shall furnish all assistance and instructions required by the Owner's representative during initial operating period. The Contractor shall acquaint the Owner's representative with the special parts required for the operation of the flush valves furnished and installed on the project.

E. It is the Contractor's responsibility to turn over to the owner all fixtures and floor drains in a clean condition.

220024 PAINTING

A. The Contractor should note that plumbing piping may be exposed in various areas. The contractor should specifically note that all exposed cast iron piping be uncoated.

B. All exposed plumbing pipe and plumbing pipe insulation in areas other than mechanical rooms shall be left clean and free from oil ready for painting by the General Contractor. All finished painting will be by the General Contractor with colors to match the surrounding areas.

220025 ELECTRICAL WIRING

A. The Electrical Contractor shall furnish and install all disconnects and motor starters and circuitry. Plumbing Contractor shall make all final electrical connections to equipment provided under Division 22. See Electrical Drawings.

220026 OPERATING AND MAINTENANCE MANUAL

A. All operation and maintenance manuals **shall** be delivered by the Contractor to the Owner thru the Architect. The manuals **shall** be installed in 3-ring hard cover heavy duty notebooks with the name of the project and the words "**Operation and Maintenance Manual**" permanently affixed to the **cover** and **spine**. All items for the project shall be separated by identification tabs correlated to the index. The manuals **shall** contain the following items as a minimum:

1. Index and page number.
2. Certificate of substantial completion.
3. A summary sheet of warranties with dates noted and a copy of all warranties.
4. List of subcontractors and suppliers with names, addresses, and phone numbers.
5. Water Line test data for sterilization.
6. Backflow preventer certificate of operation.
7. Complete start-up, operation, and shutdown procedures for each system including sequence of events, locations of switches, emergency procedures, and any other critical items
8. Lubrication schedules and types of lubricants.
9. Complete set of current shop drawings and equipment description showing all capacities and other operation conditions.
10. Equipment summary showing all capacities and ratings (HP, KW, etc.).
11. Operation manuals, installation manuals, and parts list for all installed equipment.
12. All submittal data indexed with tabs and shop drawings.

B. One copy shall be manufacturer's original published literature with manufacturer's name on all items. ***FAXED COPIES WILL NOT BE ACCEPTABLE***.

220027 AS BUILT DRAWINGS

A. The General Contractor and Plumbing Contractor, shall maintain "during the course of the work" a set of drawings marked up to show the work as installed, including dimensions to and elevations of buried work. Both Contractors shall initial and date all changes to the contract drawings. The Architectural Observer may check this set of documents monthly for compliance. Upon completion of the work, return this set of drawings to the Architect.

220028 FIXTURES

A. All exposed piping and metal parts shall be chrome plated. Slip joints will not be permitted except on fixture side of trap. Rigid supplies are specified for fixtures and it is intended that they be installed true and plumb from fixture to wall rough in. Connections for water closets shall be made by use of flanges compatible to waste piping materials and verminproofed wax gaskets.

B. **MANUFACTURER'S MODEL NUMBERS ARE PROVIDED FOR GENERAL INFORMATION ONLY.** Description of product shall take precedence over model numbers.

C. All water closets shall flush properly when flushing with 25 PSIG at the flush valve.

D. All floors drains, hub drains and mop receptors shall have a deep seal cast iron P-trap installed below floor as a separate item. Joint connection shall be compatible to piping system.

E. All floor-mounted water closets shall be set and grouted with white grout between floor and closet base.

F. All wall-hung fixtures shall be sealed between wall and fixture with white "G.E. Silicone Seal" caulking.

G. All counter mounted fixture rims shall be sealed with clear "G.E. Silicone Seal" caulking.

WC-1 WATER CLOSET: (Adult ADA) Complete HET toilet system with exposed manual flush valve with 1" screwdriver angle check stop, vandal resistant stop cap, ADA flush handle, vacuum breaker, 1" chrome plated wall supply cover pipe, chrome plated cast brass escutcheon with set screw, 1-1/2" chrome plated flush pipe, chrome plated stand-off bracket, and wall hung, vitreous china, elongated siphon jet bowl, designed to flush properly with 1.28 gallons, everclean finish shall be American Standard 2859.128, Zurn, or Sloan. White moltex open front seat with concealed stainless steel check hinge, less cover, American Standard 5901.100, Church No. 9500CT, Centoco 1500CCSS Bemis 1955SSCT, or Benekee 527. Vertical chair carrier with cast iron feet, chrome plated cap nuts, separate waste and vent connections above, less side inlet and outlet Zurn Series ZN-1209-N4 for single water closet, or Zurn Series ZN-1202-ND4 for back to back water closets, or approved equals by J.R. Smith, MiFab, or Watts, connected per the drawing details.. Contractor should note flush valve rough-in height as shown on the drawings. Flush valve handle shall be roughed in and mounted to the wide side of the toilet stall.

WC-2 WATER CLOSET: (Adult Standard) Complete HET toilet system with exposed manual flush valve with 1" screwdriver angle check stop, vandal resistant stop cap, ADA flush handle, vacuum breaker, 1" chrome plated wall supply cover pipe, chrome plated cast brass escutcheon with set screw, 1-1/2" chrome plated flush pipe, chrome plated stand-off bracket, and wall hung, vitreous china, elongated siphon jet bowl, designed to flush properly with 1.28 gallons, everclean finish shall be American Standard 2859.128, Zurn, or Sloan. White moltex open front seat with concealed stainless steel check hinge, less cover, American Standard 5901.100, Church No. 9500CT, Centoco 1500CCSS Bemis 1955SSCT,or Benekee 527. Vertical chair carrier with cast iron feet, chrome plated cap nuts, separate waste and vent connections above, less side inlet and outlet Zurn Series ZN-1209-N4 for single water closet, or Zurn Series ZN-

1202-ND4 for back to back water closets, or approved equals by J.R. Smith, MiFab, or Watts, connected per the drawing details. Contractor should note flush valve rough-in height as shown on the drawings. Flush valve handle shall be roughed in and mounted to the wide side of the toilet stall.

U-1 URINAL: (Adult ADA) Complete High Efficiency Urinal System with exposed manual flush valve with 3/4" screwdriver angle stop valve, vandal resistant stop cap, ADA handle, vacuum breaker, 3/4" chrome plated wall supply cover pipe, cast brass escutcheon with set screw, 3/4" chrome plated flush pipe, and wall hung, vitreous china, siphon jet urinal with 2" wall outlet, 3/4" top spud, wall hanger, designed to flush properly with .125 gallons of water or less shall be American Standard 6590.503, Sloan WEUS-1000.1001-0.13, or approved equal by Zurn. Chair carrier with chrome plated cap nuts, Zurn Z-1222, or approved equal by J.R. Smith, MiFab, or Watts. Lip shall be mounted at height as shown on the drawings.

U-2 URINAL: (Adult Standard) Complete High Efficiency Urinal System with exposed manual flush valve with 3/4" screwdriver angle stop valve, vandal resistant stop cap, ADA handle, vacuum breaker, 3/4" chrome plated wall supply cover pipe, cast brass escutcheon with set screw, 3/4" chrome plated flush pipe, and wall hung, vitreous china, siphon jet urinal with 2" wall outlet, 3/4" top spud, wall hanger, designed to flush properly with .125 gallons of water or less shall be American Standard 6590.503, Sloan WEUS-1000.1001-0.13, or approved equal by Zurn. Chair carrier with chrome plated cap nuts, Zurn Z-1222, or approved equal by J.R. Smith, Mifab, or Watts. Lip shall be mounted at height as shown on the drawings.

L-1 LAVATORY: (Adult ADA) 20" by 18" acid resistant enameled cast iron with 4" center set punching, back ledge, wall hanger, front overflow shall be Commercial Enameling 553 or approved equal by Zurn or Kohler. Chrome plated, lead free, metering faucet with single push button, chrome-plated cover plate, and 0.5 GPM vandal resistant aerator shall be Zurn Z86100-XL-CP4-3M, or approved equal by Kohler, or Moen. Connect faucet to cold water only. Chrome plated lead free angle stops with loose key handle and 1/2" chrome plated nipple to wall and escutcheon with set screw shall be McGuire, Zurn, or Engineered Brass Company. Stainless steel braided flexible supplies shall be as manufactured by McGuire SSLAV12050038 or approved equal by Brass Craft, Watts. Chrome plated cast brass strainer with open grid, overflow openings, cast brass locknut and 1-1/4" 17 gauge tailpiece shall be McGuire Model 155A, Zurn Model Z-8743, or Engineered Brass Company Model SG7L05. 1-1/4" by 1-1/2" chrome plated adjustable cast brass P-trap with 1-1/4" slip in inlet, cleanout, ground joint, 1-1/2" I.P.S. outlet, shall be McGuire, Zurn, or Engineered Brass Company. 1-1/2" chrome plated nipple to wall with escutcheon and setscrew shall be McGuire Model N150060, Zurn Model Z-8919-6 w/Z-8909, or Engineered Brass Company Model NF9.06. Chair carrier with floor anchor plate, upright supports, and bearing plate shall be Zurn Model Z-1224, Mifab Model MC-30, J. R, Smith Model 0800, or approved equal by Watts. Lavatory shall be mounted at height as shown on the drawings. Lavatory supplies and trap shall be protected by A.D.A. approved premolded insulation assembly as manufactured by Truebro, McGuire or EBC.

L-2 LAVATORY: (Adult Standard) 20" by 18" acid resistant enameled cast iron with 4" center set punching, back ledge, wall hanger, front overflow shall be Commercial Enameling 553 or approved equal by Zurn or Kohler. Chrome plated, lead free, metering faucet with single push button, chrome-plated cover plate, and 0.5 GPM vandal resistant aerator shall be Zurn Z86100-XL-CP4-3M, or approved equal by Kohler, or Moen. Connect faucet to cold water only. Chrome plated lead free angle stops with loose key handle and 1/2" chrome plated nipple to wall and escutcheon with set screw shall be McGuire, Zurn, or Engineered Brass Company. Stainless steel braided flexible supplies shall be as manufactured by McGuire SSLAV12050038 or approved equal by Brass Craft, Watts. Chrome plated cast brass strainer with open grid, overflow openings, cast brass locknut and 1-1/4" 17 gauge tailpiece shall be McGuire Model 155A, Zurn Model Z-8743, or Engineered Brass Company Model SG7L05. 1-1/4" by 1-1/2" chrome plated adjustable cast brass P-trap with 1-1/4" slip in inlet, cleanout, ground joint, 1-

1/2" I.P.S. outlet, shall be McGuire, Zurn, or Engineered Brass Company. 1-1/2" chrome plated nipple to wall with escutcheon and setscrew shall be McGuire Model N150060, Zurn Model Z-8919-6 w/Z-8909, or Engineered Brass Company Model NF9.06. Chair carrier with floor anchor plate, upright supports, and bearing plate shall be Zurn Model Z-1224, Mifab Model MC-30, J. R, Smith Model 0800, or approved equal by Watts. Lavatory shall be mounted at height as shown on the drawings. Lavatory supplies and trap shall be protected by A.D.A. approved premolded insulation assembly as manufactured by Truebro, McGuire or EBC.

L-3 STAFF LAVATORY: (Adult ADA) 20" by 18" acid resistant enameled cast iron with 4" center set punching, back ledge, wall hanger, front overflow shall be Commercial Enameling 553 or approved equal by Zurn or Kohler. Single lever, chrome plated, lead free supply faucet with 0.5 GPM vandal resistant aerator, single hole shall be Chicago Faucets 2200-E70ABCP (basis of design), or approved equal by Kohler or American Standard. Connect to cold water only. Chrome plated lead free angle stops with loose key handle and 1/2" chrome plated nipple to wall and escutcheon with set screw shall be McGuire, Zurn, or Engineered Brass Company. Stainless steel braided flexible supplies shall be as manufactured by McGuire SSLAV12050038 or approved equal by Brass Craft, or Watts. Chrome plated cast brass strainer with open grid, overflow openings, cast brass locknut and 1-1/4" 17 gauge tailpiece shall be McGuire Model 155A, Zurn Model Z-8743, or Engineered Brass Company Model SG7L05. 1-1/4" by 1-1/2" chrome plated adjustable cast brass P-trap with 1-1/4" slip in inlet, cleanout, ground joint, 1-1/2" I.P.S. outlet, shall be McGuire, Zurn or Engineered Brass Company. 1-1/2" chrome plated nipple to wall with escutcheon and setscrew shall be McGuire Model N150060, Zurn Model Z-8919-6 w/Z-8909, or Engineered Brass Company Model NF9.06. Chair carrier with floor anchor plate, upright supports, and bearing plate shall be Zurn Model Z-1224, Mifab Model MC-30, J. R, Smith Model 0800, or approved equal by Watts. Lavatory shall be mounted at height as shown on the drawings. Lavatory supplies and trap shall be protected by A.D.A. approved premolded insulation assembly as manufactured by Truebro, McGuire or EBC.

SK-1 CLASSROOM SINK: (ADA) 22" x 19" x 4-1/2" deep single compartment, self rimming, 18-gauge, type 304 nickel bearing stainless steel with backledge, sound deadening applied to under side, rear center drain outlet shall be Elkay LRAD2219-4.5 or Just SL-ADA-1921-A-GR-4.5 GR or approved equal by Advance Tabco. Stainless steel crumbcup strainer with 1-1/2" offset tailpiece shall be Elkay LKAD35 or Just J-ADA-35 GR or approved equal by Advance Tabco. Lead free single supply faucet with replaceable ceramic disk cartridge, 8" restricted swing gooseneck spout, 1.5 GPM vandal resistant laminar flow non-aerating outlet, 4" vandal resistant wristblade handles, Chicago No. 350-G8AE36-317XKAB, or approved equal by Delta or Zurn. 1/2" sweat x 1/2" compression sink supply stops shall be equipped with 5" extension, wheel handle ball valve angle stops shall be McGuire, Zurn, or Brasscraft. 1-1/2" x 1-1/2" chrome plated adjustable cast brass P-trap with 1-1/2" slip joint inlet, cleanout, and 1-1/2" 17-gauge tube outlet shall be McGuire, Zurn, or Kohler. Install cast brass escutcheons with setscrew on all piping entering base cabinet. Supplies and trap shall be protected by A.D.A. approved premolded insulation assembly as manufactured by Truebro, McGuire or Mainline.

SK-2 LOUNGE SINK: (ADA) 22" x 19" x 4-1/2" deep single compartment, self rimming, 18-gauge, type 304 nickel bearing stainless steel with backledge, sound deadening applied to under side, rear center drain outlet shall be Elkay LRAD2219-4.5 or Just SL-ADA-1921-A-GR-4.5 GR or approved equal by Advance Tabco. Stainless steel crumbcup strainer with 1-1/2" offset tailpiece shall be Elkay LKAD35 or Just J-ADA-35 GR or approved equal by Advance Tabco. Lead free hot and cold water supply faucet with replaceable ceramic disk cartridge, 9-1/2" restricted swing L type spout, 1.5 GPM vandal resistant laminar flow aerator, 4" vandal resistant wristblade handles, Chicago No. 786-LR9E35V317XKAB, or approved equal by Delta or Zurn. 1/2" sweat x 1/2" compression sink supply stops shall be equipped with 5" extension, wheel handle ball valve angle stops shall be McGuire, Zurn, or Brasscraft. 1-1/2" x 1-1/2" chrome plated adjustable cast brass P-trap with 1-1/2" slip joint inlet, cleanout, and 1-1/2" 17-gauge tube outlet shall be McGuire, Zurn, or Kohler. Install cast brass escutcheons with setscrew on

all piping entering base cabinet. Supplies and trap shall be protected by A.D.A. approved premolded insulation assembly as manufactured by Truebro, McGuire or Mainline.

MR-1 MOP RECEPTOR: 36" x 36" x 12" deep precast terrazzo receptor with 3" inside caulked drain, stainless steel strainer, Fiat Model TSB3002, or approved equal by Williams or Mustee. Wall mounted, polished chrome plated supply faucet with top brace, vacuum breaker, integral screwdriver shank check stops, 3/4" hose end, T&S B-0665-BSTP or approved equal by Chicago Faucets or Moen. Heavy duty, cloth reinforced rubber hose and hose hook, Fiat Model 832-AA, or approved equal by Williams or Mustee. Wall mounted, 24" long, 3 mop spring clip hanger, Fiat Model 889-CC, or approved equal by Williams or Mustee. Stainless steel wall guards with corner bracket shall be Fiat Model MSG 3636 or approved equal Williams, or Mustee. Supply faucet outlet shall be mounted 24" above receptor floor. Contractor should note that joint between receptor, wall and floor should be sealed with clear silicone sealant.

EWC-1 ELECTRIC WATER COOLER: (Dual Height) Wall mounted, dual height, vandal resistant, air cooled type cooler with stainless steel anti-splash receptor, stainless steel cabinet, in line 'Y' strainer, anti-squirt dual stream bubbler, automatic stream regulator, push controls on front, hands free bottle water filler, wall hanger, sealed hermetic compressor with capacity of 8-GPH of 50ºF drinking water at 90ºF room temperature and 80º F inlet water temperature, Elkay LVRCGRNTL8WSK, Halsey Taylor HTHB-HAC8BLSS-WF, or approved equal by Oasis, factory wired for 115 volt, single phase electrical service. Chair carrier with steel upright support legs, backing plates shall be Zurn Z-1225, or approved equal by J.R. Smith, MiFab, or Watts. A concealed quad receptacle shall be installed, see Division 26. Plumbing Contractor shall provide PVC P-trap the same size as the electric water cooler drain. Wheel handle lead free stop valve shall be McGuire LF175 or approved equal. Plumbing Contractor should note that spout should be set at height as shown on the drawings.

HB-1 HOSE BIBB: Wall mounted, polished chrome plated brass with 3/4" vacuum breaker hose end, locking shield, tee handle, 1/2" inlet wall flange, Woodford Model 26P-1/2, Mifab MHY-9240, T & S Brass B-0702/B-972 or Preir C-257CP.50.

HB-2 WALL HYDRANT: Non-freeze type with 3/4" copper inlet, 3/4" hose end, removable key handle, self draining, for wall thickness as required, Woodford Model 67, Zurn Model Z-1310 or Josam Model 71050-12.

HB-3 HOSE BIBB IN BOX: Rough brass hose bibb with wheel handle, 3/4" vacuum breaker outlet, 1/2" inlet, cast brass or 304 stainless steel wall box, hinged door, loose key door lock, chrome plated or stainless steel exposed finish, Woodford Model B26-1/2-CH, Mifab MHY-95-49 or Metcraft Model 182.

HB-4 ROOF HYDRANT: Freeze-proof, automatically draining, brass roof hydrant with field serviceable double check backflow preventer or vacuum breaker shall be Woodford Model RHY2-MS, or approved equal by Mifab or Prier.

FD-1 FLOOR DRAIN: Cast iron body drain with 4" outlet to match piping system, 6" square nickel bronze heelproof top, vandal resistant securing screws with flashing device, Zurn ZN415S-VP, or approved equal by Josam, J. R. Smith, Wade, or Watts

FD-2 FLOOR DRAIN: Cast iron body drain with 2" outlet to match piping system, 6" square nickel bronze heelproof top, vandal resistant securing screws with flashing device, Zurn ZN415S-VP, or approved equal by Josam, J. R. Smith, Wade, or Watts.

HD-1 HUB DRAIN: Provide 3" I.D. cast iron hub drain for condensate collection from HVAC equipment. Hub drain shall extend to 1" above finished floor. Pipe material shall be per

condensate drainage section of these specifications. Support shall be per hangers section of these specifications.

CB-1 ICE MAKER CONNECTION BOX: Fully recessed unit with lead free cold water shut-off valve, compression nut and ferrule as shall be LSP Products Group model OB-801, IPS Corporation model AB9700 or approved equal Oatey Company.

WH-1 WATER HEATER: (Tank-Type) Factory assembled electric 10-gallon storage type heaters shall be equipped with glass lined steel tanks, ASME pressure temperature relief valve, magnesium anode rod, tank drain with hose connection, ASHRAE/IESNA 90.1 insulated factory applied baked enamel finish jacket, single bolt-in, 4,500-watt immersion element and control box . Heater shall be controlled by immersed bulb thermostat and be equipped with high limit temperature control, control box, transformer, contactors and junction box. Control circuits shall be a maximum of 120-volts. Heaters shall be U.L. approved and shall carry 3-year factory warranty. Heater shall be factory wired for 208-volt, single-phase electrical service as shown on the plans and shall be A.O. Smith Dura-Power DEL-10, or approved equal by State, Bradford White, or Rheem. Water heater shall be started by the manufacturer's factory representative.

WH-2 WATER HEATER: (Instantaneous Type) Shall be electric instantaneous type, 14,000 watt immersion heating element, with microprocessor controlled outlet temperature. Thermostat shall be factory set for temperature indicated on Contract Drawings. Heater shall be wired for 208-volt, single-phase operation and shall be A.O. Smith C2VA-140X, or approved equal by State or Super Supreme.

220029 GUARANTEE

A. Guarantee: The Contractor shall guarantee the entire plumbing system subject to the General Conditions of these specifications.

220030 BIDDING PROCEDURE

A. The Contractor shall provide bidding for Alternate Bids in accordance with Division 1. Contractor shall refer to Division 1 for any required unit prices and allowances.

END OF SECTION 220000

SECTION 230500 - HEATING AND AIR CONDITIONING

230501 GENERAL

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. The Heating and Air Conditioning Contractor shall cooperate with the contractors of other trades and shall install his work as fast as the progress of the balance of the work will permit.

C. See Section 013100 for requirements for Coordination Drawings.

D. The Heating and Air Conditioning Contractor shall install all work in accordance with the requirements of the latest edition of the North Carolina State Building Code. Codes to be a part of these specifications: North Carolina State Building Code, National Fire Protection Association Codes Section 70, 90A, 91, and other applicable sections.

E. Inspection by local authorities will be required.

F. The drawings accompanying these specifications indicate diagrammatically the general location of the ducts, piping, and equipment and do not show all offsets, supports, fittings, bolts, connections, etc., required for a complete system. While the drawings are to be followed as closely as possible, if it is found necessary to change the location of same to accommodate the conditions at the building, such changes shall be made without additional cost to the Owner, and as directed by the Engineer. Any detail which is omitted, and which is necessary for the proper operation of any system included under the contract, shall be supplied and installed by the Heating and Air Conditioning Contractor without extra cost to the Owner. All pipes and ducts shall be run as high as possible to maintain ceiling and head clearance. All equipment shall be installed in such a manner as to allow proper maintenance access.

G. Equipment and Materials shall be delivered to the site and stored in original containers, suitably sheltered from the elements, but readily accessible for inspection by the Engineer until installed. All items subject to moisture damage shall be stored in dry spaces.

H. Conditions shall be checked at the building before placing orders for apparatus and such apparatus shall be of such dimensions as to fit the spaces allotted. The Heating and Air Conditioning Contractor shall not scale mechanical plans, but rather refer to architectural plans for dimensions.

I. By signing the Contractor's Proposal, it is understood and agreed that the Heating and Air Conditioning Contractor has, by careful examination, satisfied himself with the quantity, quality, and location of all excavation materials to be encountered in his contract. No additional payment will be approved for well pointing or any other existing conditions encountered. Refer to Division 31 for site work requirements.

J. All debris resulting from heating and air conditioning work shall be removed from the premises daily or as directed by the Engineer. Trash and rubbish shall not be allowed to accumulate either within or outside the building. Materials and debris, which in the opinion of the Engineer cannot practicably be removed from the site the same day, may be temporarily stacked or stored in a designated location on the site as directed by the Engineer.

K. Guards shall be provided for all moving equipment, motor couplings, pump shafts, belt drives and similar exposed reciprocating or rotating components.

L. All HVAC and refrigeration equipment shall be labeled in accordance with Section 301 of the North Carolina Mechanical Code and as required by the Authority having jurisdiction. Labeling shall be a

permanent factory-applied nameplate affixed to the equipment on which shall appear in legible lettering, the manufacturer's name or trademark, the model, serial number, and the seal or mark of the testing agency.

230502 SCOPE

A. The Heating and Air Conditioning Contractor shall provide labor and materials required for a complete system ready for operation as shown on the drawings and hereinafter specified. This includes all equipment, ductwork, necessary plumbing, and all other services necessary whether they are specifically mentioned herein or not. The entire installation shall be installed in a first-class, neat, professional manner to the satisfaction of the Engineer and shall conform to all applicable codes and laws.

230503 SHOP DRAWINGS AND SUBMITTAL DATA

A. The Heating and Air Conditioning Contractor shall submit within 10 days after award of the contract a list of materials and the manufacturer to be used on this project. He shall submit within thirty days after award of the contract at least five copies of submittal data in written form for the Engineer's use in approving materials and equipment. One copy will be returned. If the Heating and Air Conditioning Contractor desires the return of more than one copy, additional copies shall be provided to the Engineer at the time of the original submission. It is requested that all submittal data be sent to the Architect at one time. Unless special consideration is given, none of the submittal data will be checked until it has all been received by the Architect. Where called for, the Heating and Air Conditioning Contractor shall submit five sets of shop drawings showing the detailed arrangement or connections that are shown schematically on the drawings. Data certified for the specified project and indicated manufacturer, type, or size, capacity, etc., shall be submitted for the following equipment items:

1. Packaged Heat Pumps
2. Ductless Split System Heat Pumps
3. Power Ventilators
4. Diffusers, Grilles, and Registers
5. Heaters
6. Controls with Complete Diagram
7. Manual and Motorized Dampers
8. Insulation
9. Testing and Balancing
10. Coordination Drawings per Section 013100

230504 APPROVED EQUAL EQUIPMENT, ETC.

A. Manufacturers listed are to establish a standard of quality and not intended to limit the selection to these manufacturers. All materials and equipment which are essential and have not been specified or shown shall be new and of the highest grade and quality, free from defect or other imperfections. It should be understood that where the word "provide" is used, it is intended that the Heating and Air Conditioning Contractor shall purchase and install all materials required. Approval of equipment will not relieve the Contractor of compliance with the specifications even if such approval is made in writing, unless the attention of the Engineer is called to the non-complying features by letter accompanying the submittal data. Approval of submittal data by the Engineer shall not be construed as a complete check of approval of detailed dimensions, weights, gauges, and similar details with the proposed articles. The conformance with the necessary coordination between the various other contractors and suppliers shall be solely the responsibility of the Heating and Air Conditioning Contractor.

230505 PACKAGED HEAT PUMPS

A. Units shall be downflow with cooling performance rated in accordance with AHRI standards. Unit shall be factory assembled, piped, internally wired, fully charged with R-410A and 100% run tested to check full operation, fan and blower rotation and control sequence before leaving the factory. Wiring internal to the unit shall be numbered for simplified identification. Unit shall be UL listed and labeled, classified in accordance to UL 1995/CAN/CSA No. 236-M90 for Central Cooling Air Conditioners.

B. Units shall have the following characteristics:

1. High efficiency DX cooling and heating.
2. Auxiliary electric heating coil.
3. Downflow airflow.
4. Constant volume supply airflow.
5. Dual compressors where indicated on the drawings.
6. High pressure control.
7. Factory installed hot gas reheat - dehumidification control.
8. Microprocessor controls with Reliatel or equal controller inside unit with BACnet communication card for connection to DDC system. See Sequences of Operation and Control Diagrams on the drawings for all points to integrate into the DDC system.
9. Intelligent space sensor(s) for temperature with link to unit controller. See additional information in Section 230900.
10. Phase monitor.
11. Roof curb.

C. Unit casing shall be such that all components are mounted in a weather resistant steel cabinet with a painted enamel finished exterior. Service panels shall be hinged doors with water and air tight seals shall be provided for unit controls, indoor coils and fans with a water and air tight seal. Indoor air section shall be completely insulated with fire resistant, permanent, odorless, foil faced glass fiber material.

D. Compressors shall be hermetically sealed, direct drive, scroll type with internal over current and over temperature protection, crankcase heaters, and high pressure control. Cooling shall be multi-stage where indicated on the drawings.

E. Condenser coils shall have tubes mechanically bonded to spine aluminum fins. Evaporator coils and hot gas reheat coils shall be copper tubes mechanically bonded to high performance aluminum plate fins. There shall be a minimum of 6" space between the evaporator coil and the hot gas reheat coil. All coils shall be leak tested to 200 psig and pressure tested to 450 psig. Provide guards on units to fully protect condenser coils from hail and vandalism.

F. Entire exterior of unit including condenser coils shall have field applied protective surface treatment. Surface treatment shall be Adsil MicroGuard applied by Energy Guard (phone: 919-777-0965) or approved equal per the following:

1. Surface Treatment shall be ambient air temperature cured, inorganic film structures.
2. Surface Treatment shall not act as an insulating barrier to the substrate, which would inhibit or degrade heat transfer coefficients or increase energy consumption of the condenser.
3. Surface Treatment shall adhere to substrates by direct atom-to-atom covalent bonding, as well as London Force method.
4. Surface Treatment shall produce a dry film thickness no greater than 8 microns.
5. Surface Treatment shall have passed ASTM G-21, with a zero (0) microbial spore growth development rating. The standard ASTM G-21 test must have been conducted by an accredited, third party, independent laboratory.
6. Surface Treatment shall meet or exceed 6,000 hours of corrosion protection using ASTM B117 testing protocols.

G. Units shall have forward curve, centrifugal indoor fans with permanently lubricated motor bearings. Motors shall be EISA 2007 NEMA premium efficiency with 1.15 service factor and shall be Model J ball bearing with minimum NEMA design "B" for 40˚C ambient. Efficiency rating shall be stamped on motor nameplate. Motors shall have thermal overload protection. Motor/blower assemblies shall be isolated from the unit via rubber mounts. Fans shall have factory VFD. Belt drive fans shall have adjustable variable pitch selected at a minimum service factor of 1.2. Heating and Air Conditioning Contractor shall provide one new set of drive belts installed in units at final inspection and provide a spare drive belt set for each unit. Belt set shall be secured inside each unit. After final assembly, the entire unit shall be given final vibration test.

H. The outdoor fan shall be direct-drive statically and dynamically balanced, draw through in the vertical discharge position. The fan motors shall be permanently lubricated and have built-in thermal overload protection.

I. Units shall be completely factory wired with necessary controls and terminal block for power wiring. Units shall have a single point power entry with HACR circuit breaker. Unit protection shall include phase monitoring. Coordinate power connection routing and location with the Electrical Contractor.

J. Auxiliary heating section shall be an open-wire resistance heater factory installed. Heater shall have automatic resetting limit switches and heater limits for thermal protection. Heater shall be UL listed. Electric heaters shall be equipped with adjustable outdoor thermostats for each stage of heat. Auxiliary heaters shall have quantity of stages as indicated on the drawings as a minimum.

K. Filters shall be 2" thick UL Class 1 pleated panels with Minimum Efficiency Reporting Value of MERV 8 per ASHRAE Standard 52.2-1999. Contractor shall supply complete sets of filters to protect his equipment during construction, another change of filters at completion, and leave one additional complete set of filters at the building for the next change. Provide factory supplied fixed filter blockoffs to prevent air bypass around filters.

L. Unit's dampers shall have metal compressible jamb seals and extruded vinyl blade edge seals. Units shall have motorized outside air intake and return air dampers to modulate open and provide the specified outside air. Where indicated on the drawings, units shall have outside air economizers capable of providing 100% outside air even if additional mechanical cooling is required to meet the cooling load of the building. Relief gravity dampers shall provide means to relieve excessive outdoor air during economizer or DCV operation to prevent over pressurizing the building. Outside air intake and relief air openings shall have rain hood with moisture eliminator and bird screen.

M. Condensate drain pan shall be insulated positively sloped of durable, long-lasting and corrosion resistant construction.

N. Curbs shall be custom made from 12 gauge or heavier as required galvanized steel with welded construction, vibration isolation type where indicated on the drawings, and 1-1/2" thick rigid insulation. Curb height shall be a minimum of 16" high above finished roof height. Secure curb to roof structure and unit to curb per manufacturer's recommendations for site's seismic and wind zone loading.

O. Startup and testing shall be by factory authorized service representative.

P. Coordinate controls provided in the unit by the unit manufacturer with controls provided in Section 230900 by the Building Management System contractor.

Q. See GUARANTEE 230529 for description of unit and compressor warranty requirements.

R. Units shall be Trane, Carrier, Daikin or approved equal.

230506 DUCTLESS SPLIT SYSTEM HEAT PUMPS

A. Indoor section shall be vertical wall, ceiling cassette, or ceiling mounted ductless type split heat pump unit as indicated on the drawings. Unit cabinet shall be 20 gauge-galvanized steel with rounded corners and finished with an undercoat and topcoat of hard finish polyurethane paint. Unit shall be internally insulated and be furnished with auxiliary heater and 1" thick pre-cut washable polyester filter media. Contractor shall supply sets of filters to protect equipment during construction, another change of filters at final completion, and leave an additional complete set of pre-cut filters at the building for the next change. Unit fan shall be dual tangential blower type. Unit shall have hardwired wall-mount temperature controller with high-medium-low fan control and condensate pump. High condensate limit switch shall deenergize unit if condensate pump fails to function.

B. Outdoor section shall be by the same manufacturer as the indoor section. Units shall be compact low profile type with inverter driven compressor, R410A refrigerant, crankcase heaters, and controls for low ambient temperature operation in cooling mode down to 0°F. The fans shall be permanently lubricated, direct drive, side discharge type. Safety controls shall include loss of charge and low and high pressure switch. Coils shall have factory seacoast coating.

C. See GUARANTEE 230529 for description of unit and compressor warranty requirements.

D. Refrigerant piping systems shall be sized, pitched, and furnished with all specialties as recommended by the unit manufacturer to accommodate refrigerant piping lengths. Specialties shall include suction line accumulators, liquid line solenoid valves, thermal expansion valves, refrigerant sight glass, removable core filter drier, and any other item deemed necessary or recommended by the unit manufacturer.

E. Units shall be UL or ETL labeled and shall be Daikin, Mitsubishi, Sanyo, Friedrich, LG, or approved equal.

230507 POWER VENTILATORS

A. Power ventilators shall be tested and rated in accordance with the standards of AMCA 210 and shall carry the AMCA seal. All fans shall be UL labeled. Fans shall be Cook, Greenheck, Carnes, PennBarry, or approved equal.

B. Power roof ventilators shall be centrifugal, direct or belt driven and upblast or downblast as indicated on the drawings with factory applied finish of color selected by the Architect. All units shall be provided with bird screen, and back draft dampers. Disconnect switches shall be by the Heating and Air Conditioning Contractor. Power roof ventilators shall have spun aluminum hood. Motors shall be EISA 2007 NEMA premium efficiency with efficiency rating stamped on motor nameplate. Belt drive units shall have adjustable V-drive. Provide spare belts for belt drive units. Direct drive units shall have solid state motor speed controllers with an "OFF" position.

C. Roof curbs for roof-mounted equipment shall be provided by the Heating and Air Conditioning Contractor. It shall be the responsibility of the Heating and Air Conditioning Contractor to give the General Contractor the proper locations and sizes required for all roof openings. Opening will be framed and cut by the General Contractor. Roof curbs shall be insulated and finished with factory applied finish of color selected by the Architect. Equipment shall be attached to roof curbs with a minimum of two stainless steel fasteners and EPDM washers on each side of roof curb.

230508 DIFFUSERS, GRILLES, AND REGISTERS

A. Diffusers, Grilles, and Registers shall be as manufactured by Carnes, Metal Aire, Titus, Krueger, Price, Duct Sox, or approved equal unless otherwise noted.

B. All diffusers, grilles, and registers shall have a maximum NC level of 25 in the space for the specified airflow and shall have factory applied white baked enamel finish. Where indicated on drawings to be field painted, white factory finish shall be as necessary to receive field finish painting.

C. Lay-In Ceiling Supply Air Diffusers: Shall be steel construction, fixed square louvered face, 4-way blow, panel border to drop in 24" x 24" "T" bar ceiling grid, with adjustable vertical pattern. Vertical air adjustment shall be made by adjusting four perimeter blades to force air down in a vertical position.

D. Lay-in Ceiling Return Air Grilles: Shall be aluminum 1/2" x 1/2" egg crate with removable face, steel frame, and designed to lay in an inverted "T" bar ceiling grid. Grilles shall be full flow across the entire face of grille and tapered up to neck size.

E. Exhaust Registers: Shall be steel construction with fixed blades on 1/2" centers set at 35º angles and opposed blade dampers.

230509 HEATERS

A. Electric baseboard heaters shall be commercial grade furnished and installed complete with all necessary heating elements, brackets, and closures, splice plates, interior and exterior corners, and accessible wiring compartment. Maximum leaving air temperature at the outlet and enclosure surface temperature, under continuous operation, shall not exceed 200˚F. Heaters shall be Markel Series 2900C, Q Mark, Raywall or approved equal complete with UL label.

Heating elements shall consist of stainless steel element rod with aluminum fins. Maximum watt density per linear foot of element shall not exceed 250 watts. Enclosures shall be steel with thicknesses not less than 18 gauge front and 22 gauge back and shall be rigidly reinforced. Enclosures shall be wall hung with bottom at elevation above the finished floor as shown on the drawings and shall be suitable for the space available. End plates and corner pieces shall be die formed with round edges, fit flush with enclosure surface, and be neat in appearance. No direct contact between enclosure and heating element will be permitted. Enclosure shall be painted with rust inhibiting paint at the factory and shall have baked enamel finish of color selected by Architect. Connection box shall be designed to permit power supply and control wiring from bottom, rear, right or left side as required. Thermostat shall be built in double pole double throw adjustable with extra sensitive bulb and capillary. Thermostat shall have positive off position and be within unit enclosure or junction box. Limit controls shall be continuous end to end automatic reset thermal overheat; line voltage protection shall be provided with each individual baseboard heater to protect from overheating due to any cause. Baseboard unit shall be furnished complete, factory prewired and ready to receive branch circuit and connections. Each heater shall be provided with a factory installed safety disconnect switch or circuit breaker installed in the housing or in an auxiliary matching control section or have thermostat with positive off position.

230510 CONTROLS

A. See Section 230900.

230511 MANUAL AND MOTORIZED DAMPERS

A. Manual and Motorized dampers shall be low leakage type provided in the duct systems as indicated on the drawings in accordance with NFPA Standard No. 90A and shall conform to NFPA Standard No. 90A for materials and workmanship. Blades shall have extruded vinyl double edge seals. Jambs shall have flexible metal compression type seals. Maximum damper leakage at 1.0 in w.g. shall be 10 cfm/sf of damper area for motorized dampers. For manual dampers, maximum damper leakage at 1.0 in w.g. shall be 40 cfm/sf of damper area for dampers smaller than 24 inches in either dimension, and shall be 20 cfm/sf for larger manual dampers. Leakage ratings shall be when tested in accordance with AMCA Standard 500. The

dampers shall have electric operators and shall be normally closed. Wiring to operators shall be by the Heating and Air Conditioning Contractor. To facilitate service access and insulation installation, manual damper handles shall be on 2" stand-off brackets. Handles shall be spray painted red. Dampers shall be installed according to the manufacturer's recommendations. Dampers shall be Ruskin, Pottorff, Prefco, Air Balance, United Enertech, or approved equal.

230512 ELECTRICAL

A. Electrical circuit sizes are based on capacities of the drawings and it shall be the responsibility of Heating and Air Conditioning Contractor to change any and all electrical work in order to fit mechanical equipment. Heating and Air Conditioning Contractor shall coordinate with Electrical Contractor to assure that all units are properly connected and shall check wiring prior to starting units. Any damage to units resulting from improper wiring or connections shall be the responsibility of Heating and Air Conditioning Contractor. Flexible electrical conduits shall be 18 inches in length maximum. All electrical work shall be installed in accordance with codes having jurisdiction and the Electrical Division, Division 26, of these specifications.

B. Starters shall have integral 120V Control power transformer. Starters shall have holding coil for 120V control with hand-off-auto switch. The starters shall be inoperative if the thermal unit is removed. All magnetic starters shall be NEMA sized with applicable melting alloy overload relays and applicable enclosure. Starters shall be per the Electrical Division, Division 26, of these specifications.

C. All three phase motors shall be provided with phase loss protection.

D. Fused disconnect switches shall be per the Electrical Division, Division 26, of these specifications.

E. Motor Starters and Fused Disconnect Switches shall be neatly arranged, and securely fastened to walls with expansion bolts, lead shields, etc. Each starter or switch shall have its usage or letter designation indicated on its cover per the Electrical Division, Division 26, of these specifications.

230513 DUCTWORK

A. Mechanical drawings are schematic only and do not show all offsets etc. required. Heating and Air Conditioning Contractor shall familiarize himself with the complete contract documents and site conditions before fabricating ductwork. Any changes to ductwork found necessary to accommodate the conditions at the building shall be made without additional cost to the Owner, and as directed by the Engineer.

B. During construction, interior of ductwork shall be protected. All open ends of ductwork shall be covered with self-adhesive 3 mil polyethylene film.

C. Ductwork shall be of galvanized steel with standard gauges and construction in accordance with the recommendations of SMACNA HVAC Duct Construction Standards, Metal and Flexible, Third Addition, 2005 for appropriate pressure class. Elbows shall be long radius type or have airfoil turning vanes with 1-1/8" spacing and rail support system in all 90º square throat elbows. Ductwork shall be cross broken on all sides and shall be supported at both ends of each joint and at 10'-0" intervals maximum with galvanized angles supported by galvanized threaded rods of sizes and spacing in accordance with SMACNA. Ductwork to be exposed shall be constructed in a first class, neat, professional manner and exposed ductwork with excessive hammer marks shall be replaced. Round supply takeoffs from trunk ducts shall be made with factory 45º entry branch rectangular to round type fittings. Provide dampers in takeoff fittings where indicated on drawings. Damper handles shall be on 2" stand-off brackets. Handles shall be spray painted red. Splitter dampers shall be provided where indicated with adjustment quadrant locking device and shall be constructed of two thicknesses of 24-gauge-galvanized steel. All dimensions on the drawings are free inside dimensions. All components of the air distribution system shall be mechanically fastened with at least three equally spaced sheet metal screws with screws not more than on 12" centers.

All duct joints shall be sealed in accordance with SMACNA Seal Class A before insulation is applied. All sealants shall meet the provisions of UL181.

D. Final 8'–0" of the runout to the air outlet may be factory fabricated flexible ducts complying with NFPA Standard No. 90A, UL 181, and shall be UL Class 1 R-6 insulated type with foil vapor barrier. The flexible duct shall be air tight for factory test when bent to full recommended radius and under not less than 10" water gauge internal pressure and shall be limited to 8'-0" maximum length. Flexible ducts shall be supported by galvanized steel straps in accordance with SMACNA at intervals not exceeding 4'-0" and at each change of direction. Flexible ducts shall have a minimum of one support.

230514 PIPING

A. The Heating and Air Conditioning Contractor shall furnish all piping and supports necessary to provide a complete system as shown or intended by the plans and specifications. All piping shall be inspected, tested, and approved before being insulated or concealed. Piping 2" and smaller shall be welded or have screwed fittings with extra heavy nipples, unless otherwise noted. Piping 2-1/2" and larger shall have welded fittings of the same material and weight as the piping in which they are installed. Pipe shall be clean, run generally parallel to the building and have all open ends closed with iron caps at all times. Eccentric reducers shall be used in horizontal runs and concentric reducers in vertical runs. All piping and fittings shall have manufacturer's identification and ASTM designation incorporated thereon.

B. Drain pan condensate and pumped condensate piping above slab shall be Type M copper with all joints soldered with 95-5 solder where interior. Piping shall have dielectric union at connection to ferrous pipe. On building's exterior, condensate piping shall be Schedule 40 PVC with solvent cemented joints. Drain pan condensate piping shall have a minimum slope of 1/4" per linear foot and shall be at least as large as unit condensate connection.

C. Refrigerant piping shall be capped and dehydrated Type "L" hard drawn copper with wrought fittings. All joints shall be brazed with silver brazing alloys according to manufacturer's published recommendations.

D. Welding material and labor shall be in accordance with welding procedures of the American Standards Code for Pressure Piping ASA B31.9. Welders shall be fully qualified in above specified procedure, tested, and so certified by an approved Welding Bureau of Locally Recognized Testing Authority. Welding shall be electric arc or oxyacetylene welding method as approved using electrodes and rods that comply with ASTM specifications.

E. Swing joints or loops shall be provided wherever necessary to allow for expansion of piping. Broken piping or fittings shall be removed and replaced at the Heating and Air Conditioning Contractor's expense.

230515 PIPE HANGERS

A. All piping shall be neatly and securely supported by hangers from fire resistance rated structural elements of the building spaced in the following manner:

1. Steel Piping 1-1/4" and smaller - 7'-0" O.C.
2. Steel Piping 1-1/2" and larger - 10'-0" O.C.
3. Copper Piping 1-1/4" and smaller - 6'-0" O.C.
4. Copper Piping 1-1/2" and larger - 10'-0" O.C.
5. PVC Piping - 4'-0" O.C.
6. Provide 2 hangers at each change in direction.

B. Hangers shall be the Clevis type as manufactured by Modern Fig. 590, B-Line Fig. B 3100, or Grinnell Fig. 260 complete with hanger rods of size to conform to the type of hanger and pipe supported. Hangers shall be attached to the building by beam clamps or bolted to bar joist. At hangers provide 16" long 16

gauge galvanized sheet metal protection saddle three times the nominal pipe diameter. Under no condition shall hangers be connected directly to insulated pipe. Saddles shall be Modern Type A, B-Line Fig. B 3151, or Grinnell Fig. 167.

C. Hangers for vertical piping shall be riser clamp design as manufactured by Modern Fig. 500, B-Line Fig. B3373 or Grinnell Fig. 261. Riser clamps shall be installed on top of each floor penetration.

D. Condensate and refrigerant piping on roof shall be supported by EPDM rubber bases with integral pipe securement. Support shall be OMG PGM, PGS, PGTS -BK or approved equal. Walk pads under each support shall be appropriate for roof per roof's warranty requirements.

230516 INSULATION

A. All piping and ductwork shall be inspected and tested before insulation is applied. All insulation shall meet UL 723 and ASTM-E84 flame spread and smoke developed requirements of 25/50 and shall comply with NFPA 90A and the latest edition of the NC Building Code. Insulation shall be Certainteed, Owen Corning, Knauf, and Johns-Manville.

B. All air conditioning supply, return, relief/exhaust, and outside air ducts concealed above a ceiling and the back of all diffusers and grilles shall be externally insulated with 2" thick 1 lb. density foil scrim kraft jacketed insulation. Adhere insulation to duct with fire retardant adhesive in sufficient quantities to prevent sagging. Ducts with a width over 30" shall be further secured on all sides with mechanical fasteners on 18" maximum centers. Insulation shall be butted with facing overlapping all joints at least 2" and sealed with fire retardant vapor barrier adhesive. Tape all joints, breaks, punctures, and any penetrations with SMACNA foil faced kraft duct tape.

C. Where externally insulated ductwork is supported by angles, provide 6" long x duct width x 1-1/2" thick 6.0 pound density board insulation on bottom of duct at hanger support. External duct insulation shall be continuous around ductwork and board insulation at duct hanger. On round ducts, duct hanger shall be outside duct insulation.

D. Air handling unit drain pan condensate piping on interior, pumped condensate piping, and all refrigerant piping shall be insulated with tubular closed cell elastomeric insulation with all joints butted and cemented tight. Insulation shall have two coats of exterior protective coating on all insulation exposed on exterior. Insulation on interior condensate piping shall be 1" thick. Insulation on refrigerant piping shall be 1-1/2" thick.

230517 SPECIALTIES

A. Floor, wall and ceiling plates or escutcheons of size to fit pipe covering shall be installed where pipes pass thru finished areas and shall be chromium plated spring type as manufactured by Kenney, Connecticut Stamping and Bending Company, Dearborne or approved equal.

B. Unions or flanges shall be provided throughout the piping system to facilitate the removal and servicing of all valves, equipment, items, etc.

230518 VIBRATION ISOLATION

A. Pad type isolators shall be 3/4" thick bridge bearing quality neoprene ribbed or waffled on both sides. Pads shall be selected for a maximum durometer of 50 and designed for 15% deflection. Where required, steel load-spreading plates shall be incorporated between the equipment and the neoprene pad.

B. Flexible duct connections, both at inlet and discharge of units, shall be made of 30 oz. workinglass fiber coated with neoprene, sewn together at edges and joints. These flexible connections shall withstand the operating air-pressure, shall not permit air leakage, and shall not transmit vibration.

230519 OPENINGS

A. The Heating and Air Conditioning Contractor shall furnish all blockouts, sleeves, and openings required for his work. Pipe sleeves, where firestop penetration system allows, shall be standard weight black steel pipe and shall be provided where pipes pass through walls and floor. Sleeves through walls shall butt flush with the wall finish and shall be of sufficient size to permit passage of pipe covering through the area where pipe is installed. Sleeves through floors shall extend 3/4" above the finished floor and sealed watertight. Any penetrations of ducts through floor shall be curbed 3" high x 6" wide with concrete. Specifically inform the General Contractor as to the correct size and location of openings and sleeves to insure that they shall be cast in their proper location. Sleeves and duct opening frames shall be furnished and installed by the Heating and Air Conditioning Contractor. Failure to indicate such openings in time to avoid delaying the General Contractor shall result in the Heating and Air Conditioning Contractor providing all cutting and repairing at his own expense. Repairing shall include sealing tight around pipe sleeves and duct frames in a neat and professional manner and in accordance with the "Cutting and Patching" section of this specification.

B. All penetrations in rated floors, firewalls and any other rated separations shall be protected using a through-penetration firestopping method with an "F" rating equivalent to the rating of the membrane being penetrated for particular piping materials used and membrane construction type. Floor penetrations shall additionally have a "T" rating equivalent to the rating of the floor being penetrated. Through-penetration firestop systems shall be installed and tested in accordance with ASTM E814 or UL 1479.

230520 COLOR CODING/PAINTING

A. All exposed mechanical equipment in finished areas including ductwork, piping, hangers, etc., shall be painted the same color as the adjacent ceiling and walls by the General Contractor. Heating and Air Conditioning Contractor shall treat all items as necessary to receive paint.

230521 PIPE MARKERS

A. Markers shall have wording, wording colors, and wording background in accordance with ANSI A13.1. Markers shall have letters approximately 1" high on appropriate background, flow arrows, and shall be located on the pipe at least once in every space and at intervals not exceeding 10'-0" where in mechanical spaces and 25'-0" intervals where above ceilings. Markers shall be plastic with markers on piping completely encircling the pipe with overlap and permanent tension in the marker to grip the pipe firmly with the need of adhesives. Provide markers on all new piping in the building. Wording of markers shall be as follows:

1. Refrigerant.
2. Condensate.

230522 NAMEPLATES

A. All new packaged heat pumps, split systems, power ventilators, and heaters shall be furnished with engraved plastic laminated labels permanently attached to the equipment. Lettering shall be ½" tall. Label shall include equipment number, area served, final acceptance date, number and size of filters, number and size of belts, and capacities. Final acceptance date shall be on a separate label so as to allow equipment nameplates to be installed prior to final acceptance.

230523 CUTTING AND PATCHING

A. The Heating and Air Conditioning Contractor shall do all cutting and patching necessary to install all equipment as required under his contract in accordance with the General Conditions of these specifications and shall re-establish all finishes where cutting and patching occur to their original condition. All cutting of the structure, where unavoidable, must be approved by the Engineer and be done by the General Contractor, but shall be paid for by the Heating and Air Conditioning Contractor.

230524 PIPING PRESSURE TESTING

A. The Heating and Air Conditioning Contractor shall make the following tests of the new systems before they are insulated or covered by construction. The systems shall have no decrease in pressure during the test periods. All system components shall be protected from test pressures that exceed manufacturer's design limits.

B. Notify Architect, Engineer, and Commissioning Authority 48 hours in advance of all tests.

C. Heating and Air Conditioning Contractor shall provide written report of each test.

D. Refrigerant piping shall be tested in accordance with Chapter 11 of the North Carolina Mechanical Code and split system unit manufacturer's recommendations.

E. New condensate piping shall be tested by applying a hydrostatic pressure of 100-psig for a period of two hours.

F. No caulking of joints shall be permitted. Any joint found to leak under this test shall be broken, remade, and a new test applied. Welded joint pinhole leaks shall be repaired by welding; however, welds that show numerous pinholes shall be replaced.

230525 TESTING AND BALANCING

A. Testing and balancing of the new heating, ventilating, and air conditioning systems shall be performed by an AABC certified Test and Balance Company as a subcontractor to the Heating and Air Conditioning Contractor. All instruments used shall be accurately calibrated and in good working order. The tests shall be in strict accordance to the Standards of AABC. Test and Balance Contractor shall submit TAB plan to the Engineer and Commissioning Authority for their review and approval prior to starting any TAB work.

B. Air balance and testing shall not begin until the systems have been installed in full working order and shown to be operating satisfactory on both heating and cooling. The Contractor shall place all heating, ventilating, and air conditioning systems into full operation and shall continue operation of the system until balancing is completed. All operational cost shall be borne by the Heating and Air Conditioning Contractor. The Architect and Engineer shall be given three weeks advance notice of when tests are to be made.

C. Upon completion of the heating, ventilating, and air conditioning systems, the Test and Balance Contractor shall compile the test data and submit four copies of the completed test data to the Engineer for evaluation and approval. At final inspection and prior to final commissioning verification, Heating and Air Conditioning Contractor shall have a copy of test and balance report and all necessary personnel and equipment to facilitate spot-checking of test and balance data by the Engineer or his representative. Final payment to the Contractor shall be withheld until the complete test and balance data has been approved.

D. Testing Procedure (AIR):

1. Test and adjust air handling unit fan's RPM and CFM to design requirements. Record all data.

2. Test and record motor full load amperes on all motors.
3. Adjust all main supply, exhaust, return, relief, and outside air ducts to proper design CFM when air handling systems are in normal operating mode, DCV mode, and in outside air economizer mode. Record exhaust, relief, and outside air data.
4. Test and adjust each diffuser, grille, and register for supply, exhaust, or return systems to within 10% of design requirements. Record all data.
5. All adjustments to air diffusing devices where possible shall be made in trunk or run out dampers, not at diffuser volume control.
6. Exhaust fans shall be tested and balanced for the requirement as shown on the plans. Record all data.
7. The Heating and Air Conditioning Contractor shall make any changes in the pulleys, belts, filters, dampers, or valves necessary or as recommended by the Engineer for correct balance at no additional cost to the Owner.

230526 INSTRUCTIONS/TRAINING

A. The Heating and Air Conditioning Contractor shall give an instruction and training period in the operation of the new apparatus to the persons who will be in charge of the system. See Section 017900 for listing and training requirements.

230527 MAINTENANCE DATA

A. For all new items requiring maintenance, the Heating and Air Conditioning Contractor shall furnish two weeks prior to Final Acceptance and deliver to the Owner's representative on the job multiple copies of complete data as prepared by the manufacturer covering the details of operation and maintenance and complete parts list for all equipment specified. Each copy of the maintenance data shall be assembled into a 3-ring hardback binder with indexing and label on cover and spine. Data shall include:

1. Index with page numbers.
2. List of all subcontractors and suppliers with names, addresses, and phone numbers.
3. Contractor's certificate of Final Acceptance.
4. Copy of all warranties.
5. Equipment model numbers, etc. indicated and referenced with the same mark as shown on equipment on the drawings.
6. Filter schedules of sizes and quantities for all equipment requiring filters referenced by mark on the drawings.
7. Equipment summary showing all capacities and ratings.
8. Certified test and balance report.
9. Start-up and test reports for equipment.
10. Complete start-up, operation, and shut-down procedures for each system.
11. Lubrication schedules and types of lubricates.
12. All submittal data and shop drawings, unless included in a separate manual.
13. See Section 017823 for additional requirements.

230528 RECORD DRAWINGS

A. In accordance with Section 017839 Project Record documents, the Heating and Air Conditioning Contractor shall maintain "during the course of the work" a set of specifications and drawings marked up to show the new and renovated work as installed, including a minimum of two dimensions to indicate locations and elevations of buried work. Upon completion of the work, return this set of drawings to the Architect.

230529 GUARANTEE

A. The Heating and Air Conditioning Contractor shall guarantee the heating and air conditioning system work subject to the General Conditions of these specifications, except:

1. Refrigeration compressors for split systems and packaged heat pump systems shall have a four-year extended warranty for the compressors only. Labor, freight, refrigerant, and other required parts shall be provided or paid for by the Owner.

END OF SECTION 230500

SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 RELATED SECTIONS

A. This Section includes the Building Management System (BMS) control equipment for HVAC systems and components, including open protocol control components for terminal heating and cooling units. Depending on the scope of the project, the complete specification may have numerous sections that interface to this section, including several from Division 23 and 26.

1.3 STANDARD TERMS

A. Standard:

1. ASHRAE: American Society Heating, Refrigeration, Air Conditioning Engineers
2. AHU: Air Handling Unit
3. BACnet: Building Automation Controls Network
4. BMS: Building Management System
5. DDC: Direct Digital Control
6. EIA: Electronic Industries Alliance
7. GUI: Graphical User Interface
8. HVAC: Heating, Ventilation, and Air Conditioning
9. IEEE: Institute Electrical Electronic Engineers
10. MER: Mechanical Equipment Room
11. PID: Proportional, Integral, Derivative
12. VAV: Variable Air Volume Box

B. Communications and Protocols:

1. ARP: Address Resolution Protocol
2. BACnet: Building Automation and Control Networks
3. CORBA: Common Object Request Broker Architecture
4. CSMA/CD: Carrier Sense Multiple Access/Collision Detect
5. DDE: Dynamic Data Exchange
6. FTP: File Transfer Protocol
7. FTT: Free Topology Transceivers
8. HTTP: Hyper Text Transfer Protocol
9. IIOP: Internet Inter-ORB Protocol
10. IP: Internet Protocol
11. LAN: Local Area Network
12. LON: Echelon Communication – Local Operating Network
13. MS/TP: Master Slave Token Passing
14. OBIX: Open Building Information Exchange
15. ODBC: Open Database Connectivity
16. ORB: Object Request Broker
17. SNVT: Standard Network Variables Types
18. SQL: Structured Query Language
19. UDP: User Datagram Protocol
20. XML: eXtensible Markup Language

C. Controllers:

1. ASD: Application Specific Device
2. AAC: Advanced Application Controller
3. ASC: Application Specific Controller.
4. CAC: Custom Application Controller.
5. DCU: Distributed Control Unit
6. LCM: Local Control Module
7. MC: MicroControllers
8. MPC: Multi-purpose Controller
9. NSC: Network Server Controller
10. PEM: Package Equipment Module
11. PPC: Programmable Process Controller
12. RC: Room controller
13. SDCU: Standalone Digital Control Units
14. SLC: Supervisory Logic Controller
15. UEC: Unitary Equipment Controller
16. VAVDDC: Variable Air Volume Direct Digital Controller

D. Tools and Software:

1. AFDD: Automated Fault Detection and Diagnostic
2. APEO: Automated Predictive Energy Optimization
3. DR: Demand Response
4. CCDT: Configuration, Commissioning and Diagnostic Tool
5. BPES: BACnet Portable Engineering Station
6. LPES: LON Portable Engineering Station
7. POT: Portable Operator's Terminal
8. PEMS: Power and Energy Management Software

1.4 QUALIFICATIONS OF BIDDER AND PRE-BID SUBMITTAL

A. All bidders must be building automation contractors in the business of installing direct digital control building automation systems for a minimum of 3 years.

1. The Building Management System contractor shall have a full service facility within 200 miles of the project that is staffed with engineers trained and certified by the manufacturer in the configuration, programming and service of the automation system. The contractor's technicians shall be fully capable of providing instructions and routine emergency maintenance service on all system components.
2. Any installing contractor, not listed as prequalified in the Approved Manufacturer's section, shall submit credentials as detailed in the Pre-bid Submittal section for the engineer's review 2 weeks prior to bid date. Line by line specification compliance document must be submitted listing any deviations. Failure to follow the attached formats shall disqualify potential alternate bidders. Credentials must attest that the contractor meets all requirements of the specification and the Engineers judgment regarding approval to bid as an acceptable installer after reviewing the data will be final.

B. All bidders must be authorized distributors or branch offices of the manufacturers specified.

C. The following bidders have been pre-qualified:

1. Schneider Electric
2. Alerton
3. Reliable
4. Carrier
5. Or as approved by Owners.

D. Any installing contractors or manufacturers interested in participating as acceptable bidders for this project that are not pre-qualified shall furnish a detailed technical pre-bid submittal to the consulting engineer. All information must be submitted 2 weeks prior to the published bid date to allow the engineer adequate time to review the bidder's credentials.

E. The Pre-Bid submittal shall contain the following information as a minimum:

1. A profile of the manufacturer and the local installation and service/organization.
2. Description of how the system meets and achieves all the specified criteria in terms of configuration, operation, and control.
3. System Architecture with single line riser diagram showing all major components (digital controllers, routers, hubs, etc.) that will be required for this project. System architecture must detail single point of connection for Bacnet IP interface to existing Schneider Electric EcoStruxure county wide BAS system.
4. Procedure for commissioning and time required to startup and commission each of the systems for this project.
5. Contractors approach for the project planning and management.
6. Product Data Sheets for all components, DDC panels, and all accessories listed per the appropriate specification sections herein.
7. Examples of actual graphic screens for other similar projects.
8. Number and types of DDC panels required for this installation.
9. Number and types of spare points provided with the proposed system.
10. Recommended spare parts list for components with list price schedule.
11. List of 2 similar systems in size, point capacity, total installed value, installed and commissioned by the local office with a list of the installers/manufacturers design team members for each project and the Owners contact information.
12. Samples of service offerings and a list of current similar service contracts with contact information.
13. Resumes for the management team and all employees who will be involved with the project design, commissioning, project management, and after installation service. Resumes should include copies of manufacturer's certifications for the proposed product line.
14. Copy of this Control Specification in its entirety with a check mark beside each paragraph to signify that the manufacturer's equipment and software shall fully conform to the specified requirement. If the requirement cannot be met, indicate the reasons/limitations and the alternative proposed.
15. An interview may be conducted and the bidder will be requested to make a formal presentation concerning the proposed system and possibly provide an installed project tour prior to a final decision.

1.5 SCOPE OF WORK

A. The Contractor shall furnish and install a complete building automation system including all necessary hardware and all operating and applications software necessary to perform the control sequences of operation as called for in this specification. Network level components of the system – workstations, servers, etc. shall communicate using the BACnet protocol, as defined by ASHRAE Standard 135-2004. No gateways shall be used for communication to controllers furnished under this section.

At a minimum, provide controls for the following:

1. Packaged Units
2. Computer room air handling units
3. Exhaust and Supply Fans
4. Monitoring points for packaged equipment such as emergency generators
5. Power wiring to DDC devices, smoke control dampers and BAS panels except as otherwise specified

B. Except as otherwise noted, the control system shall consist of all necessary Ethernet Network Controllers, Standalone Digital Control Units, Room Controllers, workstations, software, sensors, transducers, relays, valves, dampers, damper operators, control panels, and other accessory equipment, along with a complete

system of electrical interlocking wiring to fill the intent of the specification and provide for a complete and operable system. Except as otherwise specified, provide operators for equipment such as dampers if the equipment manufacturer does not provide these. Coordinate requirements with the various Contractors.

C. The BAS contractor shall review and study all HVAC drawings and the entire specification to familiarize themselves with the equipment and system operation and to verify the quantities and types of dampers, operators, alarms, etc. to be provided.

D. All interlocking wiring, wiring and installation of control devices associated with the equipment listed below shall be provided under this Contract. When the BAS system is fully installed and operational, the BAS Contractor and representatives of the Owner will review and check out the system – see System Acceptance and Testing section of this document. At that time, the BAS contractor shall demonstrate the operation of the system and prove that it complies with the intent of the drawings and specifications.

E. Provide services and manpower necessary for commissioning of the system in coordination with the HVAC Contractor, Balancing Contractor and Owner's representative.

F. All work performed under this section of the specifications shall comply with all governing codes, laws and governing bodies. If the drawings and/or specifications are in conflict with governing codes, the Contractor, with guidance from the engineer, shall submit a proposal with appropriate modifications to the project to meet code restrictions. If this specification and associated drawings exceed governing code requirements, the specification shall govern. The Contractor shall obtain and pay for all necessary construction permits and licenses.

1.6 SYSTEM DESCRIPTION

A. In accordance to the scope of work, the system shall also provide a graphical, web-based, operator interface that allows for instant access to any system through a standard browser. The contractor must provide PC-based programming workstations (if not existing), operator workstations (if not existing), and microcomputer controllers of modular design providing distributed processing capability, and allowing future expansion of both input/output points and processing/control functions.

For this project, the system shall consist of the following components:

1. **System Requirements**: Schneider Electric EcoStruxure Enterprise Server software is existing on virtual server within Brunswick County Schools domain. The control system for this project must connect to the existing Schneider Electric EcoStruxure Enterprise server. Controls contractor shall include with his base bid the integration (as described herein) to Schneider Electric EcoStruxure Enterprise Server of the building controls for this project. Graphical user interface screens must be added for this site/project to the existing EcoStruxure system navigation infrastructure. Graphical interface screens must enable the Owner to read/write values from the EcoStruxure front end to the HVAC control system and controllers installed for this project. Read and write functionality from EcoStruxure front end must include (but not limited to) the following: Complete scheduling functionality (global schedules from EcoStruxure front end with default schedules at local control system), space setpoint manipulation and set point manipulation of all new mechanical equipment including RTUs, exhaust fans, etc. Extended trend logs and alarm data as it pertains to this project must also be configured within the EcoStruxure Enterprise Server.
2. **Base Bid**: For the base bid, provide pricing from one of the pre-qualified control bidders to include integration (as described above) to the Brunswick County Schools' existing Schneider Electric EcoStruxure Enterprise Server, including graphics.
3. **For Preferred Alternate**, provide pricing to provide a complete HVAC controls system by Schneider Electric. Complete HVAC controls system by Schneider Electric is defined as all unitary controllers shall either be manufactured by Schneider Electric or if specifications allow, integral factory equipment (packaged rooftop equipment, chillers, boilers, etc.) vendors BACnet compatible controllers integrated to Schneider Electric EcoStruxure system.

4. Administration and Programming Workstation(s): The BAS Contractor shall include Operation software and architecture as described in Part 2 of the specification. These workstations must be running the standard workstation software developed and tested by the manufacturer of the network server controllers and the standalone controllers. No third party front-end workstation software shall be acceptable. Workstations must conform to the B-OWS BACnet device profile.
5. Web-Based Operator Workstations: The BAS Contractor shall furnish licenses for web connection to the BAS system. Web-based users shall have access to all system points and graphics, shall be able to receive and acknowledge alarms, and shall be able to control setpoints and other parameters. All engineering work, such as trends, reports, graphics, etc. that are accomplished from the WorkStation shall be available for viewing through the web browser interface without additional changes. The web-based interface must conform to the B-OWS BACnet device profile. There shall be no need for any additional computer based hardware to support the web-based user interface.
6. Ethernet-based Network Router and/or Network Server Controller(s): The BAS Contractor shall furnish needed quantity of Ethernet-based Network Server Controllers as described in Part 2 of the specification. These controllers shall connect directly to the Operator Workstation over Ethernet at a minimum of 100mbps, and provide communication to the Standalone Digital Control Units and/or other Input/Output Modules. Network Server Controllers shall conform to BACnet device profile B-BC. Network controllers that utilize RS232 serial communications or ARCNET to communicate with the workstations shall not be accepted. Network Controllers shall be tested and certified by the BACnet Testing Laboratory (BTL) as BACnet Building Controllers (B-BC).
7. Standalone Digital Control Units (SDCUs): Provide the necessary quantity and types of SDCUs to meet the requirements of the project for mechanical equipment control including air handlers, central plant control, and terminal unit control. Each SDCU shall operate completely standalone, containing all of the I/O and programs to control its associated equipment. Each BACnet protocol SDCU shall conform to the BACnet device profile B-AAC. BACnet SDCUs shall be tested and certified by the BACnet Testing Laboratory (BTL) as BACnet Advanced Application Controllers (B-AAC).

B. The Local Area Network (LAN) shall be either a 10 or 100 Mpbs Ethernet network supporting BACnet, Modbus, XML and HTTP for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Network Server Controllers (NSCs), user workstations and a local host computer system. Data connection provided by others.

C. The Enterprise Ethernet (IEEE 802.3) LAN shall utilize Carrier Sense Multiple/Access/Collision Detect (CSMA/CD), Address Resolution Protocol (ARP) and User Datagram Protocol (UDP) operating at 10 or 100 Mbps.

D. The system shall enable an open architecture that utilizes EIA standard 709.1, the LonTalk™ protocol and/or ANSI / ASHRAE™ Standard 135-2004, BACnet functionality to assure interoperability between all system components. Native support for the LonTalk™ protocol and the ANSI / ASHRAE™ Standard 135-2004, BACnet protocol are required to assure that the project is fully supported by the HVAC open protocols to reduce future building maintenance, upgrade, and expansion costs.

E. The system shall enable an architecture that utilizes a MS/TP selectable 9.6-76.8 KBaud protocol, as a common communication protocol between controllers and integral ANSI / ASHRAE™ Standard 135-2004, BACnet functionality to assure interoperability between all system components. The AAC shall be capable of communicating as a MS/TP device or as a BACnet IP device communicating at 10/100 Mbps on a TCP/IP trunk. The ANSI / ASHRAE™ Standard 135-2004, BACnet protocol is required to assure that the project is fully supported by the leading HVAC open protocol to reduce future building maintenance, upgrade, and expansion costs.

F. LonTalk™ packets may be encapsulated into TCP/IP messages to take advantage of existing infrastructure or to increase network bandwidth where necessary or desired.

1. Any such encapsulation of the LonTalk™ protocol into IP datagrams shall conform to existing LonMark™ guide functionality lines for such encapsulation and shall be based on industry standard protocols.
2. The products used in constructing the BMS shall be LonMark™ compliant.
3. In those instances in which Lon-Mark™ devices are not available, the BMS contractor shall provide device resource files and external interface definitions for LonMark devices.

G. The software tools required for network management of the LonTalk™ protocol and the ANSI / ASHRAE™ Standard 135-2004, BACnet protocol must be provided with the system. Drawings are diagrammatic only. Equipment and labor not specifically referred to herein or on the plans and are required to meet the functional intent, shall be provided without additional cost to the Owner. BACnet clients shall comply with the BACnet Operator Workstation (B-OWS) device profile; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet IP or MS/TP. Physical connection of LonWorks devices shall be via Ethernet IP or FTT-10A.

H. The system shall provide support for Modbus TCP and RTU protocols natively, and not require the use of gateways. Vendor shall include in his bid any software cost/fees to enable the installed system to communicate with Modbus TCP and RTU devices

I. Complete temperature control system to be DDC with electronic sensors and electronic/electric actuation of Mechanical Equipment Room (MER) valves and dampers and electronic actuation of terminal equipment valves and actuators as specified herein. The BMS is intended to seamlessly connect devices throughout the building regardless of subsystem type, i.e. variable frequency drives, low voltage lighting systems, electrical circuit breakers, power metering and card access should easily coexist on the same network channel.

1. The supplied system must incorporate the ability to access all data using HTML5 enabled browsers without requiring proprietary operator interface and configuration programs. The system shall not require JAVA to be enabled in the browser.
2. Data shall reside on a supplier-installed server for all database access.
3. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network.

J. All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this work and in the regular employment of the approved manufacturer's local field office. The approved manufacturer's local field office shall have a minimum of 5 years of installation experience with the manufacturer and shall provide documentation in the bid and submittal package verifying longevity of the installing company's relationship with the manufacturer when requested. Supervision, hardware and software engineering, calibration and checkout of the system shall be by the employees of the approved manufacturer's local field office and shall not be subcontracted. The control contractor shall have an in place support facility within 200 miles of the site with factory certified technicians and engineers, spare parts inventory and all necessary test and diagnostic equipment for the installed system, and the control contractor shall have 24 hours/day, 7 days/week emergency service available.

K. Provide the Commissioning, configuration and diagnostic tool (CCDT), color display personnel computer, software, and interfaces to provide uploading/downloading of High Point Count Controllers (AAC), Unitary Equipment Controllers (UEC) and VAV controllers (VAVDDC), monitoring all BACnet objects, monitoring overrides of all controller physical input/output points, and editing of controller resident time schedules.

1.7 WORK BY OTHERS

A. The BAS Contractor shall cooperate with other contractors performing work on this project necessary to achieve a complete and neat installation. To that end, each contractor shall consult the drawings and specifications for all trades to determine the nature and extent of others' work.

B. The BAS Contractor shall furnish all Control Valves, Flow Meters, Sensor Wells and other similar equipment for installation by the Mechanical Contractor and/or others.

C. The BAS Contractor shall provide field supervision to the designated contractor for the installation of the following:

1. Automatic control dampers
2. Blank-off plates for dampers that are smaller than duct size.
3. Sheet metal baffles plates to eliminate stratification.
4. The site main Electrical Contractor shall provide:

   a. All 120VAC (and above) power wiring (line and load side) to motors (pumps, fans, chillers, boilers, RTUs, ERVs,MAUs, etc.), heat trace, junction boxes for power to BAS panels.
   b. All starters and disconnects
   c. Main site Electrical Contractor shall furnish and install smoke detectors and wire to the building fire alarm system. HVAC Contractor to mount devices. BAS Contractor to hardwire to fan shut down.

1.8 CODE COMPLIANCE

A. Provide BAS components and ancillary equipment, which are UL-916 listed and labeled.

B. All equipment or piping used in conditioned air streams, spaces or return air plenums shall comply with NFPA 90A Flame/Smoke/Fuel contribution rating of 25/50/0 and all applicable building codes or requirements.

C. All wiring shall conform to the National Electrical Code.

D. Comply with FCC rules, Part 15 regarding Class A radiation for computing devices and low power communication equipment operating in commercial environments.

E. Comply with FCC, Part 68 rules for telephone modems and data sets.

1.9 SUBMITTALS

A. All shop drawings shall be prepared in Visio Professional or AutoCAD software. In addition to the drawings, the Contractor shall furnish a CD containing the identical information. Drawings shall be B size or larger.

B. Shop drawings shall include a riser diagram depicting locations of all controllers and workstations, with associated network wiring. Also included shall be individual schematics of each mechanical system showing all connected points with reference to their associated controller. Typicals will be allowed where appropriate.

C. Submittal data shall contain manufacturer's data on all hardware and software products required by the specification. Valve, damper and air flow station schedules shall indicate size, configuration, capacity and location of all equipment.

D. Software submittals shall contain narrative descriptions of sequences of operation, program listings, point lists, and a complete description of the graphics, reports, alarms and configuration to be furnished with the workstation software. Information shall be bound or in a three ring binder with an index and tabs. Diagrams shall be on 11" by 17" foldouts. If color has been used to differentiate information, the printed copies shall be in color.

E. Submit five (5) copies of submittal data and shop drawings to the Engineer for review prior to ordering or fabrication of the equipment. The Contractor, prior to submitting, shall check all documents for accuracy.

F. The Engineer will make corrections, if required, and return to the Contractor. The Contractor shall then resubmit with the corrected or additional data. This procedure shall be repeated until all corrections are made to the satisfaction of the Engineer and the submittals are fully approved.

G. The following is a list of post construction submittals that shall be updated to reflect any changes during construction and re-submitted as "As-Built".

1. System architecture drawing.
2. Layout drawing for each control panel
3. Wiring diagram for individual components
4. System flow diagram for each controlled system
5. Instrumentation list for each controlled system
6. Sequence of control
7. Binding map
8. A matrix sheet detailing all system addresses and communication settings for the following:
    a. All IP network addresses & settings
    b. All BMS device addresses & communication settings
9. Operation and Maintenance Manuals.

H. Information common to the entire system shall be provided. This shall include but not be limited to the following.

1. Product manuals for the key software tasks.
2. Operating the system.
3. Administrating the system.
4. Engineering the operator workstation.
5. Application programming.
6. Engineering the network.
7. Setting up the web server.
8. Report creation.
9. Graphics creation.
10. All other engineering tasks.
11. System Architecture Diagram.
12. List of recommended maintenance tasks associated with the system servers, operator workstations, data servers, web servers and web clients.
13. Define the task.
14. Recommend a frequency for the task.
15. Reference the product manual that includes instructions on executing the task.
16. Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.
17. Licenses, guarantees, and warranty documents for equipment and systems.
18. Submit one copy for each building, plus two extra copies.

I. Information common to the systems in a single building shall be provided.

1. System architecture diagram for components within the building annotated with specific location information.
2. As-built drawing for each control panel.
3. As-built wiring design diagram for all components.
4. Installation design details for each I/O device.
5. As-built system flow diagram for each system.
6. Sequence of control for each system.
7. Binding map for the building.

8. Product data sheet for each component.
9. Installation data sheet for each component.
10. Submit two copies for each building and two extra copies.

J. Software shall be provided.

1. Submit a copy of all software installed on the servers and workstations.
2. Submit all licensing information for all software installed on the servers and workstations.
3. Submit a copy of all software used to execute the project even if the software was not installed on the servers and workstations.
4. Submit all licensing information for all of the software used to execute the project.
5. All software revisions shall be as installed at the time of the system acceptance.
6. Firmware Files
7. Submit a copy of all firmware files that were downloaded to or pre-installed on any devices installed as part of this project.
8. This does not apply to firmware that is permanently burned on a chip at the factory and can only be replaced by replacing the chip.
9. Submit a copy of all application files that were created during the execution of the project.
10. Submit a copy of all graphic page files created during the execution of the project.

1.10 COORDINATION

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

B. Coordinate equipment from other divisions including "Intrusion Detection," "Lighting Controls," "Motor Control Centers," "Panel boards," and "Fire Alarm" to achieve compatibility with equipment that interfaces with those systems.

C. Coordinate supply of conditioned electrical circuits for control units and operator workstation.

D. Coordinate location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete".

E. Coordinate with the Owner's IT department on locations for NSC's, Ethernet communication cabling and TCP/IP addresses.

1.11 OWNERSHIP

A. The Owner shall retain licenses to software for this project.

B. The Owner shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition off this contractor. Such license shall grant use of all programs and application software to the Owner as defined by the manufacturer's license agreement, but shall protect the manufacturer's rights to disclosure of Trade Secrets contained within such software.

C. The licensing agreement shall not preclude the use of the software by individuals under contract to the Owner for commissioning, servicing or altering the system in the future. Use of the software by individuals under contract to the Owner shall be restricted to use on the Owner's computers and only for the purpose of commissioning, servicing, or altering the installed system.

D. All project developed software, files and documentation shall become the property of the Owner. These include but are not limited to:

1. Server and workstation software
2. Application programming tools

3. Configuration tools
4. Network diagnostic tools
5. Addressing tools
6. Application files
7. Configuration files
8. Graphic files
9. Report files
10. Graphic symbol libraries
11. All documentation

1.12 QUALITY ASSURANCE - SYSTEM STARTUP AND COMMISSIONING

A. Each point in the system shall be tested for both hardware and software functionality. In addition, each mechanical and electrical system under control of the BAS shall be tested against the appropriate sequence of operation specified herein. Successful completion of the system test shall constitute the beginning of the warranty period. A written report shall be submitted to the Owner indicating that the installed system functions in accordance with the plans and specifications.

B. The BAS contractor shall commission and set in operating condition all major equipment and systems, such as the chilled water, hot water and all air handling systems, in the presence of the equipment manufacturer's representatives, as applicable, and the Owner and Architect's representatives.

C. The BAS Contractor shall provide a technician and engineering services as required to assist the HVAC Contractor and Balancing Contractor in testing, adjusting, and balancing all systems in the building. The BAS Contractor shall coordinate all requirements to provide a complete air balance with the Balancing Contractor and shall include all labor and materials in his contract.

D. Startup Testing shall be performed for each task on the startup test checklist, which shall be initialed by the technician and dated upon test was completion along with any recorded data such as voltages, offsets or tuning parameters. Any deviations from the submitted installation plan shall also be recorded.

E. Required elements of the startup testing include:

1. Measurement of voltage sources, primary and secondary
2. Verification of proper controller power wiring.
3. Verification of component inventory when compared to the submittals.
4. Verification of labeling on components and wiring.
5. Verification of connection integrity and quality (loose strands and tight connections).
6. Verification of bus topology, grounding of shields and installation of termination devices.
7. Verification of point checkout.
8. Each I/O device is landed per the submittals and functions per the sequence of control.
9. Analog sensors are properly scaled and a value is reported
10. Binary sensors have the correct normal position and the state is correctly reported.
11. Analog outputs have the correct normal position and move full stroke when so commanded.
12. Binary outputs have the correct normal state and respond appropriately to energize/de-energize commands.
13. Documentation of analog sensor calibration (measured value, reported value and calculated offset).
14. Documentation of Loop tuning (sample rate, gain and integral time constant).

F. A performance verification test shall also be completed for the operator interaction with the system. Test elements shall be written to require the verification of all operator interaction tasks including, but not limited to the following:

1. Graphics navigation.
2. Trend data collection and presentation.
3. Alarm handling, acknowledgement and routing.

4. Time schedule editing.
5. Application parameter adjustment.
6. Manual control.
7. Automatic backups.
8. Web Client access.

G. A Startup Testing Report and a Performance Verification Testing Report shall be provided upon test completion.

1.13 WARRANTY AND MAINTENANCE

A. All components, system software, and parts furnished and installed by the BMS contractor shall be guaranteed against defects in materials and workmanship for 1 year of substantial completion. Labor to repair, reprogram, or replace these components shall be furnished by the BMS contractor at no charge during normal working hours during the warranty period. Materials furnished but not installed by the BMS contractor shall be covered to the extent of the product only. Installation labor shall be the responsibility of the trade contractor performing the installation. All corrective software modifications made during warranty periods shall be updated on all user documentation and on user and manufacturer archived software disks. The Contractor shall respond to the Owner's request for warranty service within 24 standard working hours.

1.14 TRAINING

A. **The BAS Contractor shall provide an Allowance of five (5) hours for on-site training to the Owner's representative and maintenance personnel per the following.**

B. On-site training shall consist of hands-on instruction geared at the operation and maintenance of the systems. The curriculum shall include:

1. System Overview
2. System Software and Operation
3. System access
4. Software features overview
5. Changing setpoints and other attributes
6. Scheduling
7. Editing programmed variables
8. Displaying color graphics
9. Running reports
10. Workstation maintenance
11. Viewing application programming
12. Operational sequences including start-up, shutdown, adjusting and balancing.
13. Equipment maintenance

PART 2 - PRODUCTS

2.1 PRE-APPROVED MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following pre-qualified manufacturers:

1. Electric Components:

a. Schneider-Electric Field Devices
b. Or approved equal.

2. Electronic Components:

a. Schneider-Electric Field Devices
b. Or approved equal.

3. Direct Digital Control Systems Field Controller Devices:

a. Schneider Electric EcoStruxure Building MPC BACnet series, b3 BACnet series, MNB BACnet (IP or MSTP) installed by approved manufacturer's local field office.
b. Or approved equal.

2.2 SYSTEM ARCHITECTURE

A. General:

1. The Building Automation System (BAS) shall consist of Network Server/Controllers (NSCs), a family of Standalone Digital Control Units (SDCUs), Administration and Programming Workstations (APWs), and Web-based Operator Workstations (WOWs). The BAS shall provide control, alarm detection, scheduling, reporting and information management for the entire facility, and Wide Area Network (WAN) if applicable.
2. An Enterprise Level BAS shall consist of an Enterprise Server, which enables multiple NSCs (including all graphics, alarms, schedules, trends, programming, and configuration) to be accessible from a single Workstation simultaneously for operations and engineering tasks.
3. The Enterprise Level BAS shall be able to host up to 250 servers, or NSCs, beneath it.
4. For Enterprise reporting capability and robust reporting capability outside of the trend chart and listing ability of the Workstation, a Reports Server shall be installed on a Microsoft Windows SQL based computer. The Reports Server can be installed on the same computer as the Enterprise Server.
5. The system shall be designed with a top-level 10/100bT Ethernet network, using the BACnet/IP, LonWorks IP, and/or Modbus TCP protocol.

B. Modbus RTU/ASCII (and J-bus), Modbus TCP, BACnet MS/TP, BACnet IP, LonTalk FTT-10A, and WebServices shall be native to the NSCs. There shall not be a need to provide multiple NSCs to support all the network protocols, nor should there be a need to supply additional software to allow all three protocols to be natively supported.

C. A sub-network of SDCUs using the BACnet IP, BACnet MS/TP protocol shall connect the local, stand-alone controllers with Ethernet-level Network Server Controllers/IP Routers.

D. TCP/IP Level: The TCP/IP layer connects all of the buildings on a single Wide Area Network (WAN) isolated behind the campus firewall. Fixed IP addresses for connections to the campus WAN shall be used for each device that connects to the WAN.

E. Fieldbus Level with Standalone Digital Control Units (SDCUs):

1. The fieldbus layer shall support all of the following types of SDCUs:

a. BACnet IP SDCU requirements: The system shall consist of one or more BACnet/IP field buses managed by the Network Server Controller. The field bus layer shall consist of up to 50 IP SDCUs in daisy chain topology, or 39 if using RSTP, per layer, with a max of 5 sub networks in daisy chain for a total of 250 SDCUs or 6 sub networks in RSTP for a total of 234 SDCUs.
b. BACnet MS/TP SDCU requirements: The system shall consist of one or more BACnet MS/TP field buses managed by the Network Server Controller. Minimum speed shall be 76.8kbps. The field bus layer consists of an RS485, token passing bus that supports up to 127 Standalone Digital Control Units (SDCUs) for operation of HVAC and lighting equipment. These devices shall conform to BACnet standard 135-2004. The NSCs shall be capable of at least two BACnet MS/TP field buses for a total capability of 254 SDCUs per NSC.

F. BAS LAN Segmentation: The BAS shall be capable of being segmented, through software, into multiple local area networks (LANs) distributed over a wide area network (WAN). Workstations can manage a

single LAN (or building), and/or the entire system with all portions of that LAN maintaining its own, current database.

G. Standard Network Support: All NSCs, Workstation(s) and Servers shall be capable of residing directly on the Owner's Ethernet TCP/IP LAN/WAN with no required gateways. Furthermore, the NSC's, Workstation(s), and Server(s) shall be capable of using standard, commercially available, off-the-shelf Ethernet infrastructure components such as routers, switches and hubs. With this design the Owner may utilize the investment of an existing or new enterprise network or structured cabling system. This also allows the option of the maintenance of the LAN/WAN to be performed by the Owner's Information Systems Department as all devices utilize standard TCP/IP components.

H. System Expansion:

1. The BAS system shall be scalable and expandable at all levels of the system using the same software interface, and the same TCP/IP level and fieldbus level controllers. Systems that require replacement of either the workstation software or field controllers in order to expand the system shall not be acceptable.
2. Web-based operation shall be supported directly by the NSCs and require no additional software.
3. The system shall be capable of using graphical and/or line application programming language for the Network Server Controllers.

I. Support for Open Systems Protocols: All Network Server Controllers must natively support the BACnet IP, BACnet MS/TP, LonWorks FTT-10, Modbus TCP, Modbus RTU (RS-485 and RS-232), and Modbus ASCII protocols.

2.3 OPERATOR WORKSTATION REQUIREMENTS (**Contractor Shall Provide If Not Existing**)

A. General:

1. The operator workstation portion of the BAS shall consist of one or more full-powered configuration and programming workstations, and one or more web-based operator workstations. For this project provide a minimum of 10 concurrent operator users and/or 2 concurrent engineering users within the enterprise server.
2. The programming and configuration workstation software shall allow any user with adequate permission to create and/or modify any or all parts of the NSC and/or Enterprise Server database.
3. Web-based workstations (webstations) shall have a minimum of 10 concurrent operator users.
4. All configuration workstations shall be personal computers operating under the Microsoft Windows operating system. The application software shall be capable of communication to all Network Server Controllers and shall feature high-resolution color graphics, alarming, trend charting. It shall be user configurable for all data collection and data presentation functions.
5. A minimum of 1 physical Workstation shall be allowed on the Ethernet network. In this client/server configuration, any changes or additions made from one workstation shall automatically appear on all other workstations since the changes are accomplished to the databases within the NSC. Systems with a central database will not be acceptable.

B. Administration/Programming Workstation, Enterprise Server, and Enterprise Central Requirements:

1. The Enterprise Central shall consist of the following:

a. Processor:

1) Minimum: Intel Core i5 @ 2.0 GHz or equivalent
2) Recommended: Intel Core i5 @ 3.0 GHz or better

b. Memory:

1) Minimum: 4GB
2) Recommended: 8GB or higher

c. Operating Systems:

1) Microsoft Windows 7 32-bit (Professional, Enterprise, or Ultimate)
2) Microsoft Windows 7 64-bit (Professional, Enterprise, or Ultimate)
3) Microsoft Windows 8.1 32-bit (Pro, Pro N, Enterprise, or Enterprise N)
4) Microsoft Windows 8.1 64-bit (Pro, Pro N, Enterprise, or Enterprise N)
5) Microsoft Windows 10 64-bit (Pro or Enterprise)
6) Microsoft Windows Server 2008 R2 64-bit (Standard, Enterprise, Datacenter, Web, or Itanium)
7) Microsoft Windows Server 2012 64-bit (Standard, Datacenter, Essentials, or Foundation)
8) Microsoft Windows Server 2012 R2 64-bit (Standard, Datacenter, Essentials, or Foundation)
9) Microsoft Windows Server 2016 R2 64-bit (Standard, Datacenter, Essentials, or Foundation)

d. 10/100MBPS Ethernet NIC
e. 100 GB hard disk (minimum)
f. Required additional software:

1) Microsoft .Net 4.5

g. License agreement for all applicable software.

2. The workstation shall consist of the following:

a. Processor:

1) Minimum: 2.0 GHz
2) Recommended: 3.0 GHz or higher

b. Memory:

1) Minimum: 4GB
2) Recommended: 8GB or higher

c. Operating Systems:

1) Microsoft Windows 7 32-bit (Professional, Enterprise, or Ultimate)
2) Microsoft Windows 7 64-bit (Professional, Enterprise, or Ultimate)
3) Microsoft Windows 8.1 32-bit (Pro, Pro N, Enterprise, or Enterprise N)
4) Microsoft Windows 8.1 64-bit (Pro, Pro N, Enterprise, or Enterprise N)
5) Microsoft Windows 10 64-bit (Pro or Enterprise)
6) Microsoft Windows Server 2008 R2 64-bit (Standard, Enterprise, Datacenter, Web, or Itanium)
7) Microsoft Windows Server 2012 64-bit (Standard, Datacenter, Essentials, or Foundation)
8) Microsoft Windows Server 2012 R2 64-bit (Standard, Datacenter, Essentials, or Foundation)

d. Serial port, parallel port, USB port
e. 10/100MBPS Ethernet NIC
f. 20 GB hard disk
g. DVD drive
h. High resolution (minimum 1280 x 1024), 17" flat panel display
i. Optical mouse and full function keyboard
j. Audio sound card and speakers
k. Required additional software:

1) Microsoft .Net 4.5

l. License agreement for all applicable software

C. Web-Based Operator PC Requirements:

1. Any user on the network can access the system, using the following software:

   a. Internet Explorer 11
   b. Mozilla Firefox
   c. Google Chrome

D. General Administration and Programming Workstation Software:

1. System architecture shall be truly client server in that the Workstation shall operate as the client while the NSCs shall operate as the servers. The client is responsible for the data presentation and validation of inputs while the server is responsible for data gathering and delivery.
2. The workstation functions shall include monitoring and programming of all DDC controllers. Monitoring consists of alarming, reporting, graphic displays, long term data storage, automatic data collection, and operator-initiated control actions such as schedule and setpoint adjustments.
3. Programming of SDCUs shall be capable of being done either off-line or on-line from any operator workstation. All information shall be available in graphic or text displays stored at the NSC. Graphic displays shall feature animation effects to enhance the presentation of the data, to alert operators of problems, and to facilitate location of information throughout the DDC system. All operator functions shall be selectable through a mouse.

E. User Interface:

1. The BAS workstation software shall allow the creation of a custom, browser-style interface linked to the user when logging into any workstation. Additionally, it shall be possible to create customized workspaces that can be assigned to user groups. This interface shall support the creation of "hot-spots" that the user may link to view/edit any object in the system or run any object editor or configuration tool contained in the software. Furthermore, this interface must be able to be configured to become a user's "PC Desktop" – with all the links that a user needs to run other applications. This, along with the Windows user security capabilities, shall enable a system administrator to setup workstation accounts that not only limit the capabilities of the user within the BAS software, but may also limit what a user can do on the PC and/or LAN/WAN. This might be used to ensure, for example, that the user of an alarm monitoring workstation is unable to shutdown the active alarm viewer and/or unable to load software onto the PC.
2. System shall be able to automatically switch between displayed metric vs. imperial units based on the workstation/webstations localization.
3. The BMS workstation/webstations shall be capable of multiple language display, including English, Spanish, German, French, Japanese, Italian, Finnish, Portuguese, Swedish, Russian, and traditional and simplified Chinese. The multiple languages shall not require additional add on software from the standard workstation installer and shall be selectable within said workstation.
4. Webstations shall have the capability to automatically re-direct to an HTTPS connection to ensure more secure communications.
5. Personalized layouts and panels within workstations shall be extended to webstations to ensure consistent user experiences between the two user interfaces.
6. Servers and clients shall have the ability to be located in different time zones, which are then synchronized via the NTP server.
7. Workstation shall indicate at all times the communication status between it and the server.

F. User Security:

1. The software shall be designed so that each user of the software can have a unique username and password. This username/password combination shall be linked to a set of capabilities within the software, set by and editable only by, a system administrator. The sets of capabilities shall range from View only, Acknowledge alarms, Enable/disable and change values, Program, and Administer. The system shall allow the above capabilities to be applied independently to each and every class of object in the system. The system must allow a minimum of 256 users to be configured per workstation. Additionally, the software shall enable the ability to add/remove users based upon

Microsoft Windows Security Domains that enable the customer IT department to assist in user access.

2. Additional requirements include mandatory change of passwords:
    a. At first logon with default credentials
    b. Of admin passwords before deploying
3. No general accounts, one account per user.
4. Capability to integrate and use Windows Active Directory for user log on credentials.
5. Include a timed auto log off feature.
6. Use TLS 1.2 encryption or higher.
7. Capability to use blacklisted and whitelisted IPs/MAC addresses to gate access.
8. All devices and software that support HTTP shall allow disabling the HTTP access and require access via HTTPS.
9. All devices that have web portals for the configuration of IP addresses and other configuration attributes shall have the ability, through commands issued, to disable this service upon completion. A direct connection method with ASCII commands shall enable this service again if changes need to be applied. Loss of power or cycling the device shall not reverse this command. Disabling this web portal eliminates the security risk and the need for updating security patches.
10. All devices shall support SNMP V3 monitoring of network performance and stack statistics for the purpose of managing denial of service attacks.
11. The Integrated Control Platform shall support the feature to alarm on a predetermined period of time until the default password for each device is changed from the default factory setting.
12. The Integrated Control Platform shall support encrypted password authentication for all web services whether serving or consuming.

G. Configuration Interface:

1. The workstation software shall use a familiar Windows Explorer style interface for an operator or programmer to view and/or edit any object (controller, point, alarm, report, schedule, etc.) in the entire system. In addition, this interface shall present a "network map" of all controllers and their associated points, programs, graphics, alarms, and reports in an easy to understand structure. All object names shall be alphanumeric and use Windows long filename conventions.
2. The configuration interface shall also include support for user defined object types. These object types shall be used as building blocks for the creation of the BAS database. They shall be created form the base object types within the system input, output, string variables, setpoints, etc., alarm algorithms, alarm notification objects, reports, graphics displays, schedules, and programs. Groups of user defined object types shall be able to be set up as a predefined aggregate of subsystems and systems. The configuration interface shall support copying/pasting and exporting/importing portions of the database for additional efficiency. The system shall also maintain a link to all "child" objects created. If a user wishes to make a change to a parent object, the software shall ask the user if he/she wants to update all of the child objects with the change.

H. Color Graphic Displays:

1. The system shall allow for the creation of user defined, color graphic displays for the viewing of mechanical and electrical systems, or building schematics. These graphics shall contain point information from the database including any attributes associated with the point (engineering units, etc.). In addition operators shall be able to command equipment or change setpoints from a graphic through the use of the mouse.
2. Requirements of the color graphic subsystem include:
    a. At a minimum, the user shall have the ability to import .gif, .png, .bmp, .jpeg, .tif, and CAD generated picture files as background displays, and layering shall be possible.
    b. The system shall support HTML5 enabled graphics.
    c. It shall be possible for the user to use JavaScript to customize the behavior of each graphic.
    d. The editor shall use Scalable Vector Graphics (SVG) technology.

e. A built-in library of animated objects such as dampers, fans, pumps, buttons, knobs, gauges, ad graphs which can be "dropped" on a graphic through the use of a software configuration "wizard". These objects shall enable operators to interact with the graphic displays in a manner that mimics their mechanical equivalents found on field installed control panels.
f. Support for high DPI icons shall be included and automatically chosen if viewing on a high definition display such as Retina or 4K displays.
g. Using the mouse, operators shall be able to adjust setpoints, start or stop equipment, modify PID loop parameters, or change schedules.
h. Status changes or alarm conditions must be able to be highlighted by objects changing screen location, size, color, text, blinking or changing from one display to another.
i. Ability to link graphic displays through user defined objects, alarm testing, or the result of a mathematical expression. Operators must be able to change from one graphic to another by selecting an object with a mouse - no menus shall be required.
j. It shall be possible to create and save graphical components and JavaScript code in reusable and transferrable, customized libraries.
k. Graphics should rescale based on whatever monitor or viewing device is being used.
l. Be able to create graphics on varying layers that can be moved and repeated.
m. Be able to create graphics within varying window panes that can be moved and/or re-referenced. For example, creating the graphical menu within a pane and referencing it on every graphics page, therefore not rebuilding thus allowing for a single spot for updates that get pushed to all the pages that reference it.
n. The ability to create re-usable cascading menus.
o. The ability to have multiple instances of a graphic and edit one instance to change all.

3. Additionally, the Graphics Editor portion of the Engineering Software shall provide the following capabilities:

a. Create and save pages.
b. Group and ungroup symbols.
c. Modify an existing symbol.
d. Modify an existing graphic page.
e. Rotate and mirror a symbol.
f. Place a symbol on a page.
g. Place analog dynamic data in decimal format on a page.
h. Place binary dynamic data using state descriptors on a page.
i. Create motion through the use of animated .gif files or JavaScript.
j. Place test mode indication on a page.
k. Place manual mode indication on a page.
l. Place links using a fixed symbol or flyover on a page.
m. Links to other graphics.
n. Links to web sites.
o. Links to notes.
p. Links to time schedules.
q. Links to any .exe file on the operator work station.
r. Links to .doc files.
s. Assign a background color.
t. Assign a foreground color.
u. Place alarm indicators on a page.
v. Change symbol/text/value color as a function of an analog variable.
w. Change a symbol/text/value color as a function of a binary state.
x. Change symbol/text/value as a function of a binary state.
y. All symbols used by Schneider Electric EcoBuilding Business in the creation of graphic pages shall be saved to a library file for use by the Owner.

I. Automatic Monitoring: The software shall allow for the automatic collection of data and reporting from any controller or NSC. The frequency of data collection shall be user-configurable.

J. Alarm Management:

1. The software shall be capable of accepting alarms directly from NSCs or controllers, or generating alarms based on evaluation of data in controllers and comparing to limits or conditional equations configured through the software. Any alarm (regardless of its origination) shall be integrated into the overall alarm management system and shall appear in all standard alarm reports, be available for operator acknowledgment, and have the option for displaying graphics, or reports.
2. Alarm management features shall include:
    a. A minimum of 1000 alarm notification levels at the NSC, workstation, and webstation levels. At the Enterprise level the minimum number of active and viewable alarms shall be 10,000. Each notification level shall establish a unique set of parameters for controlling alarm display, distribution, acknowledgment, keyboard annunciation, and record keeping.
    b. Automatic logging in the database of the alarm message, point name, point value, source device, timestamp of alarm, username and time of acknowledgement, username and time of alarm silence (soft acknowledgement).
    c. Playing an audible sound on alarm initiation or return to normal.
    d. Sending an email page to anyone specifically listed on the initial occurrence of an alarm. The ability to utilize email paging of alarms shall be a standard feature of the software using Simple Mail Transfer Protocol (SMTP) with support for secure email using Simple Mail Transfer Protocol Secure (SMTPS) No special software interfaces shall be required and no email client software must be running in order for email to be distributed. The email notification shall be able to be sent to an individual user or a user group.
    e. Individual alarms shall be able to be re-routed to a user at user-specified times and dates. For example, a critical high temp alarm can be configured to be routed to a Facilities Dept. workstation during normal working hours (7am-6pm, Mon-Fri) and to a Central Alarming workstation at all other times.
    f. An active alarm viewer shall be included which can be customized for each user or user type to hide or display any alarm attributes.
    g. The active alarm viewer can be configured such that an operator must type in text in an alarm entry and/or pick from a drop-down list of user actions for certain alarms.
    h. The active alarm viewer can be configured such that an operator must type in text in an alarm entry and/or pick from a drop-down list of causes for certain alarms. This ensures accountability (audit trail) for the response to critical alarms.
    i. The active alarm viewer can be configured such that an operator must confirm that all of the steps in a check list have been accomplished prior to acknowledging the alarm.
    j. The active alarm viewer shall, if filtered, show the quantity of visible and total number of alarms that are not equal to 'normal' and the quantity of disabled and hidden alarms.
    k. The alarm viewer can be configured to auto hide alarms when triggered.
    l. An operator shall have the capability to assign an alarm to another user of the system.
    m. Time schedules shall be able to be used to set control notifications to users.
    n. An operator shall have the capability to save and apply alarm favorites.
    o. Alarm notifications must support multiple distribution methods within one notification.

K. Report Generation:

1. The Reports Server shall be able to process large amounts of data and produce meaningful reports to facilitate analysis and optimization of each installation.
2. Reports shall be possible to generate and view from the operator Workstation, and/or Webstation, and/or directly from a reports-only web interface.
3. A library of predefined automatically generated reports that prompt users for input prior to generation shall be available. The properties and configurations made to these reports shall be possible to save as Dashboard reports, so that the configurations are saved for future used.
4. It shall be possible to create reports standard tools, such as Microsoft Report Builder 2.0 or Visual Studio, shall be used for customized reports.
5. Additional reports or sets of reports shall be downloadable, transferrable, and importable
6. All reports shall be able to be set up to automatically run or be generated on demand.

7. Each report shall be capable of being automatically emailed to a recipient in Microsoft Word, Excel, and/or Adobe .pdf format.
8. Reports can be of any length and contain any point attributes from any controller on the network.
9. Image management functionality shall be possible to enable the system administrators to easily upload new logos or images to the system.
10. It shall be possible to run other executable programs whenever a report is initiated.
11. Report Generator activity can be tied to the alarm management system, so that any of the configured reports can be displayed in response to an alarm condition.
12. Minimum supplied reports shall include:

    a. Activities Per Server Report
    b. Activities Per User Report
    c. Alarm Amount by Category Report
    d. Alarm Amount by Type Report
    e. Alarms Per Sever Report
    f. Current Alarm Report
    g. Most Active Alarm Report
    h. System Errors Per Server Report
    i. Top Activities Report
    j. Top Alarms Report
    k. Top System Errors Report
    l. Trend Log Comparison Report
    m. User Logins Report
    n. Users and Groups Reports

13. Minimum Energy Reports shall include:

    a. Energy Monitoring Calendar Consumption Report: Shall provide an interactive report that shows the energy usage on one or multiple selected days.
    b. Energy Monitoring Consumption Breakdown Report: Shall provide a report on energy consumption broken down using sub-metering.
    c. Energy Monitoring Consumption Report: Shall show the energy consumption against a specified target value.

14. Reports Server Hardware Requirements:

    a. Processor:

        1) Minimum: 2.0 GHz
        2) Recommended: 2.0 GHz or higher

    b. Memory:

        1) Minimum: 6 GB
        2) Recommended: 8GB or higher

    c. Hard Disk: 500 GB

15. Reports Server Software Requirements:

    a. Operating System:

        1) Microsoft Windows 7 32-bit (Professional)
        2) Microsoft Windows 7 64-bit (Professional)
        3) Microsoft Windows 8.1 32-bit (Pro or Enterprise)
        4) Microsoft Windows 8.1 64-bit (Pro or Enterprise)
        5) Microsoft Windows 10 64-bit (Pro or Enterprise)
        6) Microsoft Windows Server 2008 R2 64-bit (Standard, Enterprise, Datacenter, Web, or Itanium)
        7) Microsoft Windows Server 2012 64-bit (Standard)
        8) Microsoft Windows Server 2012 R2 64-bit (Standard, Datacenter)

b. SQL Versions:

1) Microsoft SQL Server 2008 R2 64-bit SP2 (Standard and Express with Advanced Services)
2) Microsoft SQL Server 2012 64-bit (Standard and Express with Advanced Services)

c. Additional required software:

1) Microsoft .Net 4.5

L. Scheduling:

1. From the workstation or webstation, it shall be possible to configure and download schedules for any of the controllers on the network.
2. Time of day schedules shall be in a calendar style and viewable in both a graphical and tabular view.
3. Schedules shall be programmable for a minimum of one year in advance.
4. To change the schedule for a particular day, a user shall simply select the day and make the desired modifications.
5. Additionally, from the operator webstations, each schedule shall appear on the screen viewable as the entire year, monthly, week and day. A simple mouse click shall allow switching between views. It shall also be possible to scroll from one month to the next and view or alter any of the schedule times.
6. Schedules shall be assigned to specific controllers and stored in their local RAM memory. Any changes made at the workstation shall be automatically updated to the corresponding schedule in the controller.
7. It shall be possible to assign a lead schedule such that shadow/local schedules are updated based upon changes in the Lead.
8. It shall be possible to assign a list(s) of exception event days, dates, date ranges to a schedule.
9. It shall be possible to view combined views showing the calendar and all prioritized exemptions on one screen.
10. It should accommodate a minimum of 16 priority levels.
11. Values should be able to be controlled directly from a schedule, without the need for special program logic.

M. Programmer's Environment:

1. Programming in the NSC shall be either in graphical block format or line-programming format or both.
2. Programming of the NSC shall be available offline from system prior to deployment into the field. All engineering tasks shall be possible, except, of course, the viewing of live tasks or values.
3. The programmer's environment shall include access to a superset of the same programming language supported in the SDCUs.
4. NSC devices shall support both script programming language as well as the graphical function block programming language. For both languages, the programmer shall be able to configure application software for custom program development, and write global control programs. Both languages shall have debugging capabilities in their editors.
5. It shall be possible to save custom programs as libraries for reuse throughout the system. A wizard tool shall be available for loading programs from a library file in the program editor.
6. It shall be possible to view graphical programming live and real-time from the Workstation.
7. The system shall be capable of creating 'binding templates' allowing the user to bind multiple points to multiple objects all at once.
8. Key terms should appear when typing (IntelliType).
9. Applications should be able to be assigned different priorities and cycle times for a prioritized execution of different function.
10. The system shall be able to create objects that allow common objects such as power meters, VFD drives, etc. to be integrated into the system with simple import actions without the need of complicated programming or configuration setups.

N. Saving/Reloading:

1. The workstation software shall have an application to save and restore NSC and field controller memory files.
2. For the NSC, this application shall not be limited to saving and reloading an entire controller – it must also be able to save/reload individual objects in the controller. This allows off-line debugging of control programs, for example, and then reloading of just the modified information.

O. Audit Trail:

1. The workstation software shall automatically log and timestamp every operation that a user performs at a workstation, from logging on and off a workstation to changing a point value, modifying a program, enabling/disabling an object, viewing a graphic display, running a report, modifying a schedule, etc.
2. It shall be possible to view a history of alarms, user actions, and commands for any system object individually or at least the last 5000 records of all events for the entire system from Workstation.
3. The Enterprise server shall be able to store up to 5 million events.
4. The event view shall support viewing of up to 100,000 events.
5. It shall be possible to save custom filtered views of event information that are viewable and configurable in Workstation.
6. It shall be capable to search and view all forced values within the system.

P. Fault Tolerant Enterprise Server Operation (Top level NSC): A single component failure in the system shall not cause the entire system to fail. All system users shall be informed of any detectable component failure via an alarm event. System users shall not be logged off as a result of a system failure or switchover.

Q. Web-based Operator Software:

1. General:

   a. Day-to-day operation of the system shall be accessible through a standard web browser interface, allowing technicians and operators to view any part of the system from anywhere on the network.
   b. The system shall be able to be accessed on site via a mobile device environment with, at a minimum, access to overwrite and view system values.

2. Graphic Displays:

   a. The browser-based interface must share the same graphical displays as the Administration and Programming Workstations, presenting dynamic data on site layouts, floor plans, and equipment graphics. The browser's graphics shall support commands to change setpoints, enable/disable equipment and start/stop equipment.
   b. Through the browser-based interface, operators must be able to navigate through the entire system, and change the value or status of any point in any controller. Changes are effective immediately to the controller, with a record of the change stored in the system database.

3. Alarm Management:

   a. Systems requiring additional client software to be installed on a PC for viewing the webstation from that PC shall not be considered.
   b. Through the browser interface, a live alarm viewer identical to the alarm viewer on the Administration and Programming workstation shall be presented, if the user's password allows it. Users must be able to receive alarms, silence alarms, and acknowledge alarms through a browser. If desired, specific operator text must be able to be added to the alarm record before acknowledgement, attachments shall be viewable, and alarm checklists shall be available.

R. Groups and Schedules:

1. Through the browser interface, operators must be able to view pre-defined groups of points, with their values updated automatically.
2. Through the browser interface, operators must be able to change schedules – change start and stop times, add new times to a schedule, and modify calendars.

S. User Accounts and Audit Trail:

1. The same user accounts shall be used for the browser interface and for the operator workstations. Operators must not be forced to memorize multiple passwords.
2. All commands and user activity through the browser interface shall be recorded in the system's activity log, which can be later searched and retrieved by user, date, or both.

T. Web Services:

1. The installed system shall be able to use web services to "consume" information within the Network Server/Controllers (NSCs) with other products and systems. Inability to perform web services within the NSCs will be unacceptable.

    a. Shall be able to "consume" data into the system via SOAP and REST web services.

2.4 NETWORK SERVER CONTROLLERS (NSCS)

A. Network Router Controllers shall combine both network routing functions, control functions, and server functions into a single unit.

B. The BACnet NSC shall be classified as a "native" BACnet device, supporting the BACnet Network Server Controller (B-BC) profile. Controllers that support a lesser profile such as B-SA are not acceptable. NSCs shall be tested and certified by the BACnet Testing Laboratory (BTL) as BACnet Network Server Controllers (B-BC).

C. The Network Server Controller shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the NRS.

D. The NSCs shall be capable of whitelisting IPs to restrict access to a pre-defined list of hosts or devices.

E. Whitelisting of file extensions for documents shall be capable.

F. Encrypted and authenticated communication shall be configurable for non-open protocol communications using TLS 1.2

G. The NSCs shall support Simple Network Management Protocol version 3 (SNMPv3) for monitoring of the NSCs using a Network Management Tool.

H. The NSCs shall support remote system logging for used by System Information and Event Monitoring (SIEM) software.

I. They shall also be responsible for monitoring and controlling their own HVAC equipment such as an AHU or boiler.

J. They shall also contain graphics, trends, trend charts, alarm views, and other similar presentation objects that can be served to workstations or web-based interfaces. A sufficient number of NSCs shall be supplied to fully meet the requirements of this specification and the attached point list.

K. It shall be capable of executing application control programs to provide:

1. Calendar functions
2. Scheduling

3. Trending
4. Alarm monitoring and routing
5. Time synchronization by means of an Internet site including automatic synchronization
6. Native integration of LonWorks controller data and Modbus controller data or BACnet controller data and Modbus controller data
7. Network Management functions for all LonWorks based devices

L. Hardware Specifications:

1. Memory:

a. The operating system of the controller, application programs, and all other portions of the configuration database, shall be stored in non-volatile, FLASH memory. Servers/Controllers shall contain enough memory for the current application, plus required history logging, plus a minimum of 20% additional free memory.

2. Each NRC shall provide the following on-board hardware for communication:

a. Two 10/100b Ethernet for communication to Workstations, other NRCs, IP field bus controllers, other SDCUs, and onto the internet.

1) The two Ethernet ports shall support active switch and BACnet/IP communication protocols.
2) Support IPv4 addressing
3) Ethernet port 1 shall support static or DHCP client configuration for communication to Workstation or other NSCs
4) Ethernet port 2 shall support switch mode or DHCP server to set addressing of DHCP client devices
5) It shall be possible to disable Ethernet port 2
6) In DHCP server mode, the Ethernet port 2 shall support 50 BACnet/IP field controllers in daisy chain configuration directly from the port
7) Each NSC shall be able to support a total of 250 IP SDCUs in daisy chain configuration (5 sub networks via switch)
8) If using RSTP (Rapid Spanning Tree Protocol) with a managed switch (with IEEE 802.1W or IEEE 802.1Q-2014 support), Ethernet port 2 shall support up to 39 devices
9) Each NSC shall be able to support a total of 234 IP SDCUs in RSTP configuration (6 sub networks via managed switch)
10) Where a switch is needed, use an EtherWAN EX63402-01B, or other equal and approved equivalent.

b. Two RS-485 ports for communication to BACnet MSTP bus or serial Modbus (software configurable).
c. One TP/FT port for communication to LonWorks devices.
d. One device USB port.
e. One host USB port.

3. The NSC shall conform to a small footprint no larger than 100W x 125H x 75D mm (3.94W x 4.92H x 2.95D in).

M. Modular Expandability:

1. The system shall employ a modular I/O design to allow expansion. Input and output capacity is to be provided through plug-in modules of various types. It shall be possible to combine I/O modules as desired to meet the I/O requirements for individual control applications.
2. One shall be able to "hot-change" (hot-swap) the I/O modules preserving the system on-line without any intervention on the software; addressing and configuration shall be automatic.
3. If for any reason the backplane of the modular I/O system were to fail, I/O module addresses shall be protected.

N. Universal Input Temperatures:

1. All universal inputs directly connected to the NSC via modular expansion shall be capable of using the following thermistors for use in the system without any external converters needed.

    a. 10 kohm Type I (Continuum)
    b. 10 kohm Type II (I/NET)
    c. 10 kohm Type III (Satchwell)
    d. 10 kohm Type IV (FD)
    e. Linearized 10 kohm Type V (FD w/11k shunt)
    f. Linearized 10 kohm (Satchwell)
    g. 1.8 kohm (Xenta)
    h. 1 kohm (Balco)
    i. 20 kohm (Honeywell)
    j. 2.2 kohm (Johnson)

2. In addition to the above, the system shall be capable of using the below RTD sensors, however it is not required that all universal inputs be compatible with them.

    a. PT100 (Siemens)
    b. PT1000 (Sauter)
    c. Ni1000 (Danfoss)

O. Local Status Indicator Lamps: The NSC shall provide as a minimum LED indication of CPU status, Ethernet LAN status, and field bus status. For each input or output, provide LED indication of the value of the point (On/Off). The LED indication shall support software configuration to set whether the illumination of the LED corresponds to On or Off or whether the color when illuminated is Red or Green.

P. Real Time Clock (RTC):

1. Each NSC shall include a real time clock, accurate to 10 seconds per day. The RTC shall provide the following: time of day, day, month, year, and day of week. Each NSC shall allow for its own UTC offset, depending upon the time zone. When the time zone is set, the NSC shall also store the appropriate times for daylight savings time.
2. The RTC date and time shall also be accurate, up to 30 days, when the NSC is powerless.
3. No batteries may be used to for the backup of the RTC.

Q. Power Supply:

1. The 24 VDC power supply for the NSCs shall provide 30 watts of available power for the NSC and associated IO modules. The system shall support the use of more than one power supply if heavily power consuming modules are required.
2. The power supply, NSC, and I/O modules shall connect power wise and communication wise via the separate terminal base allowing for ease of replacement and no separate or loose wiring.

R. Automatic Restart After Power Failure: Upon restoration of power after an outage, the NSC shall automatically and without human intervention update all monitored functions, resume operation based on current, synchronize time and status, and implement special start-up strategies as required.

S. Data Retention: During a power failure, the NSC shall retain all programs, configuration data, historical data, and all other data that is configured to be retained. There shall be no time restriction for this retention and it must not use batteries to achieve it.

T. Software Specifications:

1. The operating system of the controller, application programs, and all other portions of the configuration database such as graphics, trends, alarms, views, etc., shall be stored in non-volatile, FLASH memory. There shall be no restrictions placed on the type of application programs in the system. Each NSC shall be capable of parallel processing, executing all control programs simultaneously. Any program may affect the operation of any other program. Each program shall have the full access of all I/O facilities of the processor. This execution of control function shall not

be interrupted due to normal user communications including interrogation, program entry, printout of the program for storage, etc.

2. Each NSC shall have an available capacity of 4 GB of memory. This shall represent 2 GB for application and historical data and 2 GB dedicated for backup storage.

U. User Programming Language:

1. The application software shall be user programmable. This includes all strategies, sequences of operation, control algorithms, parameters, and setpoints. The source program shall be either a script-based structured text or graphical function block based and fully programmable by the user. The language shall be structured to allow for the configuration of control programs, schedules, alarms, reports, telecommunications, local displays, mathematical calculations, and histories. Users shall be able to place comments anywhere in the body of either script or function block programs.
2. Network Server Controllers that use a "canned" program method will not be accepted.

V. Control Software:

1. The NSC shall have the ability to perform the following pre-tested control algorithms:

a. Proportional, Integral plus Derivative Control (PID)
b. Two Position Control
c. Digital Filter
d. Ratio Calculator
e. Equipment Cycling Protection

W. Mathematical Functions: Each controller shall be capable of performing basic mathematical functions (+, -, *, /), squares, square roots, exponential, logarithms, Boolean logic statements, or combinations of both. The controllers shall be capable of performing complex logical statements including operators such as >, <, =, and, or, exclusive or, etc. These must be able to be used in the same equations with the mathematical operators and nested up to five parentheses deep.

X. NSCs shall have the ability to perform any or all of the following energy management routines:

1. Time of Day Scheduling
2. Calendar Based Scheduling
3. Holiday Scheduling
4. Temporary Schedule Overrides
5. Optimal Start
6. Optimal Stop
7. Night Setback Control
8. Enthalpy Switchover (Economizer)
9. Peak Demand Limiting
10. Temperature Compensated Duty Cycling
11. CFM Tracking
12. Heating/Cooling Interlock
13. Hot/Cold Deck Reset
14. Hot Water Reset
15. Chilled Water Reset
16. Condenser Water Reset
17. Chiller Sequencing

Y. History Logging:

1. Each NSC controller shall be capable of LOCALLY logging any input, output, calculated value or other system variable either over user defined time intervals ranging from 1 second to 1440 minutes or based upon a user configurable change of value. A minimum of 1000 logs, with a minimum of 100,000 records, shall be stored. Each log can record either the instantaneous, average, minimum

or maximum value of the point. Logged data shall be downloadable to a higher level NSC long term archiving based upon user-defined time intervals, or manual command.

2. For extended trend logging a minimum of 1500 trends shall be capable, with a minimum number of 600,000 records within.
3. Management of a power meter replacement to ensure meter log data is accurate shall be possible in the NSC.
4. Every hardware input and output point, hosted within the NSC and attached I/O modules, shall be trended automatically without the requirement for manual creation, and each of these logs shall log values based upon a change of value and store at least 500 trend samples before replacing the oldest sample with new data.
5. The presentation of logged data shall be built into the server capabilities of the NSC. Presentation can be in time stamped list formats or in a chart format with fully configurable pen colors, weights, scales and time spans.
6. Tooltips shall be present, magnetic, and visible based on users preference.
7. Comments shall be visible whenever viewing the trend log list.
8. System shall give indication of memory usage and be able to alert the user if too many logs are allocated.

Z. Alarm Management:

1. For each system point, alarms can be created based on high/low limits or in comparison to other point values. All alarms shall be tested each scan of the NSC and can result in the display of one or more alarm messages or reports.
2. There is no limit to the number of alarms that can be created for any point
3. Alarms can be configured to be generated based upon a single system condition or multiple system conditions.
4. Alarms shall be generated based on an evaluation of the alarm conditions and can be presented to the user in a fully configurable order, by priority, by time, by category, etc. These configurable alarm views shall be presented to a user upon logging into the system regardless of whether the log in takes place at a WorkStation or a Webstation.
5. The alarm management system shall support the ability to create and select cause and action notes to be selected and associated with an alarm event. Checklists shall also be possible in order to present to an operator a suggested mode of troubleshooting. When acknowledging an alarm, it shall be possible to assign it to a user of the system such that the user is notified of the assignment and is made responsible for the alarm resolution.
6. Alarms must be capable of being routed to any BACnet workstation that conforms to the B-OWS device profile and uses the BACnet/IP protocol.

AA. Embedded Web Server:

1. Each NSC must have the ability to serve out web pages containing the same information that is available from the WorkStation. The development of the screens to accomplish shall not require any additional engineering labor over that required to show them at the WorkStation itself.
2. The NSC shall be configurable to logging all Embedded Web Server access attempts
3. The NSC shall have the option to redirect HTTP based Embedded Web Server connections to secure, HTTPS connections.
4. The NSC shall authenticate and authorize all users connecting to the Embedded Web Server
5. The NSC shall provide to ability to configure an automatic logoff for Embedded Web Server users that have not had any activity for an adjustable time period.

2.5 BACNET IP FIELDBUS CONTROLLERS

A. Controllers – BACnet/IP Protocol:

1. All BACnet/IP Fieldbus controllers shall be BACnet Testing Laboratory listed (v12 or later) as specified BACnet Advanced Application Controller (B-AAC)

2. All BACnet/IP Fieldbus controllers shall use the following communication specifications and achieve performance as specified herein:

    a. All controllers shall be able to communicate peer-to-peer without the need for a NSC
    b. Any BACnet/IP Fieldbus controllers on the Ethernet Data Link/Physical layer shall be able to act as a Master to allow for the exchange and sharing of data variables and messages with any other controller connected on the same communication cabling. Slave controllers are not acceptable.

B. The BACnet/IP Fieldbus controllers shall be equipped with 2x 10/100bT Ethernet communication ports with active switch and shall support BACnet/IP communication protocols with the following configurations:

1. Supporting IPv4 addressing
2. Supporting Static IP setting, DHCP client and Auto-IP address acquisition
3. It shall be possible to disable Ethernet port 2

C. Topologies:

1. BACnet/IP Fieldbus controllers shall support daisy chain topology of up to 50 controllers. In case of any disruption to the communication, a system alarm shall notify the NSC/BMS of the point disruption has occurred.
2. BACnet/IP Fieldbus Controllers shall support RSTP loop whereby up to 39 controllers are supported.

    a. In case of any disruption there shall be no communication interruption
    b. In case of any disruption there shall be system alarms that shall inform the operator of the disruption

D. Performance:

1. Each BACnet/IP Fieldbus Controllers shall have a 32-bit microprocessor operating at 500 MHz and support a BACnet protocol stack in accordance with the ANSI/ASHRAE Standard 135-2008 and the BACnet Device Profile supported.
2. They shall be multi-tasking, real-time digital control processors consisting of communication controllers, controls processing, power supplies with built-in inputs and outputs.

E. Programmability:

1. The BACnet/IP Fieldbus controllers shall support both script programming language and graphical that shall be consistent with the NSC.
2. The control program shall reside within the same enclosure as the input/output circuitry, that reads inputs and controls outputs
3. All control sequences programmed into the BACnet/IP Fieldbus Controllers shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained.
4. BACnet/IP Fieldbus controllers shall communicate with the Network Server Controller (NSC) via a BACnet/IP connection at a baud rate of not less than 100 Mbps
5. BACnet/IP Fieldbus controllers shall support a dedicated communications port for connecting and supplying power to a matching room temperature and/or humidity sensor and/or CO2 and/or presence detector that does not utilize any of the I/O points of the controller.
6. BACnet/IP Fieldbus controllers (Excluding VAV) shall support an add-on display to supply and provide access in real-time for monitoring inputs and overriding of outputs
7. The override functionality must be supported by a dedicated processor to assure reliable operation (overriding of output)
8. Each BACnet/IP Fieldbus controller shall have sufficient memory, to support its own operating system and databases, including:

    a. Control processes
    b. Energy management applications

c. Alarm management
d. Historical/trend data
e. Maintenance support applications
f. Custom processes
g. Manal override monitoring

9. Each BACnet/IP Fieldbus controller shall support local trend data up to 2x the built-in I/O and at a minimum be capable of holding 5 days @ 15 min intervals locally.
10. The BACnet/IP Fieldbus controller analog or universal input shall use a 16 bit A/D converter.
11. The BACnet/IP Fieldbus controller analog or universal output shall use a 10 bit D/A converter.
12. Built-in I/O: each BACnet/IP Fieldbus controllers shall support:

    a. At minimum 8 and up to 20 configurable IO channels to monitor and to control the following types of inputs and outputs without the addition of equipment inside or outside the DDC Controller cabinet.

        1) Universal Inputs – the following thermistors for use in the system without any external converters needed.

            a) 10 kohm Type I (Continuum)
            b) 10 kohm Type II (I/NET)
            c) 10 kohm Type III (Satchwell)
            d) 10 kohm Type IV (FD)
            e) Linearized 10 kohm Type V (FD w/11k shunt)
            f) Linearized 10 kohm (Satchwell)
            g) 1.8 kohm (Xenta)
            h) 1 kohm (Balco)
            i) 20 kohm (Honeywell)
            j) 2.2 kohm (Johnson)
            k) PT100 (Siemens)
            l) PT1000 (Sauter)
            m) Ni1000 (Danfoss)

        2) Analog inputs:

            a) Current Input - 0-20 mA
            b) Voltage Input 0-10 Vdc

        3) Digital inputs from dry contact closure, pulse accumulators, voltage sensing.
        4) Digital outputs.
        5) Analog outputs of 4-20 mA and/or 0-10 Vdc.

13. Real Time Clock (RTC):

    a. Each BACnet/IP Fieldbus controller shall include a real time clock, accurate to +/-1 minute per month. The RTC shall provide the following: time of day, day, month, year, and day of week.
    b. The RTC date and time shall also be accurate, up to 7 days, when the BACnet/IP Fieldbus controller is powerless.
    c. No batteries may be used to for the backup of the RTC.

14. The BACnet/IP Fieldbus controller for Variable Air Volume (VAV) applications.

    a. The BACnet/IP Fieldbus controller for VAV applications shall include a built-in 'flow thru' differential pressure transducer.
    b. The VAV differential pressure transducer shall have a measurement range of 0 to 1 in. W.C. and measurement accuracy of ±5% at 0.001 to 1 in. W.C. and a minimum resolution of 0.001 in. W.C., insuring primary air flow conditions shall be controlled and maintained to within ±5% of setpoint at the specified minimum and maximum air flow parameters.
    c. The BACnet/IP FieldBus controller for VAV applications shall support a dedicated commissioning tool for air flow balancing.

d. The BACnet/IP Fieldbus controller for VAV applications shall require no programing for air balancing algorithm.
e. All balancing parameters shall be synchronized in NSC.

15. Each BACnet/IP Fieldbus controller shall have a minimum of 10% spare capacity for each point type represented on the controller for future point connection.
16. Power Requirements.{BIP}{BIP}: 24VDC (21 to 33 VDC) and 24 VAC +/-20% with local transformer power.

F. Commissioning Tool - The BACnet/IP Fieldbus controller shall be supported via a dedicate mobile based commissioning tool for configuration, programming, air balancing and I/O checkout.

1. The Commissioning Tool shall be supported across: iOS, Android and Windows 10 platforms
2. The Commissioning Tool shall be available for download on App Store, Google Store and Windows Store
3. Commissioning Tool Interface to BACnet/IP Fieldbus controllers shall be via a Bluetooth adapter interface through the Intelligent Space Sensor or via a Wi-Fi access point on the LAN
4. Functionality:

a. Device Configuration – the Commissioning Tool shall be able to set or edit all Network configurations associated with the BACnet/IP Fieldbus controller
b. Programming – The Commissioning Tool shall be able to load offline engineered applications directly in to the controller directly
c. Air Balancing:

1) The Commissioning Tool shall allow the air balancer to manually control the action of the actuator including the following function: open VAV damper, close VAV damper, open all VAV dampers, and close all VAV dampers.
2) The Commissioning Tool shall be able to generate Air Balancing report

d. IO Checkout:

1) The Commissioning Tool shall be able to support overriding of the outputs and reading value of inputs live
2) The Commissioning Tool shall be able to support generation of I/O checkout report

e. There shall be no limit to the number of Commissioning Tools that can be used on a network segment, however, one connection per controller is recommended

G. Intelligent Space Sensors: Provide where indicated to be provided with the HVAC equipment. The shall have a dedicated RJ45 communication port.

1. The Intelligent Space Sensor shall communicate with the BACnet/IP Fieldbus controller through the sensor port and via category 5 or category 6 cable.
2. The Intelligent Space Sensor shall provide ambient space condition sensing without the use of hardware I/O.

H. Each Intelligent Space Sensor shall provide a color touch display with:

1. Minimum 61 mm (2.4") by 61 mm (2.4") display
2. Backlit

I. The Intelligent Space Sensor shall be capable of displaying measured space temperature from 0 to 50 °C (32 to 122 °F) with accuracy of ±0.2 °C (±0.4 °F) selectable for 0.1 or 1 degree display resolution of °F or °C.

1. Sensing Element: 10k Type 3 Thermistor
2. Accuracy of ±0.2 °C (±0.4 °F)
3. Resolution: 0.1 or 1 degree display resolution
4. Range: 0 to 50 °C (32 to 122 °F)

J. The Intelligent Space Sensor shall have the option for humidity sensor support sensing humidity from 0 % RH to 100 % RH Digital humidity indication (selectable for 0.1 or 1% RH with selectable display resolution of 0.1 or 1 % RH.

1. Accuracy: ±2 % RH
2. Resolution: 0.1 or 1 % RH
3. Range: 0 % RH to 100 % RH

K. The Intelligent Space Sensor shall have the option for support of CO2 sensor with display resolution with 0 to 2000 ppm resolution.

1. Accuracy: ±30 ppm ±2% of measured value
2. Range: 0 to 2,000 ppm
3. Operating elevation: 0 to 16,000 ft.
4. Temperature dependence: 0.11% FS per ˚F
5. Stability: <2% of FS over life of sensor (15 years)
6. Sensing method: Non-dispersive infrared (NDIR), diffusion sampling

L. The Intelligent Space Sensor shall have the option for motion sensor.

M. Display options: The Intelligent Space Sensor shall be capable of displaying the following elements:

1. Space temperature
2. Cooling space temperature set point
3. Heating space temperature set point
4. Current heating or cooling mode
5. Current occupancy mode
6. Fan speed
7. Current time

2.6 BACNET FIELDBUS AND BACNET SDCUS

A. Networking:

1. IP Network: All devices that connect to the WAN shall be capable of operating at 10 megabits per second or 100 megabits per second.
2. IP To Field Bus Routing Devices:
    a. A Network Server Controller shall be used to provide this functionality.
    b. These devices shall be configurable locally with IP crossover cable and configurable via the IP network.
    c. The routing configuration shall be such that only data packets from the field bus devices that need to travel over the IP level of the architecture are forwarded.

B. Field Bus Wiring and Termination:

1. The wiring of components shall use a bus or daisy chain concept with no tees, stubs, or free topology.
2. Each field bus shall have a termination resistor at both ends of each segment.
3. The field bus shall support the use of wireless communications.

C. Repeaters:

1. Repeaters are required to connect two segments.
2. Repeaters shall be installed in an enclosure. The enclosure may be in an interstitial space.

D. Field Bus Devices:

1. General Requirements:
    a. Devices shall have a light indicating that they are powered.

b. Devices shall be locally powered. Link powered devices (power is furnished from a central source over the field bus cable) are not acceptable.
c. Application programs shall be stored in a manner such that a loss of power does not result in a loss of the application program or configuration parameter settings. (Battery backup, flash memory, etc.)

E. Advance Application Controllers (B-AAC):

1. The key characteristics of a B-AAC are:

a. They have physical input and output circuits for the connection of analog input devices, binary input devices, pulse input devices, analog output devices, and binary output devices. The number and type of input and output devices supported will vary by model.
b. They may or may not provide support for additional input and output devices beyond the number of circuits that are provided on the basic circuit board. Support for additional I/O shall be provided by additional circuit boards that physically connect to the basic controller.
c. The application to be executed by a B-AAC is created by an application engineer using the vendor's application programming tool.
d. If local time schedules are embedded, the B-AAC shall support the editing of time schedule entries from any BACnet OWS that supports the BACnet service for writing of time schedule parameters.
e. If local trend logging is embedded, the B-AAC shall support the exporting of trend log data to any BACnet OWS that supports the read range BACnet service for trending.
f. If local alarm message initiation is embedded, the B-AAC shall:

1) Deliver alarm messages to any BACnet OWS that supports the BACnet service for receiving alarm messages and is configured to be a recipient off the alarm message.
2) Support alarm acknowledgement from any BACnet OWS that supports the BACnet service for executing alarm/event acknowledgement,

g. Shall support the reading of analog and binary data from any BACnet OWS or Building Controller that supports the BACnet service for the reading of data.
h. Shall support the control of the out of service property and assignment of value or state to analog and binary objects from any BACnet OWS that supports writing to the out of service property and the value property of analog and binary objects.
i. Shall support the receipt and response to Time Synchronization commands from a BACnet Building Controller.
j. Shall support the "Who is" and "I am." BACnet services.
k. Shall support the "Who has" and "I have." BACnet services.

2. Analog Input Circuits:

a. The resolution of the A/D chip shall not be greater than 0.01 Volts per increment. For an A/D converter that has a measurement range of 0 to 10 VDC and is 10 bit, the resolution is 10/1024 or 0.00976 Volts per increment.
b. For non-flow sensors, the control logic shall provide support for the use of a calibration offset such that the raw measured value is added to the (+/-) offset to create a calibration value to be used by the control logic and reported to the Operator Workstation (OWS).
c. For flow sensors, the control logic shall provide support for the use of an adjustable gain and an adjustable offset such that a two point calibration concept can be executed (both a low range value and a high range value are adjusted to match values determined by a calibration instrument).
d. For non-linear sensors such as thermistors and flow sensors the B-AAC shall provide software support for the linearization of the input signal.

3. Binary Input Circuits:

a. Dry contact sensors shall wire to the controller with two wires.
b. An external power supply in the sensor circuit shall not be required.

4. Pulse Input Circuits:

   a. Pulse input sensors shall wire to the controller with two wires.
   b. An external power supply in the sensor circuit shall not be required.
   c. The pulse input circuit shall be able to process up to 20 pulses per second.

5. True Analog Output Circuits:

   a. The logical commands shall be processed by a digital to analog (D/A) converter chip. The 0% to 100% control signal shall be scalable to the full output range which shall be either 0 to 10 VDC, 4 to 20 milliamps or 0 to 20 milliamps or to ranges within the full output range (Example: 0 to 100% creates 3 to 6 VDC where the full output range is 0 to 10 VDC).
   b. The resolution of the D/A chip shall not be greater than 0.04 Volts per increment or 0.08 milliamps per increment.

6. Binary Output Circuits:

   a. Single pole, single throw or single pole, double throw relays with support for up to 230 VAC and a maximum current of 2 amps.
   b. Voltage sourcing or externally powered triacs with support for up to 30 VAC and 0.5 amps at 24 VAC.

7. Program Execution:

   a. Process control loops shall operate in parallel and not in sequence unless specifically required to operate in sequence by the sequence of control.
   b. The sample rate for a process control loop shall be adjustable and shall support a minimum sample rate of 1 second.
   c. The sample rate for process variables shall be adjustable and shall support a minimum sample rate of 1 second.
   d. The sample rate for algorithm updates shall be adjustable and shall support a minimum sample rate of 1 second.
   e. The application shall have the ability to determine if a power cycle to the controller has occurred and the application programmer shall be able to use the indication of a power cycle to modify the sequence of controller immediately following a power cycle.

8. Local Interface:

   a. The controller shall support the connection of a portable interface device such as a laptop computer or vendor unique hand-held device. The ability to execute any tasks other than viewing data shall be password protected. Via this local interface, an operator shall be able to:

      1) Adjust application parameters.
      2) Execute manual control of input and output points.
      3) View dynamic data.

F. Application Specific Devices:

1. Application specific devices shall have fixed function configurable applications.
2. If the application can be altered by the vendor's application programmable tool, the device is an advanced application controller and not an application specific device.
3. Application specific devices shall be BTL certified.

2.7 DDC SENSORS AND POINT HARDWARE

A. Temperature Sensors:

1. Acceptable Manufacturers: Veris Industries.

2. All temperature devices shall use precision thermistors accurate to +/- 1 degree F over a range of –30 to 230 degrees F. Space temperature sensors shall be accurate to +/- .5 degrees F over a range of 40 to 100 degrees F.
3. Room Sensor (Not Intelligent Space Sensors): Standard space sensors shall be available in an off white enclosure made of high impact ABS plastic for mounting on a standard electrical box. Basis of Design: Veris TW Series.
    a. Where manual overrides are required, the sensor housing shall feature both an optional sliding mechanism for adjusting the space temperature setpoint, as well as a push button for selecting after hours operation.
    b. Where a local display is specified, the sensor shall incorporate an LCD display for viewing the space temperature, setpoint and other operator selectable parameters. Using built in buttons, operators shall be able to adjust setpoints directly from the sensor.
4. Duct Probe Sensor: Sensing element shall be fully encapsulated in potting material within a stainless steel probe. Useable in air handling applications where the coil or duct area is less than 14 square feet. Basis of Design: Veris TD Series
5. Duct Averaging Sensor: Averaging sensors shall be employed in ducts which are larger than 14 square feet. The averaging sensor tube shall contain at least one thermistor for every 3 feet, with a minimum tube length of 6 feet. The averaging sensor shall be constructed of rigid or flexible copper tubing. Basis of Design: Veris TA Series
6. Outside Air Sensor: Provide the sensing element on the building's north side. Sensing element shall be fully encapsulated in potting material within a stainless steel probe. Probe shall be encased in PVC solar radiation shield and mounted in a weatherproof enclosure. Operating range -40 to 122 F, Basis of Design: Veris TO Series
7. A pneumatic signal shall not be allowed for sensing temperature.

B. Humidity Wall Transmitter:

1. Acceptable Manufacturer: Veris Industries
2. Transmitters shall be accurate to +/- 2 % at full scale.
3. Transmitter shall have replaceable sensing element.
4. Sensor type shall be thin-film capacitive.
5. Sensor element shall contain multipoint calibration on-board in nonvolatile memory
6. Operating range shall be 0 - 100% RH noncondensing, 50 to 95 F
7. Output shall be field selectable 4-20 mA or 0-5/0-10 VDC.
8. Transmitter shall accept 12-30 VDC or 24 VAC supply power.
9. Transmitter shall be available in an off white enclosure made of high impact ABS plastic for mounting on a standard electrical box.
10. Transmitter shall have option of having an LCD display
11. Transmitter shall have option of being NIST certified
12. Transmitter shall have option of an integrated temperature sensor
13. Basis of Design: Veris HWL Series

C. Humidity Duct Transmitter:

1. Acceptable Manufacturer: Veris Industries.
2. Transmitters shall be accurate to +/- 2 % at full scale.
3. Transmitter shall be fully encapsulated in potting material within a stainless steel probe.
4. Transmitter shall have replaceable sensing element.
5. Sensor type shall be thin-film capacitive.
6. Sensor element shall contain multipoint calibration on-board in nonvolatile memory.
7. Operating range shall be 0 - 100% RH noncondensing, -40 to 122 F.
8. Output shall be 4-20 mA or 0-5/0-10 VDC.
9. Transmitter shall accept 12-30 VDC or 24 VAC supply power.
10. Transmitter shall have option of being NIST certified.
11. Transmitter shall have option of an integrated temperature sensor.
12. Basis of Design: Veris HD Series.

D. Humidity Outdoor Transmitter:

1. Acceptable Manufacturer: Veris Industries.
2. Transmitters shall be accurate to +/- 2% at full scale.
3. Transmitter shall be fully encapsulated in potting material within a stainless steel probe. Probe shall be encased in PVC solar radiation shield and mounted in a weatherproof enclosure.
4. Transmitter shall have replaceable sensing element.
5. Sensor type shall be thin-film capacitive.
6. Sensor element shall contain multipoint calibration on-board in nonvolatile memory.
7. Operating range shall be 0 - 100% RH noncondensing, -40 to 122 F.
8. Output shall be 4-20 mA or 0-5/0-10 VDC.
9. Transmitter shall accept 12-30 VDC or 24 VAC supply power.
10. Transmitter shall have option of being NIST certified .
11. Transmitter shall have option of an integrated temperature sensor.
12. Basis of Design: Veris HO Series.

E. Current Sensors: Current status switches shall be used to monitor fans, pumps, motors and electrical loads. Current switches shall be available in split core models, and offer either a digital or an analog signal to the automation system. Acceptable manufacturer is Veris Industries.

F. Current Status Switches for Constant Load Devices:

1. Acceptable Manufacturer: Veris Industries.
2. General: Factory programmed current sensor to detect motor undercurrent situations such as belt or coupling loss on constant loads. Sensor shall store motor current as operating parameter in non-volatile memory. Push-button to clear memory.
3. Visual LED indicator for status.
4. Split core sensor, induced powered from monitored load and isolated to 600 VAC rms. Sensor shall indicate status from 0.5 A to 175 A.
5. Normally open current sensor output. 0.1A at 30 VAC/DC.
6. Basis of Design: Veris Model H608.

G. Current Status Switches for Constant Load Devices (Auto Calibration):

1. Acceptable Manufacturer: Veris Industries.
2. General: Microprocessor based, self-learning, self-calibrating current switch. Calibration-free status for both under and overcurrent, LCD display, and slide-switch selectable trip point limits. At initial power-up automatically learns average current on the line with no action required by the installer.
3. Split core sensor, induced powered from monitored load and isolated to 600 VAC rms. Sensor shall indicate status from 2.5 A to 200 A.
4. Display: Backlit LCD; illuminates when monitored current exceeds 4.5A.
5. Nominal Trip Point: ±40%, ±60%, or on/off (user selectable).
6. Normally open current sensor output. 0.1A at 30 VAC/DC.
7. Basis of Design: Veris Model H11D.

H. Current Status Switches for Variable Frequency Drive Application:

1. Acceptable Manufacturer: Veris Industries.
2. General: Microprocessor controlled, self-learning, self-calibrating current sensor to detect motor undercurrent and overcurrent situations such as belt loss, coupling shear, and mechanical failure on variable loads. Sensor shall store motor current as operating parameter in non-volatile memory. Push-button to clear memory and relearn.
3. Visual LED indicator for status.
4. Alarm Limits: ±20% of learned current in every 5 Hz freq. band.
5. Split core sensor, induced powered from monitored load and isolated to 600 VAC rms. Sensor shall indicate status from 1.5 A to 150 A and from 12 to 115 Hz.
6. Normally open current sensor output. 0.1A at 30 VAC/DC.
7. Basis of Design: Veris Model H614.

I. Dampers:

1. Automatic dampers, furnished by the Building Automation Contractor shall be single or multiple blade as required. Dampers are to be installed by the HVAC Contractor under the supervision of the BAS Contractor. All blank-off plates and conversions necessary to install smaller than duct size dampers are the responsibility of the Sheet Metal Contractor.
2. Dampers shall be as specified in Division 23.
3. Provide opposed blade dampers for modulating applications and parallel blade for two position control.

J. Damper Actuators:

1. Direct-coupled type non-hydraulic designed for minimum 100,000 full-stroke cycles at rated torque.
2. Direct-coupled damper actuators must have a five-year warrantee.
3. Size for torque required for damper seal at maximum design conditions and valve close-off pressure for system design.
4. Overload protected electronically throughout rotation except for selected Floating actuators the have a mechanical clutch.
5. Spring Return Actuators: Mechanical fail safe shall incorporate a spring-return mechanism.
6. Non-Spring Return Actuators shall stay in the position last commended by the controller with an external manual gear release to allow positioning when not powered.
7. Power Requirements: 24Vac/dc.
8. Proportional Actuators controller input range from 0…10 Vdc, 2…10 Vdc or 4…20 mA models.
9. Housing: Minimum requirement NEMA type 2
10. Actuators with a microprocessor should not be able to be modified by an outside source (cracked or hacked).
11. Actuators of 133 and 270 lb.-in. of torque or more should be able to be tandem mount or "gang" mount.
12. Agency Listings: ISO 9001, cULus, CE and CSA
13. Basis of Design: Schneider Electric SmartX Actuators, or approved equal.

PART 3 - EXECUTION

3.1 CONTRACTOR RESPONSIBILITIES

A. General: Installation of the building automation system shall be performed by the Contractor or a subcontractor. However, all installation shall be under the personal supervision of the Contractor. The Contractor shall certify all work as proper and complete. Under no circumstances shall the design, scheduling, coordination, programming, training, and warranty requirements for the project be delegated to a subcontractor.

B. Demolition: Remove controls which do not remain as part of the building automation system, all associated abandoned wiring and conduit, and all associated pneumatic tubing. The Owner will inform the Contractor of any equipment which is to be removed that will remain the property of the Owner. All other equipment which is removed shall be disposed of by the Contractor.

C. Access to Site: Unless notified otherwise, entrance to building is restricted. No one shall be permitted to enter the building unless their names have been cleared with the Owner or the Owner's Representative.

D. Code Compliance: All wiring shall be installed in accordance with all applicable electrical codes and shall comply with equipment manufacturer's recommendations. Should any discrepancy be found between wiring specifications in Division 23 and Division 26, wiring requirements of Division 26 shall prevail for work specified in Division 23.

E. Cleanup: At the completion of the work, all equipment pertinent to this contract shall be checked and thoroughly cleaned, and all other areas shall be cleaned around equipment provided under this contract.

3.2 WIRING, CONDUIT, AND CABLE

A. All wire shall be copper and meet the minimum wire size and insulation class listed below:

Wire Class	Wire Size	Isolation Class
Power	12 Gauge	600 Volt
Class One	14 Gauge Std.	600 Volt
Class Two	18 Gauge Std.	300 Volt
Class Three	18 Gauge Std.	300 Volt
Communications	Per Mfr.	Per Mfr.

B. Power and Class One wiring may be run in the same conduit. Class Two and Three wiring and communications wiring may be run in the same conduit.

C. Where different wiring classes terminate within the same enclosure, maintain clearances and install barriers per the National Electric Code.

D. **Wiring run concealed but accessible may be installed as properly supported cable**.

E. **Where run in walls, in shafts, where exposed, above non-lay-in ceilings, or in mechanical equipment rooms, wiring shall be installed in conduit**.

F. Where wiring is required to be installed in conduit, EMT shall be used. Conduit shall be minimum 3/4 inch galvanized EMT. Fittings shall be steel insulated throat compression type. *Set screw fittings, fittings constructed of alloys of aluminium or fittings of the indenter type are prohibited.* Watertight compression fittings shall be used for exterior locations and interior locations subject to moisture. Provide conduit seal-off fitting where exterior conduits enter the building or between areas of high temperature/moisture differential.

G. Flexible metallic conduit (maximum length of 3 feet) shall be used for connections to motors, actuators, controllers, and sensors mounted on vibration producing equipment. Liquid-tight flexible conduit shall be use in exterior locations and interior locations subject to moisture.

H. Junction boxes shall be provided at all cable splices, equipment termination, and transitions from EMT to flexible conduit. Interior dry location J-boxes shall be galvanized pressed steel, nominal four-inch square with blank cover. Exterior and damp location JH-boxes shall be cast alloy FS boxes with threaded hubs and gasketed covers.

I. EMT conduit, flexible metallic conduit, and junction box covers shall be blue in color.

J. Where installed not in conduit and the space above the accessible ceiling is a supply or return air plenum, the wiring shall be plenum rated. EXCEPTION: Any wire run above suspended ceilings that is used to control outside air dampers or to connect the system to the fire management system shall be in conduit.

K. Fiber optic cable shall include the following sizes; 50/125, 62.5/125 or 100/140.

L. Only glass fiber is acceptable, no plastic.

M. Fiber optic cable shall only be installed and terminated by an experienced contractor. The BAS contractor shall submit to the Engineer the name of the intended contractor of the fiber optic cable with his submittal documents.

3.3 HARDWARE INSTALLATION PRACTICES FOR WIRING

A. All controllers are to be mounted vertically and per the manufacturer's installation documentation.

B. The 120VAC power wiring to each Ethernet or Remote Site controller shall be a dedicated run, with a separate breaker. Each run shall include a separate hot, neutral and ground wire. The ground wire shall terminate at the breaker panel ground. This circuit shall not feed any other circuit or device.

C. A true earth ground must be available in the building. Do not use a corroded or galvanized pipe, or structural steel.

D. Wires are to be attached to the building proper at regular intervals such that wiring does not droop. Wires are not to be affixed to or supported by pipes, conduit, etc.

E. Concealed accessible wiring may be installed as properly supported cable using bridal rings a minimum of 2" in diameter and located a maximum of 10'-0" on center so as to prevent excess sagging from occurring. Wire-ties or cable straps shall not be used for cable support. Provide protective sleeves at wall and floor penetrations.

F. **Conduit in finished areas** shall **be concealed in ceiling cavity spaces, plenums, furred spaces and wall construction.**

G. Conduit, in non-finished areas where possible, shall be concealed in ceiling cavity spaces, plenums, furred spaces, and wall construction. Exposed conduit shall run parallel to or at right angles to the building structure.

H. Wires are to be kept a minimum of three (3) inches from hot water, steam, or condensate piping.

I. Where sensor wires leave the conduit system, they are to be protected by a plastic insert.

J. Wire shall not be allowed to run across telephone equipment areas.

K. Provide fire caulking at all rated penetrations.

3.4 INSTALLATION PRACTICES FOR FIELD DEVICES

A. Well-mounted sensors shall include thermal conducting compound within the well to insure good heat transfer to the sensor.

B. Actuators shall be firmly mounted to give positive movement and linkage shall be adjusted to give smooth continuous movement throughout 100 percent of the stroke.

C. Relay outputs shall include transient suppression across all coils. Suppression devices shall limit transients to 150% of the rated coil voltage.

3.5 ENCLOSURES

A. For all I/O requiring field interface devices, these devices where practical shall be mounted in a field interface panel (FIP). The Contractor shall provide an enclosure which protects the device(s) from dust, moisture, conceals integral wiring and moving parts.

B. FIPs shall contain power supplies for sensors, interface relays and contactors, and safety circuits.

C. The FIP enclosure shall be of steel construction with baked enamel finish; NEMA 1 rated with a hinged door and keyed lock. The enclosure shall be sized for twenty percent spare mounting space. All locks shall be keyed identically.

D. All wiring to and from the FIP shall be to screw type terminals. Analog or communications wiring may use the FIP as a raceway without terminating. The use of wire nuts within the FIP is prohibited.

E. All outside mounted enclosures shall meet the NEMA-4 rating.

F. The wiring within all enclosures shall be run in plastic track. Wiring within controllers shall be wrapped and secured.

3.6 IDENTIFICATION

A. Identify all control wires with labeling tape or sleeves using words, letters, or numbers that can be exactly cross-referenced with as-built drawings.

B. All field enclosures, other than controllers, shall be identified with a Bakelite nameplate. The lettering shall be in white against a black or blue background.

C. Junction box covers shall be marked to indicate that they are a part of the BAS system.

D. All I/O field devices (except space sensors) that are not mounted within FIP's shall be identified with name plates.

E. All I/O field devices inside FIP's shall be labeled.

3.7 EXISTING CONTROLS (WITHIN THE PROJECT AREA).

A. Existing controls which are to be reused must each be tested and calibrated for proper operation. Existing controls which are to be reused and are found to be defective requiring replacement, shall be noted to the Owner. The Owner will be responsible for all material and labor costs associated with their repair.

3.8 CONTROL SYSTEM SWITCH-OVER

A. Demolition of the existing control system shall occur after the new temperature control system is in place including new sensors and new field interface devices.

B. Switch-over from the existing control system to the new system shall be fully coordinated with the Owner. A representative of the Owner will be on site during switch-over.

C. The Contractor shall minimize control system downtime during switch-over. Sufficient installation mechanics shall be on site so that the entire switch-over can be accomplished in a reasonable time frame.

3.9 LOCATION

A. The location of sensors is per mechanical and architectural drawings.

B. Space humidity or temperature sensors shall be mounted away from machinery generating heat, direct light and diffuser air streams.

C. Outdoor air sensors shall be mounted on the north building face directly in the outside air. Install these sensors such that the effects of heat radiated from the building or sunlight is minimized.

D. Field enclosures shall be located immediately adjacent to the controller panel(s) to which it is being interfaced.

3.10 SOFTWARE INSTALLATION

A. General: The Contractor shall provide all labor necessary to install, initialize, start-up and debug all system software as described in this section. This includes any operating system software or other third party software necessary for successful operation of the system.

3.11 DATABASE CONFIGURATION.

A. The Contractor shall provide all labor to configure those portions of the database that are required by the points list and sequence of operation.

3.12 COLOR GRAPHIC DISPLAYS.

A. Unless otherwise directed by the Owner, the Contractor shall provide color graphic displays as depicted in the mechanical drawings for each system and floor plan. For each system or floor plan, the display shall contain the associated points identified in the point list and allow for setpoint changes as required by the Owner.

B. Central Plant Equipment Graphics: Graphics shall depict equipment in a two-dimensional diagram format for central plant equipment (i.e., chillers, steam to hot water equipment, boilers, pumps, etc.) Place sensors and controlled devices associated with each piece of equipment in their appropriate locations.

C. Floor Plan Graphics: Provide a single graphic for each floor, unless the graphic shall contain more information than can reasonably be shown on a single graphic. Each heating or cooling zone within a floor plan shall have its current temperature displayed in the zone for which it applies. Owner to provide blueprints or CAD files for building floor plans where possible.

D. AHU (FCU/Split Systems/Heat Pumps/VAVs, etc.) Graphics: Provide a two-dimensional graphic to depict each piece of equipment. Do not use line drawings. Place sensors and controlled devices associated with the AHU in their appropriate locations. Provide visual warning of each point in alarm. Provide capability to change setpoints from the graphical interface.

3.13 DOCUMENTATION

A. As built software documentation shall include the following:

1. Descriptive point lists.
2. Application program listing.
3. Application programs with comments.
4. Printouts of all reports.
5. Alarm list.
6. Printouts of all graphics.
7. Commissioning and System Startup.
8. An electronic copy of all databases, configuration files, or any type of files created specifically for each system.

3.14 POINT TO POINT CHECKOUT.

A. Each I/O device (both field mounted as well as those located in FIPs) shall be inspected and verified for proper installation and functionality. A checkout sheet itemizing each device shall be filled out, dated and approved by the Project Manager for submission to the Owner or Owner's representative.

B. In case of wireless devices, the signal strength recorded during checkout shall be reported.

3.15 CONTROLLER AND WORKSTATION CHECKOUT.

A. A field checkout of all controllers and front end equipment (computers, printers, modems, etc.) shall be conducted to verify proper operation of both hardware and software. A checkout sheet itemizing each device and a description of the associated tests shall be prepared and submitted to the Owner or Owner's representative by the completion of the project.

3.16 SYSTEM ACCEPTANCE TESTING

A. All application software shall be verified and compared against the sequences of operation.

B. Control loops shall be exercised by inducing a setpoint shift of at least 10% and observing whether the system successfully returns the process variable to setpoint. Record all test results and attach to the Test Results Sheet.

C. Test each alarm in the system and validate that the system generates the appropriate alarm message, that the message appears at all prescribed destinations (workstations or printers), and that any other related actions occur as defined (i.e. graphic panels are invoked, reports are generated, etc.). Submit a Test Results Sheet to the Owner.

D. Perform an operational test of each unique graphic display and report to verify that the item exists, that the appearance and content are correct, and that any special features work as intended. Submit a Test Results Sheet to the Owner.

E. Perform an operational test of each third party interface that has been included as part of the automation system. Verify that all points are properly polled, that alarms have been configured, and that any associated graphics and reports have been completed. If the interface involves a file transfer over Ethernet, test any logic that controls the transmission of the file, and verify the content of the specified information.

END OF SECTION 230900

SECTION 260000 - ELECTRICAL, BASICS

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.

1.2 GENERAL

A. Applicable requirements of the Instructions to Bidders and General Conditions of the Contract shall be a part of the Electrical Specifications. The electrical contractor shall examine the general and special conditions before submitting a proposal.

B. The electrical work shall be performed by a licensed electrical contractor.

C. The electrical contractor shall assume total responsibility for any portion of the work provided by his subcontractors.

1.3 CODES AND STANDARDS

A. Building Codes:

1. National Fire Protection Association No. 70, National Electrical Code
2. North Carolina State Building Code, Latest Edition and Revisions (NCSBC)
3. National Electrical Safety Code (NESC)
4. National Bureau of Standards (NBS)
5. Local Codes where applicable

B. Industry Standards:

1. Underwriter's Laboratories, Inc. Standards and approved listings (UL)
2. Electrical Testing Laboratories Standards (ETL)
3. National Electrical Manufacturers Association Standards (NEMA)
4. Insulated Power Cable Engineers Association Standards (IPCEA)
5. American National Standards Institute (ANSI)
6. American Society for Testing Materials Standards (ASTM)
7. Canadian Standards Association (CSA)

1.4 SCOPE OF WORK

A. It is the intent and meaning of the drawings and specifications to call for finished work that has been tested and is ready for operation. The electrical contractor shall take this into consideration and include in his proposal allowance for contingencies that will allow him to provide minor pieces of materials and labor not specifically indicated but required for the job to operate properly. This paragraph is intended to insure a complete job will be provided without requests for minor extras.

1.5 ELECTRICAL SERVICE

A. The electrical contractor shall be totally responsible for coordination with the Utility Company and assistance to the OWNER to obtain a permanent electrical service for the structure. He shall act as coordinator between the Utility Company and the OWNER and shall supply the Utility Company with equipment characteristics, load data, etc. Any installation, connection, underground service or special

fees charged by the Utility Company for the new service shall be paid by the OWNER. Construction and testing power shall be paid for as described in the General Conditions of the project manual.

B. Electrical service to the structure shall be 277/480 volts, 3 phase, 4 wire.

C. The electrical contractor shall coordinate the electrical service, metering and metering equipment with the local utility company for arrangements, locations, connections, etc.

D. Utility transformer pads shall be installed by the electrical contractor. Coordinate equipment pad requirements with the local utility company.

E. The electrical service entrance raceways shall be installed by the electrical contractor and sized as shown on the contract drawings, or as required by the Utility Company. Service entrance conductors will be provided and installed by the Utility Company to the line side of the metering equipment. Service entrance conductors from the metering equipment to the service equipment shall be provided by the electrical contractor. Load side connections shall be made by the electrical contractor.

1.6 RECORD DRAWINGS

A. A set of drawings covering the electrical contract will be provided to the electrical contractor to mark all changes, modifications, or revisions effected during construction. These field mark-up drawings are to be turned over to the electrical designer.

B. The electrical contractor shall provide detailed photographs of switchboards and panelboards. Photographs shall clearly show equipment designations, manufacturer nameplates, breaker positions, breaker ratings, and directory descriptions.

1.7 APPROVAL OF MATERIALS

A. See project manual contract documents for pre-bid substitution requirements.

B. Construction phase: The CONTRACTOR shall submit his proposal on the specified materials and equipment, or their equivalent, provided the words "or equal" or "or approved equal" follow the named manufacturers. If the above phrases do not appear, the specified manufacturers shall be furnished without substitution. Equivalent shall be interpreted to mean an item of material or equipment, similar to that named and which is suitable for the same use and capable of performing the same functions as that named, the Architect and/or Engineer being the judge of equality.

C. Where no specific material or equipment type is mentioned, any first-class product of a reputable manufacturer may be used provided it conforms to the requirements of the specifications. These materials shall be third party listed or labeled in accordance with the General Statutes of the State (example: UL, ETL, CSA, etc.).

1.8 SHOP DRAWINGS AND SUBMITTAL DATA PROCEDURES

A. Unless directed otherwise in the Architectural Specifications, Civil Specifications, or General Provisions and/or Conditions of the Contract, the CONTRACTOR shall submit PDF files of shop drawings, certified prints, literature, and cuts to the Architect and/or Engineer for all major items of equipment and materials for review and approval. It is preferred that all electrical submittals for the project shall be submitted at one and the same time.

B. Product data cut sheets with multiple components, part numbers, etc. shall be clearly marked to identify what is proposed for this project.

C. The CONTRACTOR shall analyze all shop drawings and submittal data and certify that they meet requirements of Contract Drawings and Specifications, prior to delivery to the Architect and/or Engineer. CONTRACTOR Certification shall be in the form of suitable approval stamp placed on each shop drawing submitted for approval.

D. If the Architect and/or Engineer deems submittal data is either incomplete or incorrect, a resubmittal submittal will be required.

E. At least one set of all "approved" shop drawings, certified prints, etc., shall be maintained at the job site and available to representative of the Architect and/or Engineer.

F. Approval by the Architect and/or Engineer of shop drawings for any materials, apparatus, devices, and layouts shall not relieve the CONTRACTOR from the responsibility of furnishing same of proper dimensions, size, quantity, quality and all performance characteristics to efficiently perform the requirements and intent of the contract documents. Such approval shall not relieve the CONTRACTOR from responsibility for errors of any sort on the shop drawings. If the shop drawings deviate from the Contract Documents, the CONTRACTOR shall advise the Architect and/or Engineer of the deviations in writing, accompanying the shop drawings, including the reason for the deviations.

G. Physical sizes of equipment used in the design layout are those of reputable equipment manufacturers. The CONTRACTOR is responsible for providing equipment that will fit the space available. If the CONTRACTOR elects to use equipment that results in conflicts with space clearance or codes, it shall be the responsibility of the CONTRACTOR to correct at his expense. The CONTRACTOR shall assume responsibility for providing code clearances. Where equipment is designated for existing space, the CONTRACTOR shall make necessary field measurements to ascertain space requirements, including those for connections; and shall furnish and install such sizes and shapes of equipment that the final installation shall suit the intent and meaning of the drawings and specifications.

H. Catalog Data for OWNER:

1. The CONTRACTOR shall provide compilations of catalog data, bound in suitable loose-leaf binders, for each manufactured item of equipment used in the electrical work. These shall be presented to the Architect and/or Engineer for transmittal to the OWNER before the final inspection is made. Data shall include printed installation, operation, and maintenance instructions for each item, indexed by product with heavy sheet dividers and tabs. All warranties shall be included with each item. Each manufacturer’s name, address, and telephone number shall be clearly indicated. Generally, shop drawings and submittal data alone are not adequate for catalog data.

I. Record Documents for OWNER:

1. Conductor and cable megger test results.
2. Grounding electrode system test results.
3. Transformer tap settings and output voltages.
4. Circuit breaker trip settings.
5. Communications backbone cable:
    a. Test results.
    b. Cable schedule.
    c. Cable administration drawings.
6. Communications Horizontal Cable:
    a. Test results.
    b. Cable schedule.
    c. Cable administration drawings.
7. Fire Alarm System:

a. NFPA 72 Fire Alarm System Record of Completion.
b. System Status and Programming Report.
c. System operational matrix.
d. Digital copy of system software on USB flash drive.

8. Emergency responder radio coverage system:

a. RF Survey / Shop Drawings: Final installed measurement drawings of the building which indicate relative RF field strength for each frequency and band of interest.

1.9 DRAWINGS AND SPECIFICATIONS

A. The Electrical drawings and specifications are complementary each to the other, and what may be called for by one shall be as binding as if called for by both. The drawings are diagrammatic and indicate generally the location of outlets, devices, equipment wiring, etc and show the general arrangement of raceways, fixtures, and equipment. Drawings shall be followed as closely as actual building construction and the work of other trades will permit; however, all work shall suit the finished surroundings and/or trim.

B. It shall be understood that where the words "furnish," "provide," and/or "install" are used, it is intended that this CONTRACTOR shall purchase and install completely all material necessary and required for this particular item, system, equipment, etc.

C. Any omission from either the drawings or the specifications are unintentional, and it shall be the responsibility of the CONTRACTOR to call to the attention of the Architect and/or Engineer any pertinent omissions before submitting a proposal. Complete and working systems are required, whether every small item of material is shown and specified or not.

D. The electrical work shall conform to the requirements shown on all of the drawings. General and Structural drawings shall take precedence over Electrical Drawings. Because of small scale of the electrical drawings, it is not practical to indicate offsets, fittings and accessories that may be required. The CONTRACTOR shall investigate the structural and finish conditions affecting the work and shall arrange his work accordingly, providing such fittings and accessories as may be required to meet such conditions, without additional cost to the OWNER and as directed by the Architect and/or Engineer.

E. Load circuits shall be installed as indicated on the drawings. Circuit number revisions will not be accepted unless approved in writing by the Engineer.

1.10 COORDINATION OF WORK

A. It is understood and agreed that by submitting a bid, the CONTRACTOR has, by careful examination, satisfied himself as to the nature and location of the work, the conformation of the ground, the character, quality and quantity of the materials to be encountered, the general and local conditions and all other matters which can and may affect the work under this contract. The CONTRACTOR shall be held responsible for visiting the site and thoroughly familiarizing himself with the existing conditions and also any contractual requirements as may be set forth in the other divisions of these specifications. No extras will be considered because of additional work necessitated by obvious job conditions that are not indicated on the drawings.

B. The CONTRACTOR shall compare the electrical drawings and specifications with the drawings and specifications for other trades and shall report any discrepancies between them to the Architect and/or Engineer and obtain from him written instructions for changes necessary in the electrical work. The electrical work shall be installed in cooperation with other trades installing interrelated work. Before installation, the CONTRACTOR shall make proper provisions to avoid interferences in a manner

approved by the Architect and/or Engineer. All changes required in the work of the CONTRACTOR caused by his neglect to do so shall be made by him at his expense.

C. Location of electrical raceways, switches, panels, equipment, fixtures, etc., shall be adjusted to accommodate the work to interferences anticipated and encountered. The CONTRACTOR shall determine the exact route and location of each electrical raceway prior to make up and assembly.

D. Right-of-Way: Lines which pitch shall have the right-of-way over those which do not pitch. For example, steam, condensate and plumbing drains shall normally have right of way. Lines whose elevations cannot be changed shall have the right of way over lines whose elevations can be changed.

E. Offsets and changes in direction of electrical raceways shall be made as required to maintain proper headroom and to clear pitched lines whether or not indicated on the drawings. The CONTRACTOR shall furnish and install elbows, pull boxes, etc., as required to affect these offsets, transitions, and changes in directions. Conflicts between electrical raceways, fixtures, etc., and ductwork which cannot be resolved otherwise, will be resolved by the Architect and/or Engineer.

F. The CONTRACTOR shall install all electrical work to permit removal (without damage to other parts) of any equipment requiring periodic replacement or maintenance. The CONTRACTOR shall arrange electrical raceways and equipment to permit ready access to valves, cocks, traps, starters, motors, control components, etc., and to clear the opening of swinging and overhead doors and of access panels.

G. Work at Existing Facilities:

1. Where work may be required to be performed at existing and/or occupied facilities, such work shall be scheduled and arranged to be done at the convenience of the OWNER so as not to interfere with, disrupt, or disturb normal operations at the facilities. The CONTRACTOR shall obtain written approval from the OWNER before proceeding with work at existing facilities and shall work at existing facilities on schedule as agreed upon with the OWNER. This is not to be necessarily construed to mean that the CONTRACTOR is expected to perform work at existing facilities on holidays, weekends, etc., but that the Contractor must schedule work with the OWNER for the OWNER's beneficial and normal usage of the facilities, and that the CONTRACTOR will be required to maintain the schedule as approved by the OWNER.
2. The CONTRACTOR shall, at all times, provide safety barriers, protective devices, screening, dust barriers, etc., as required to maintain the safety and comfort of the building's personnel and/or occupants in or near his work area.
3. The CONTRACTOR shall be responsible for cleanup in connection with his work at existing facilities. At the end of each working day, all debris, boxes, waste, etc. shall be removed from the facilities and properly disposed of. Equipment, materials, etc. may be left inside the facilities, but such must be properly stored, stacked, and located as approved by the OWNER.
4. The CONTRACTOR shall do all cutting, patching, finishing, repairing, painting, etc., necessary for electrical work to be installed at existing facilities. All finishes shall be left to equal finish and condition prior to cutting. No cutting of structural members will be allowed. All cutting of walls, floors, roofs, etc. shall be repaired and/or replaced to equal finish prior to cutting. The CONTRACTOR shall route conduits and locate equipment as approved by the OWNER and Architect and/or Engineer. Routing and locations shall be firmly established and approved before proceeding with any phase of the work.
5. The CONTRACTOR shall be responsible for any and all damage to the existing facilities, grounds, walkways, paving, etc. caused by the work, the CONTRACTOR and/or his personnel, and/or his equipment in the accomplishment of this work. Such damages shall be repaired and/or replaced by the CONTRACTOR at no additional cost to the OWNER, to equal finish prior to damage. The ARCHITECT AND/OR ENGINEER shall be the judge as to equal finishes, etc.
6. Certain power requirements must be met without interruption during certain times on the existing electrical system. It is anticipated that partial power outages will be necessary to accomplish the work covered by these drawings and specifications. The CONTRACTOR shall determine in

advance the dates, times and duration of these outages and shall obtain permission from the OWNER to shut down the electric power. Unauthorized power outages will not be tolerated.

7. Heating, Ventilating and Air Conditioning Equipment:

    a. The electrical contractor shall provide a source of power for all mechanical equipment. "Source" shall include conductors, raceways, circuit breakers, junction boxes, panelboards and/or wiring troughs as required by conditions and codes and/or as shown on the contract drawings.
    b. In general, individual disconnecting means and circuitry for each mechanical equipment unit will be furnished and installed by the electrical contractor. Line side and load side connections at the disconnect shall be made by the electrical contractor. Load side wiring from the disconnect shall be installed by the EC, and equipment connections shall be made by the subMechanical Contractor.

8. Plumbing Equipment:

    a. Electric Water Coolers: As indicated on the drawings, the electrical contractor. shall provide either a grounding type 120V, GFCI receptacle for power supply at each electric water cooler, or the branch breaker supplying a grounding type 120V receptacle shall be GFCI type. The electrical contractor shall consult the Plumbing Contractor to determine the exact outlet location required before roughing in. All outlets and cords shall be concealed within the cabinet.
    b. Water Heaters: The electrical contractor shall provide a disconnect adjacent to the water heater as a source of power. Circuitry from the disconnect to the water heater shall be provided by the electrical contractor. Final connections shall be provided by the contractor providing the equipment.
    c. Hot Water Circulating Pump: See drawing detail. The plumbing contractor will provide an "Aquastat". The remainder of devices and equipment shall be provided by the electrical contractor.

H. Equipment and Materials (General):

1. Materials shall be new and shall bear the manufacturer's name, trade name, and listing label in every case where a standard has been established for the particular material. The equipment to be furnished under this specification shall be essentially the standard product of manufacturers regularly engaged in the production of the required type of equipment and shall be the manufacturer's latest approved design.
2. Electrical motors shall meet the minimum efficiency requirements of applicable tables in the North Carolina Energy Conservation Code.
3. Delivery and Storage:

    a. Store products to allow for inspection and measurement of quantity or counting of units.
    b. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.

        1) Electrical equipment shall be delivered to the site and stored in original containers. Store inside dry, heated spaces, but readily accessible for inspection by the ARCHITECT AND/OR ENGINEER until installed.
        2) Rusty and/or corroded materials and equipment will be replaced at the direction of the Architect and/or Engineer.

    c. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
    d. Protect stored products from damage.

4. Equipment and materials of the same general type shall be of the same make throughout the work to provide uniform appearance, operation and maintenance.
5. At the completion of the work; fixtures, equipment, and materials shall be cleaned and polished thoroughly and turned over to the OWNER in a condition satisfactory to the Architect and/or

Engineer. Damage or defects, developing before acceptance of the work shall be corrected at the CONTRACTOR's expense.

6. Manufacturer's directions shall be followed completely in the delivery, storage, protection, and installation of all equipment and materials. The CONTRACTOR shall promptly notify the Architect and/or Engineer, in writing, of any conflicts between any requirements of the Contract Documents and the manufacturer's directions and shall obtain the Architect and/or Engineer's written instructions before proceeding with the work. Should the CONTRACTOR perform any work that does not comply with the manufacturer's instructions, recommendations, or requirements; it shall be corrected at the direction of the Architect and/or Engineer at no additional cost to the Owner.

I. Sleeves, Inserts, Openings, Etc.: Anchor bolts, sleeves, inserts, supports, etc., that may be required for electrical work shall be furnished, located, and installed by the electrical contractor. Where working under a subcontract for a General Contractor, the electrical contractor shall give sufficient information (marked and located) to the General Contractor in time for proper placement in the construction schedule. Should the electrical contractor delay or fail to provide sufficient information in time, the electrical contractor shall cut and patch construction as necessary and required to install electrical work, with finishes completed to the satisfaction of the Owner, and Architect and/or Engineer.

J. Cutting and Patching: The electrical contractor shall do all rough cutting and patching as required for the proper installation of work under this contract. Cutting shall be kept to a minimum, and finishes shall be restored to the satisfaction of the Owner, and Architect and/or Engineer.

K. Locations and Measurements: Outlets, equipment, and appliances are shown and located on the drawings as accurately as possible. All measurements shall be verified on the project and coordinated with the drawings of other disciplines. In all cases, the work shall suit the surrounding trim and/or decoration and construction. The locations of outlets for special appliances shall be installed so that when extended, they are flush with the finished wall, floor, or ceiling and permit the proper installation of fixtures, devices, equipment, appliances, etc. Heights of all outlets shown on the drawings are approximate only. Slight relocations of outlets, devices, and equipment shall be made by the electrical contractor as required or as directed by the Architect and/or Engineer at no additional cost to the OWNER.

L. Workmanship: Work shall be executed as required by the specifications and the accompanying drawings and shall be done in a workmanlike manner by skilled mechanics, and shall present a neat, trim, and mechanical appearance when completed. All work shall be performed as required by the progress of the job.

M. Final Inspections and Equipment Demonstrations:

1. The CONTRACTOR shall acquire permits for construction & coordinate all required inspections with the office of the local electrical inspector and/or local authority having jurisdiction, if required. The CONTRACTOR shall provide the Owner two (2) copies of Electrical Inspectors' written reports.
2. The CONTRACTOR shall furnish ladders, required tools, and men to open fixtures, boxes, panels, or any other equipment to enable the Architect and/or Engineer representatives to see into any parts of the installation he may request.
3. The CONTRACTOR shall furnish meters for observation of readings as directed by the Architect and/or Engineer representative. Meters to be furnished include: clamp-on type ammeter, voltmeter, megger, and clamp-on type ground resistance tester.

N. Operating Instructions:

1. At the completion of the entire installation, the CONTRACTOR shall arrange to operate each component of systems and then systems as a whole. When all the requirements of the plans and specifications have been met, the CONTRACTOR shall then arrange to instruct the OWNER's

operating and maintenance personnel in the correct and proper procedures for the operation and maintenance of the systems

END OF SECTION 260000

SECTION 260500 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Supporting devices for electrical components.
2. Cutting and patching for electrical construction.
3. Touchup painting.
4. Firestopping

1.3 SUBMITTALS

A. Product Data:

1. For materials to firestop cable and raceway penetrations of fire-rated floor and wall assemblies.

B. Shop Drawings: UL details for firestopping cable and raceway penetrations of fire-rated floor and wall assemblies.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 ELECTRICAL EQUIPMENT

A. Provide new electrical equipment with minimum 75 degrees C terminations.

2.2 SUPPORTING DEVICES

A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.

B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.

C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch diameter slotted holes at a maximum of 2 inches o.c., in webs.

1. Channel Thickness: Selected to suit structural loading.

2. Fittings and Accessories: Products of the same manufacturer as channel supports.

D. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.

E. Expansion Anchors:

1. Inside: Carbon-steel wedge or sleeve type.
2. Outside: Hot-dip galvanized steel wedge or sleeve type.

F. Toggle Bolts:

1. Inside: All steel springhead type.
2. Outside: Hot-dip galvanized steel springhead type.

2.3 TOUCHUP PAINT

A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.

B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

2.4 FIRESTOPPING

A. Penetration Firestopping Systems: Systems that resist spread of fire, 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.

PART 3 - EXECUTION

3.1 COORDINATION

A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange during progress of construction to facilitate the electrical installations that follow.

1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.

C. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces.

3.2 ELECTRICAL EQUIPMENT INSTALLATION

A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.

B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

D. Right of Way: Give to raceways and piping systems installed at a required slope.

3.3 ELECTRICAL SUPPORTING DEVICE APPLICATION

A. Selection of Supports: Comply with manufacturer's written instructions.

B. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb design load.

3.4 SUPPORT INSTALLATION

A. Install support devices to securely and permanently fasten and support electrical components.

B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.

C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.

D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.

E. Support individual horizontal raceways with separate pipe hangers or clamps.

F. Install 1/4-inch-diameter or larger threaded hanger rods, unless otherwise indicated.

G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of hangers for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.

H. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches from the box.

I. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.

J. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.

K. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:

1. Wood: Fasten with wood screws or screw-type nails.
2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
3. New Concrete: Concrete inserts with machine screws and bolts.
4. Existing Concrete: Expansion bolts.

5. Steel: Spring-tension clamps on steel.
6. Light Steel: Sheet-metal screws.
7. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

3.5 FIRESTOPPING

A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly.

3.6 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.

B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.7 FIELD QUALITY CONTROL

A. Inspect installed components for damage and faulty work.

3.8 REFINISHING AND TOUCHUP PAINTING

A. Refinish and touch up paint.

1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.9 CLEANING AND PROTECTION

A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.

B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION 260500

SECTION 260519 - CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.3 SUBMITTALS

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

B. Field Quality-Control Test Reports: From Contractor.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 POWER CONDUCTORS AND CABLES

A. Manufacturers:

1. Cerro Wire LLC.
2. Colonial Wire and Cable.
3. Encore Wire Corporation.
4. General Cable Corporation.
5. Okonite.
6. Prysmian Group.
7. Republic Wire, Inc.
8. Southwire.
9. Or approved equal.

B. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.

C. Conductor Material:

1. Copper complying with NEMA WC70 / ICEA S-95-658 solid conductor for No. 10 AWG and smaller, stranded for No. 8 AWG and larger.
2. Power and lighting circuitry: Minimum conductor size shall be #12, and maximum conductor size shall be #500 kcmil.

D. Conductor Insulation Types: Type THHN/THWN-2 complying with NEMA WC70 / ICEA S-95-658.

E. Metal-Clad Cable, Type MC:

1. Description: A factory assembly of current-carrying insulated copper conductors in an overall metallic sheath.
2. Comply with NEMA WC 70 / ICEA S-95-658 for metal-clad cable, Type MC with ground wire.
3. Power-Limited Fire-Alarm Circuits: Comply with UL 1424

2.3 CONTROL CONDUCTORS AND CABLE

A. Discrete control conductors: Copper, stranded, type THHN/THWN-2.

1. Manufacturers:

a. Cerro Wire LLC.
b. Colonial Wire and Cable.
c. Encore Wire Corporation.
d. General Cable Corporation.
e. Okonite.
f. Prysmian Group.
g. Republic Wire, Inc.
h. Southwire.
i. Or approved equal.

2.4 CONNECTORS AND SPLICES

A. Manufacturers:

1. AFC Cable Systems.
2. AMP Incorporated/Tyco International.
3. FCI.
4. Greaves Polaris.
5. Hubbell/Anderson.
6. ILSCO.
7. NSI.
8. O-Z/Gedney; EGS Electrical Group LLC.
9. Penn Union.
10. 3M Company; Electrical Products Division.
11. Or approved equal.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

1. For conductors #8 and smaller, use wirenut type twist connectors.
2. For conductors #6 and larger, use pre-insulated solderless connectors with one spare port(s) for future cable connection.

PART 3 - EXECUTION

3.1 CONDUCTOR AND INSULATION APPLICATIONS

A. Service Entrance, Feeders: Type THHN/THWN-2, single conductors in raceway.

B. Branch Circuits:

1. Concealed in Accessible Ceilings:

a. Homeruns: Type THHN/THWN-2, single conductors in raceway.

2. Other than homeruns: Type THHN/THWN-2, single conductors in raceway or metal-clad cable, Type MC.
3. Concealed in Walls and Partitions:

a. Homeruns: Type THHN/THWN-2, single conductors in raceway
b. Other than homeruns: Type THHN/THWN-2, single conductors in raceway or metal-clad cable, Type MC.

4. Exposed: Type THHN/THWN-2, single conductors in raceway.
5. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

C. Discrete Control Circuits: Type THHN/THWN-2, in raceway.

D. Class 1 Control Circuits: Type THHN/THWN-2, in raceway.

3.2 INSTALLATION

A. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

B. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables, conductors, or raceway.

C. Identify and color-code conductors and cables according to Section 260553 "Electrical Identification."

D. Shared neutral conductors shall not be used unless specifically indicated so on homerun circuitry designations on the drawings.

3.3 CONNECTIONS

A. Connect outlet and component connections to wiring systems and to ground. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.4 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:

1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements.
2. Inspect for physical damage; test conductors and cable for continuity and shorts.
3. Megger testing for building wire and cable:

   a. All current carrying phase conductors and neutrals shall be tested as installed, and before connections are made, for insulation resistance and accidental grounds. This shall be done with a 500 volt megger. Megger testers shall not be electronic type. Megger testers shall be hand crank or power driven crank type. Minimum readings between conductors and between conductor and the grounded metal raceway shall be: 25 mega-ohms for #6 wire and smaller; 50 mega-ohms for #4 wire or larger.
   b. The CONTRACTOR shall correct malfunctioning conductors and cables, including replacement if necessary, and retest to demonstrate compliance.
   c. Certify compliance with test parameters.

4. Control / Signal Transmission Media Tests:

   a. Test cable segments for faulty connectors, splices, terminations, and the integrity of the cable and its component parts.
   b. Correct malfunctioning conductors and cables at Project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

B. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
4. Provide tabulated megger readings for each panel circuit.

C. Witness Tests:

1. The CONTRACTOR shall furnish a megger and show A/E representative and/or Owner that the conductors and panels comply with the above requirements.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Ground rods.
2. Connection / test / inspection wells.

B. Field Test Reports: Submit written test reports to include the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with UL 467.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Grounding Conductors, Cables, Connectors, and Rods:

a. Chance/Hubbell.
b. Copperweld.
c. Erico Inc.; Electrical Products Group.
d. Framatome Connectors/Burndy Electrical.
e. Galvan Industries.
f. Harger.
g. Heary Brothers Lightning Protection Co.
h. Ideal Industries.
i. ILSCO.

j. Kearney/Cooper Power Systems.
k. Lyncole XIT Grounding.
l. O-Z/Gedney Co.
m. Raco, Inc.
n. Salisbury: W. H. Salisbury & Co.
o. Southern Grounding / South Atlantic LLC.
p. Thomas & Betts.
q. Thompson Lightning Protection.
r. Or approved equal.

2. Connection Test / Inspection Wells:

a. ALT Fabrication.
b. Charles Industries.
c. Harger Lightning Protection, Inc.
d. Heary Brothers Lightning Protection Co.
e. Quazite / Strongewell.
f. PVC piping manufacturers.
g. Or approved equal.

2.2 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Section 260519 "Conductors and Cables."

B. Grounding Electrode Conductors: Stranded cable.

C. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.

D. Bare Copper Conductors: Comply with the following:

1. Solid Conductors: ASTM B 3.
2. Assembly of Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.

E. Grounding Bus:

1. Bare, annealed copper bars of rectangular cross section
2. 1/4" thick, 4" wide, length as required
3. Stand-off insulator mounting brackets.

2.3 CONNECTOR PRODUCTS

A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.

C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

2.4 GROUNDING ELECTRODES

A. Ground Rods: Sectional type; copper-clad steel, 3/4" diameter by 120 inches in length.

B. Connection / Test / Inspection Wells: Provide handholes as specified below:

1. Cylinder, minimum dimensions of 12" diameter x 19" deep, PVC, with cover.
2. Box, minimum dimensions of 12" x 12" x 12" deep with cover, green PVC or polyethylene.

PART 3 - EXECUTION

3.1 APPLICATION

A. In raceways, use insulated equipment grounding conductors.

B. Exothermic-Welded Connections: Use for connections to ground rods and for underground connections.

C. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.

D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Use insulated spacers; space 1 inch minimum from wall and support 12 inches above finished floor, unless otherwise indicated.

E. Underground Grounding Conductors: Use tinned- copper conductor. Bury at least 24 inches below grade or bury 12 inches above duct bank when installed as part of the duct bank.

3.2 EQUIPMENT GROUNDING CONDUCTORS

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

B. Install equipment grounding conductors in all feeders and circuits.

C. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.
2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

3.3 INSTALLATION

A. Ground Rods: For service entrance, install a minimum of two rods spaced at least twenty feet from each other and located at least the same distance from other grounding electrodes.

1. Drive ground rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds for connections. Make connections without exposing steel or damaging copper coating.

B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

C. Building Steel: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to building steel. Connect grounding conductors to building steel by compression lug bolted to the steel.

D. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Connection shall be made within the first five feet of where the water service line enters the building. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

E. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.

3.4 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

D. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

E. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.5 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:

1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

    a. Perform tests by the fall-of-potential method according to IEEE 81; or
    b. Perform tests with a clamp-on ground tester.

3. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

a. Equipment Rated 500 kVA and Less: 10 ohms.
b. Equipment Rated 500 to 1000 kVA: 5 ohms.
c. Equipment Rated More Than 1000 kVA: 3 ohms.
d. Substations and Pad-Mounted Switching Equipment: 5 ohms.
e. Manhole Grounds: 10 ohms.

4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect and/or Engineer promptly and take corrective action to reduce ground resistance to comply with specified values. Demonstrate compliance by retesting.

END OF SECTION 260526

SECTION 260533 - RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Related Sections include the following:

1. Section 260500 "Basic Electrical Materials and Methods" for supports, anchors, and identification products.
2. Section 262726 "Wiring Devices" for devices installed in boxes and for floor-box service fittings.
3. Section 260548 "Seismic Controls for Electrical Work" for seismic restraints and bracing of raceways, boxes, enclosures, and cabinets.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. FMC: Flexible metal conduit.

C. LFMC: Liquidtight flexible metal conduit.

D. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For raceways, fittings, wireways, surface raceways, hinged-cover enclosures, and cabinets.

B. Shop Drawings: Signed and sealed by a qualified professional engineer.

1. Design Calculations: Calculate requirements for selecting seismic restraints.
2. Detail assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

C. Manufacturer Seismic Qualification Certification: Submit certification that enclosures, cabinets, accessories, and components will withstand seismic forces defined in Section 260548 "Seismic Controls for Electrical Work." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.7 FIELD CONDITIONS

A. Ground Water: Assume ground-water level is at grade level unless a lower water table is noted on Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 METAL CONDUIT AND TUBING

A. Manufacturers:

1. Alflex Inc.
2. Allied Tube and Conduit.
3. Anamet Electrical, Inc.; Anaconda Metal Hose.
4. Atkore International / Calbrite.
5. Conduit Pipe Products Company.
6. Electri-Flex Co.
7. Gibson Stainless.
8. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
9. Manhattan/CDT/Cole-Flex.
10. Maverick Tube.
11. O-Z Gedney; Unit of General Signal.
12. Patriot Industries.
13. Republic Conduit.
14. Shaw Stainless and Alloy.
15. Wheatland Tube Co.
16. Or approved equal.

B. Rigid Aluminum Conduit: Produced to ANSI C80.5; listed to UL 6A.

C. EMT and Fittings: Produced to ANSI C80.3; listed to UL 797.

1. Fittings: Plated-steel, hexagonal, compression type.

D. FMC: Listed to UL 1.

E. LFMC: Listed to UL 360.

F. Fittings: NEMA FB 1; compatible with conduit and tubing materials.

2.3 NONMETALLIC CONDUIT AND TUBING

A. Manufacturers:

1. American International.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arnco.
4. Blue Diamond Industries.
5. Cantex.
6. Certainteed.
7. Condux International.
8. ElecSYS.
9. Electri-Flex.
10. Heritage Plastics / Atkore International.
11. Lamson & Sessions; Carlon Electrical Products.
12. Manhattan/CDT/Cole-Flex.
13. Queen City Plastics.
14. RACO.
15. Southern Pipe, Inc.
16. Spiralduct, Inc./AFC Cable Systems, Inc.
17. Thomas & Betts.
18. Or approved equal.

B. RNC: Produced to NEMA TC 2; listed to UL 651.

1. Schedule 40 and Schedule 80 PVC.

C. RNC Fittings: Produced to NEMA TC 3; listed to UL 514B; match to conduit or tubing type and material.

2.4 METAL WIREWAYS

A. Listed to UL 870.

B. Manufacturers:

1. Austin.
2. B-Line.
3. Hammond/
4. Hoffman.
5. Milbank.
6. Square D.
7. Thomas & Betts.
8. Unity Manufacturing.
9. Or approved equal.

C. Material and Construction: Sheet metal sized and shaped as indicated.

1. Indoors: NEMA 1.
2. Outdoors: NEMA 3R

D. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

E. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

F. Wireway Covers:

1. Indoors: Hinged type.
2. Outdoors: Flanged-and-gasketed type.

G. Finish: Manufacturer's standard enamel finish.

2.5 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers:

1. Arlington.
2. Austin.
3. B-Line.
4. Cooper Crouse-Hinds.
5. Emerson/General Signal; Appleton Electric Company.
6. Erickson.
7. FSR.
8. Hammond.
9. Hoffman.
10. Hubbell.
11. Milbank.
12. O-Z/Gedney.
13. Peerless.
14. RACO.
15. Robroy Industries.
16. Rose + Bopla.
17. Scott Fetzer Co.; Adalet-PLM Division.
18. Spring City Electrical.
19. Strong.
20. Thomas & Betts.
21. Vynckier.
22. Walker Systems.
23. Woodhead Industries.
24. Or approved equal.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.

D. Floor Boxes: Cast metal, fully adjustable, rectangular.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

G. Metal Hinged-Cover Enclosures:

1. Interior Locations: NEMA 250, Type 1 with continuous hinged cover, concealed hinge, and flush latch. Finished inside and out with manufacturer's standard enamel.
2. Exterior Locations: NEMA 250, Type 3R galvanized steel with continuous hinged cover and 3-point latch.
3. Removable interior panel.
4. Metal barriers to separate wiring of different systems and voltages.
5. Accessory feet where required or freestanding applications.

H. Handholes and Boxes for Exterior Underground Wiring:

1. General Requirements for Handholes and Boxes:

a. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
b. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

a. Manufacturers:

1) Oldcastle Infrastructure.
2) Quazite.
3) Or preapproved equal.

b. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
c. Cover:

1) Weatherproof, secured by tamper-resistant locking devices.
2) Structural load rating consistent with enclosure and handhole location. See drawing details for additional requirements.
3) Nonskid finish.
4) Cover legend text as detailed.

d. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors:

1. Exposed: Rigid aluminum conduit.
2. Concealed: Rigid aluminum conduit.
3. Underground, Single Run: RNC.
4. Underground, Grouped: RNC.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
6. For grounding electrode conductors: RNC Schedule 80.
7. Boxes and Enclosures: NEMA 250, Type 3R.

B. Indoors:

1. Exposed, Higher than 10' AFF: EMT.

2. Exposed, Lower than 10' AFF:

    a. In Electrical Rooms: EMT.
    b. Elsewhere: Rigid aluminum conduit.

3. Concealed: EMT.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except use LFMC in damp or wet locations.
5. Damp or Wet Locations: Rigid aluminum conduit.
6. For grounding electrode conductors: RNC Schedule 80.
7. Boxes and Enclosures: NEMA 250, Type 1, except as follows:

    a. Damp or Wet Locations: NEMA 250, Type 4.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

E. Do not install aluminum conduits embedded in or in contact with earth or concrete. For direct burial or concrete encasement or penetrations, coat conduit with asphaltum or bituminous type coating.

F. EMT shall not be installed where raceway or fittings would be in direct contact with the earth, underground, in/below concrete, exposed to the elements, exposed to severe physical damage, or exposed to severe corrosive influence.

3.2 INSTALLATION

A. Keep raceways a minimum of 6 inches away from runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

B. Complete raceway installation before starting conductor installation.

C. Support raceways as specified in Section 260500 "Basic Electrical Materials and Methods."

D. Install temporary closures to prevent foreign matter from entering raceways.

E. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.

F. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.

G. Conceal raceways within finished walls, ceilings, and floors, unless otherwise indicated.

1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

H. Conduits installed on the inside face of exterior building walls shall be spaced off the wall surface a minimum of 1/4" using strut-type channel or "clamp-backs".

I. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.

1. Run parallel or banked raceways together on common supports.
2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

J. Join raceways with fittings designed and approved for that purpose and make joints tight.

K. Raceway connectors shall be insulated throat type. If uninsulated throat connectors are installed, use insulating bushings to protect conductors.

L. Expansion joints: Where raceways of any type pass a building or structure expansion joint, a standard expansion joint fitting, compatible with the type of raceway being used, shall be provided and installed. Review architectural and structural drawings for locations of expansion joints.

M. Underground Raceways: Where turning up to cabinets, equipment, poles, etc.; transition from horizontal underground PVC to rigid metal for elbows and raceway stub-ups.

N. Terminations:

1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.
3. Where using boxes with concentric, eccentric, or over-sized knockouts; provide bonding bushings and jumpers. Size bonding jumpers in accordance with NEC Table 250-122, connecting to the box with ground lugs.

O. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Label each end of pull wires with location of opposite end.

P. Telephone and Signal System Raceways, 2-Inch Trade Sizeand Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

Q. Flexible Connections:

1. Use maximum of 72 inches of flexible conduit for:
    a. Recessed lighting fixtures.
    b. Semi-recessed lighting fixtures.
    c. Other ceiling mounted devices and appliances.
2. Use maximum of 24 inches of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for all motors.
3. Use LFMC in damp or wet locations.

R. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

3.3 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Final Acceptance.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.4 CLEANING

A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

1. Exposed threads on galvanized conduits and fittings, installed outdoors, shall be coated with galvanizing paint or equivalent protective coating.

END OF SECTION 260533

SECTION 260538 - WIRE MESH CABLE TRAYS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.

1.2 SECTION INCLUDES:

A. Continuous, rigid, welded steel wire mesh cable management system.

B. Cable tray systems are defined to include, but are not limited to, straight sections, supports and accessories.

1.3 SUMMARY

A. References:

1. IEC 61537– Cable Tray Systems and Cable Ladder Systems for Cable Management.
2. NEMA VE 1-2002/CSA C22.2 No. 126.1-02 – Metal Cable Tray Systems.
3. ANSI/NFPA 70– National Electrical Code (NEC).
4. TIA 569-A– Commercial Building Standard for Telecommunications Pathways & Spaces.
5. ASTM A 510 - Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel.
6. ASTM A 123 – Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

1.4 SUBMITTALS

A. Comply with requirements of Section 013300 "Submittal Procedures."

B. Product Data: Submit manufacturer's product data sheets for cable tray indicating dimensions, materials, and finishes, including UL Classification and NEMA/CSA Certification.

C. Shop Drawings: Submit shop drawings indicating materials, finish, dimensions, accessories, layout, supports, splices, and installation details.

D. Delegated-Design Submittal: For seismic restraints.

1. Seismic-Restraint Details: Signed and sealed by a qualified professional engineer who is licensed in the state where Project is located and who is responsible for their preparation.
2. Seismic Performance: Cable trays and supports shall withstand the effects of earthquake motions. The term "withstand" means "cable trays will remain in place without separation of any parts when subjected to seismic forces.
3. Design Calculations: Calculate requirements for selecting seismic restraints.
4. Detail fabrication, including anchorages and attachments to structure and to supported cable trays.

E. Seismic Qualification Certificates: For cable trays, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain cable tray components through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70, National Electrical Code, Article 392: Cable Trays; provide UL Classification and labels.

D. Comply with IEC 61537, Cable Tray Systems and Cable Ladder Systems for Cable Management.

E. Comply with NEMA VE 1/CSA C22.2 No. 126.1, Metal Cable Tray Systems, for materials, sizes, and configurations; provide cCSAus Certificate and labels.

1.6 COORDINATION

A. Coordinate layout and installation of cable tray with other installations.

1. Revise locations and elevations from those indicated as required to suit field conditions and as approved by the Architect.
2. Storage and Handling: Avoid breakage, denting and scoring finishes. Damaged products shall not be installed. Store cable trays and accessories in original cartons and in clean dry space; protect from weather and construction traffic. Wet materials shall be unpacked and dried before storage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products by the following:

1. B-Line.
2. Cablofil, Inc.
3. Chalfant.
4. Code Electric.
5. Hoffmann.
6. MonoSystems.
7. MP Husky.
8. Thomas and Betts.

2.2 MATERIALS AND FINISHES:

A. Cable Tray Materials: Carbon steel wire, ASTM A 510, Grade 1008. Wire welded, bent, and surface treated after manufacture.

B. Cable Tray Finishes:

1. Finish for Carbon Steel Wire after welding and bending of mesh:

a. Electrodeposited Chromium-zinc Plating.

2. Hardware shall match the carbon steel wire cable tray finish.

C. Cable tray will consist of continuous, rigid, welded steel wire mesh cable management system, to allow continuous ventilation of cables and maximum dissipation of heat.

D. Provide splices, supports, and other fittings necessary for a complete, continuously grounded system.

1. Mesh: 2 x 4 inches.
2. Straight Section Lengths: 10 feet.

E. Cable Tray Size: As indicated on the drawings.

2.3 CABLE TRAY SUPPORTS AND ACCESSORIES

A. Fittings/Supports: Wire mesh cable tray fittings shall be field-fabricated from straight tray sections, in accordance with manufacturer's instructions. Supports shall include manufacturer recommended hardware. Place supports so that support span does not exceed manufacturer recommendations or code limitations.

1. Suspended-mounting; from building structure with 3/8" or 1/2" threaded rod. Tray shall be supported from both sides. Center mounted supports are not acceptable. Wall mounted supports as the sole support method are not acceptable. If a wall mounted supports are used, support of the opposite side of the cable tray shall be by suspension from the building structure.
2. Threaded rod shall be covered by smooth metal conduit to a minimum of 12" above the top of the cable tray.
3. Splices as recommended by cable tray manufacturer.
4. Accessories: As required to protect, support, and install a cable tray system. Select from the following accessories, if applicable:
    a. Divider Strips, of same material and finish as cable tray, 6 inch
    b. Cable Routing Accessories:
        1) Dropout: Bolt to tray; slotted design.
        2) Cable exit.
    c. Support Accessories:
        1) J-Bolt kit to mount tray to 19" or 23" racks.
        2) Beam Supports:
            a) Beam Clamp: To clamp threaded rod to beam.
        3) Supports for Cables: 1/2" x 15' Velcro Roll to bundle cables.
    d. Grounding Clamp to ground cable tray.
    e. Roller: Cable Pulling Kit.
    f. Seismic Bracing Kit.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of cable trays. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 COORDINATION

A. Coordinate layout and installation of cable tray with other installations.

1. Storage and Handling: Avoid breakage, denting and scoring finishes. Damaged products shall not be installed. Store cable trays and accessories in original cartons and in clean dry space; protect from weather and construction traffic. Wet materials shall be unpacked and dried before storage.
2. Revise locations and elevations from those indicated as required to suit field conditions and as approved by the Architect/Engineer/Owner.

3.3 INSTALLATION

A. Install cable tray level and plumb according to manufacturer's written instructions, coordination drawings, original design, and referenced standards.

1. Cutting: Field-fabricate changes in direction and elevation by cutting and bending cable tray.

a. Cut cable tray wires in accordance with manufacturer's instructions.
b. Cable tray wires must be cut with side-action bolt cutters with offset head to ensure integrity of protective galvanic layer.
c. Remove burrs and sharp edges from cable trays.

B. Install cable tray, so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.

C. Install cable tray, so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.

D. Fasten cable tray supports to building structure and install seismic restraints.

E. Design fasteners and supports to carry cable tray, cables, and a concentrated load of 200 lb. Comply with seismic-restraint details according to Section 260548 "Seismic Controls for Electrical Systems."

F. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.

G. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed recommended dimensions. Space connectors and set gaps according to applicable standard.

H. Seal penetrations through fire and smoke barriers.

I. Install cable trays with enough workspace to permit access for installing cables.

J. Two separate, independent cable tray systems are required for this project.

1. One system will support power MC cables for receptacle, lighting, etc. circuitry homeruns.
2. One system will support low voltage cables, including but not limited to: data, intercom, security, fire alarm.

3.4 CABLE TRAY GROUNDING

A. Ground cable trays according to NFPA 70 unless additional grounding is specified.

B. Cable trays with communications cable shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.

3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications are separated from power circuits by installation in separate cable trays.
4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
7. Check for improperly sized or installed bonding jumpers.
8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.

3.6 PROTECTION

A. Protect installed cable trays and cables.

1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.

END OF SECTION 260538

SECTION 260548 - SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Restraint channel bracings.
2. Restraint cables.
3. Seismic-restraint accessories.
4. Mechanical anchor bolts.
5. Adhesive anchor bolts.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

    a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
    b. Annotate to indicate application of each product submitted and compliance with requirements.

B. Delegated-Design Submittal: For each seismic-restraint device.

1. Include design calculations and details for selecting seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Design Calculations: Calculate static and dynamic loading caused by equipment weight, operation, and seismic and wind forces required to select seismic and wind restraints and for designing vibration isolation bases.

    a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.

3. Seismic- and Wind-Restraint Details:

    a. Design Analysis: To support selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.
    b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.

c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
d. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

C. Product Certificates: Signed by manufacturers of seismic restraints certifying that products furnished comply with requirements, including the testing requirements of the 2012 North Carolina Building Code, Section 1708.4.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.

B. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Comply with seismic restraint requirements in 2012 North Carolina Building Code, Section 1613, unless requirements in this Section are more stringent.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing seismic engineering services, including the design of seismic restraints, that are similar to those indicated for this Project.

C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis. They shall bear anchorage preapproval from OSHPD in addition to preapproval, showing maximum seismic-restraint ratings, by ICC-ES or another agency acceptable to authorities having jurisdiction. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) that support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

D. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

A. Seismic Design Category: See the project Code Summary drawing and structural drawings.

B. See the project Code Summary drawing and structural drawings for additional building construction criteria.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Wind-Restraint Loading:

1. Basic Wind Speed: Obtain value from Figure 1609, North Carolina Basic Wind Map, in the 2012 North Carolina Building Code.
2. Building Classification Category: See the project Code Summary drawing and structural drawings.

3. Minimum 10 lb/sq. ft. multiplied by maximum area of equipment component projected on vertical plane normal to wind direction and 45 degrees either side of normal.

B. Seismic-Restraint Loading:

1. Seismic Design Category: See the project Code Summary drawing and structural drawings.

2.2 RESTRAINT CHANNEL BRACINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.; a Division of Cooper Industries.
2. Hilti, Inc.
3. Mason Industries, Inc.
4. Unistrut; Atkore International.

B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end, with other matching components, and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.3 RESTRAINT CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Kinetics Noise Control, Inc.
2. Loos & Co., Inc.
3. Vibration Mountings & Controls, Inc.

B. Restraint Cables: ASTM A 603 galvanized steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.4 SEISMIC-RESTRAINT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.; a Division of Cooper Industries.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.
4. TOLCO; a brand of NIBCO INC.

B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod.

C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.

E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.5 MECHANICAL ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.; a Division of Cooper Industries.
2. Hilti, Inc.
3. Kinetics Noise Control, Inc.
4. Mason Industries, Inc.

B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Note: Expansion-type anchor bolts are not permitted by ASCE/SEI 7 for nonisolated equipment in excess of 10 hp (7.46 kW).

2.6 ADHESIVE ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hilti, Inc.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.

B. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for reinforcement and cast-in-place anchors to verify actual locations before installation.

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

3.2 COORDINATION

A. Coordinate layout and installation of seismic bracing with building structural system and architectural features, and with mechanical, fire-protection, electrical, and other building features in the vicinity.

B. Coordinate concrete bases with building structural system.

3.3 APPLICATIONS

A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where required to prevent buckling of hanger rods caused by seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.4 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork.

B. Equipment and Hanger Restraints:

1. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

E. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

F. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.5 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.6 FIELD QUALITY CONTROL

A. The Professional Engineer retained for seismic restraint calculations shall visit the job site as necessary to comply with the Special Inspections requirement of the North Carolina Building Code, Section 1707. This engineer shall provide in writing verification of compliance of the installation with the approved seismic submittal. This verification shall be submitted as a Special Inspections Report and shall bear the Engineer's professional seal. Job site inspections by other than this engineer are not acceptable.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative (if required):

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect / Engineer, before connecting anchorage device to restrained component (unless post-connection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect / Engineer's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect / Engineer.
5. Test to 90 percent of rated proof load of device.

C. Seismic controls will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.7 ADJUSTING

A. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 260548

SECTION 260553 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes electrical identification materials and devices intended to comply with NFPA 70, OSHA standards, and authorities having jurisdiction.

1.3 SUBMITTALS

A. Product Data:

1. For each electrical identification product indicated.
2. For double coated, adhesive tape product indicated.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with NFPA 70 for color-coding.

PART 2 - PRODUCTS

2.1 CABLE LABELS

A. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches.

B. Underground-Line Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape.

1. Not less than 6 inches wide by 4 mils thick.
2. Compounded for permanent direct-burial service.
3. Embedded continuous metallic strip or core.
4. Printed legend indicating type of underground line.

2.2 NAMEPLATES AND SIGNS

A. Engraved Plastic Nameplates and Signs: Engraving stock, plastic laminate, minimum 1/16" thick for signs up to 20 sq. in. and 1/8" thick for larger sizes.

B. Fasteners for Nameplates and Signs:

1. High performance, double coated tape with adhesive. Design Basis: 3M #06383, or approved equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.

C. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before applying.

E. Circuit Identification Labels on Boxes: Panel and circuit number.

1. Interior Boxes:

a. Exposed: Pressure-sensitive, self-adhesive plastic label on cover.
b. Concealed:

1) Pressure-sensitive, self-adhesive plastic label on cover; or
2) Permanent marker on cover, legible by Architect, Engineer, and Owner.

2. Exterior Boxes:

a. Engraved plastic label on cover; and
b. Pressure-sensitive, self-adhesive plastic label inside cover.

F. Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communication lines, install continuous underground-line warning tape located directly above line at 6 to 8 inches below finished grade. Where width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches overall, use a single line marker. Install line marker for underground wiring, both direct-buried cables and cables in raceway.

G. Color-Coding of Phase, Neutral, and Ground Conductors: Use the following colors for service, feeder, and branch-circuit phase conductors:

	Configuration	Phase A	Phase B	Phase C	Neutral	Ground
1.	120/208-V, 3 Ph, 4W	Black	Red	Blue	White	Green
2.	277/480-V, 3 Ph, 4W	Brown	Orange	Yellow	Gray	Green

2. For conductors #6 AWG and smaller, factory apply color the entire length of conductors.
3. For conductors #4 AWG and larger, field apply colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inchesfrom terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.
4. At each panelboard, a color code legend shall be permanently posted corresponding to the conductors and voltage in that panelboard.

H. Apply identification to conductors as follows:

1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.
2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding to identify circuits' voltage and phase.

3. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.

I. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment unless units are delivered with their own self-explanatory identification. Attached engraved labels with high performance double coated adhesive tape. Apply labels for each unit of the following categories of equipment:

1. Switchgear, switchboards, panelboards, electrical cabinets, and enclosures.
2. Access doors and panels for concealed electrical items.
3. Disconnect switches and enclosed circuit breakers.
4. Transformers.
5. Inverters.
6. Contactors.
7. Remote-controlled switches.
8. Control devices and push-button stations.
9. Fire alarm control panels, master stations, control panels, local operator consoles, and power supplies.
10. Security-monitoring master stations and control panels.
11. Telephone system equipment.
12. Public address, intercom, and paging system equipment.

J. Nameplate colors shall be: White surface with black core.

END OF SECTION 260553

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following lighting control devices:

1. Time switches.
2. Outdoor photoelectric switches
3. Switchbox-mounted occupancy and vacancy sensors.
4. Indoor occupancy and vacancy sensors.
5. Multipole contactors.

1.3 DEFINITIONS

A. PIR: Passive infrared.

1.4 SUBMITTALS

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

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

C. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS

A. Line-Voltage Surge Protection: An integral part of the devices for 120- and 277-V solid-state equipment. For devices without integral line-voltage surge protection, field-mounting surge protection shall comply with IEEE C62.41 and with UL 1449.

2.3 TIME SWITCHES

A. Manufacturers:

1. Area Lighting Research, Inc.
2. Fisher Pierce.
3. Grasslin Controls Corporation.
4. Intermatic, Inc.
5. Paragon Electric Co.
6. TORK.
7. Watt Stopper (The).

B. Digital Time Switches: Electronic, solid-state programmable units with alphanumeric display complying with UL 917.

1. Contact Configuration: DPST.
2. Contact Rating: 30-A inductive or resistive, 240-V ac.
3. Program: Single channel, 8 on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.
4. Circuitry: Allow connection of a photoelectric relay as substitute for on and off function of a program.
5. Astronomical Time: All channels.
6. Battery Backup: For schedules and time clock.

2.4 OUTDOOR PHOTOELECTRIC SWITCHES

A. Manufacturers:

1. Area Lighting Research, Inc.
2. Fisher Pierce.
3. Grasslin Controls Corporation.
4. Intermatic, Inc.
5. Paragon Electric Co.
6. TORK.
7. Touchplate Technologies, Inc.
8. Watt Stopper (The).

B. Description: Solid state, with DPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, microprocessor input, and complying with UL 773A.

1. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.
2. Time Delay: 15-second minimum, to prevent false operation.
3. Surge Protection: Metal-oxide varistor type, complying with IEEE C62.41 for Category A1 locations.
4. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the North sky exposure.

2.5 SWITCHBOX-MOUNTED OCCUPANCY AND VACANCY SENSORS

A. Manufacturers:

1. Cooper Controls.
2. Hubbell Lighting Inc.
3. Leviton Mfg. Company Inc.
4. Watt Stopper (The).

B. Description: Dual technology, ultrasonic and PIR type, with integral power-switching contacts rated for 800 W at 120-V ac and 1200 W at 277-V ac, minimum; suitable for electronic ballasts, LED drivers, or 1/6-hp motors.

1. Configurable occupancy sensing or vacancy sensing operating modes. Operation:

   a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
   b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

2. Include ground wire.

C. Single Relay Unit: Device contains one relay for controlling load circuit.

1. Design Basis: Hubbell # LHMTS1.
2. One On-Off button for manual control.

D. Dual Relay Unit: Device contains two relays for controlling independent lighting loads or circuits.

1. Design Basis: Hubbell #LHMTD2.
2. Two On-Off buttons for manual control.

E. Dimmer Unit:

1. Design Basis: Legrand / WattStopper #DW-311.
2. Dimming Control Signal: 0-10 VDC.
3. Suitable for multi-way control from up to four locations.

2.6 INDOOR OCCUPANCY AND VACANCY SENSORS

A. Manufacturers:

1. Cooper Controls.
2. Hubbell Lighting Inc.
3. Leviton Mfg. Company Inc.
4. Watt Stopper (The).

B. General Description: Wall- or ceiling-mounting, as indicated on the drawings; solid-state units with a separate relay unit.

1. Configurable occupancy sensing or vacancy sensing operating modes. Operation:

   a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
3. Relay Units: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.

   a. Where indicated for 277-V ac lighting systems, provide additional relay units where required for simultaneous control of 120-V ac exhaust fans.

4. Mounting:

   a. Sensor: Suitable for mounting in any position on a standard outlet box.
   b. Relay: Externally mounted though a 1/2-inch knockout in a standard electrical enclosure.
   c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the on function in case of sensor failure.
7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keeps lighting off when selected lighting level is present.

C. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on and off functions shall be selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch minimum movement of any portion of a human body that presents a target of at least 36 sq. in., and detect a person of average size and weight moving at least 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 2000 sq. ft.when mounted on a 96-inch- high ceiling.

D. Design Basis: Hubbell # OMNIDT2000. If room size is significantly smaller than 2000 sq. ft., evaluate the use of a unit with applicably sized reduced range.

2.7 MULTIPOLE CONTACTORS

A. Manufacturers:

1. Allen-Bradley/Rockwell Automation.
2. Cutler-Hammer; Eaton Corporation.
3. GE Industrial Systems.
4. Siemens.
5. Square D.

B. Description: Electrically operated and mechanically held, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
2. Control-Coil Voltage: Match control power source.

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve at least 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 WIRING INSTALLATION

A. Wiring Method: Comply with Section 260519 "Conductors and Cables."

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

E. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Electrical Identification."

B. Label time switches and contactors with a unique designation.

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
2. Operational Test: Verify actuation of each sensor and adjust time delays.

B. Remove and replace lighting control devices where test results indicate that they do not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 6 months from date of Final Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.

END OF SECTION 260923

SECTION 262200 - DRY-TYPE TRANSFORMERS (600 V AND LESS)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:

1. Distribution transformers.

1.3 SUBMITTALS

A. Product Data Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

B. Shop Drawings: Wiring and connection diagrams.

C. Manufacturer Seismic Qualification Certification: Submit certification that transformer assembly and components will withstand seismic forces defined in Section 260548 "Seismic Controls for Electrical Work." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
    b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Output Settings Reports: Record of tap adjustments specified in Part 3.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with IEEE C 57.12.91, "Standard Test Code for Dry-Type Distribution and Power Transformers".

C. Comply with IEEE C 57.96, "Guide for Loading Dry-Type Distribution and Power Transformers".

D. Comply with IEEE C 57.110, "Recommended Practice for Establishing Transformer Capability When Supplying Nonsinusoidal Load Currents".

E. Energy-Efficient Transformers Rated 15 kVA and Larger: Certified as meeting NEMA TP 1, Class 1 efficiency levels when tested according to NEMA TP 2.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.6 COORDINATION

A. Coordinate installation of floor supported, wall-mounting, and structure-hanging supports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton / Cutler-Hammer.
2. GE Electrical Distribution & Control.
3. Hammond Power Solutions.
4. Siemens Energy & Automation, Inc.
5. Sola/Hevi-Duty Electric.
6. Square D / Schneider.

2.2 MATERIALS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices, except for taps.

1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: Copper or aluminum.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Provide transformers that are internally braced to withstand seismic forces specified in Section 260548 "Seismic Controls for Electrical Work."

C. Cores: One leg per phase.

D. Enclosure:

1. Indoors: Ventilated, NEMA 250, Type 2.
2. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

E. Indoor Transformer Enclosure Finish: Comply with NEMA 250 for "Indoor Corrosion Protection"; Finish Color: Gray.

F. Efficiency: Meet or exceed DOE 2016 efficiency standards for distribution transformers.

G. Distribution Transformer Energy Efficiency Minimum Requirements

kVA	Single Phase Efficiency	Three Phase Efficiency
15	97.7%	97.89%
25	98.0%	-
30	-	98.23%
37.5	98.2%	-
45	-	98.40%
50	98.3%	98.60%
75	98.5%	98.60%
100	98.6%	-
112.5	-	98.74%
150	-	98.83%
167	98.7%	-
225	-	98.94%
250	98.8%	-
300	-	99.02%
333	98.9%	-
500	-	99.14%
750	-	99.23%
1000	-	99.28%

H. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise.

I. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

J. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

2.4 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls and floors for suitable mounting conditions where transformers will be installed.

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

3.2 INSTALLATION

A. Install floor-mounting transformers level.

1. Anchor transformers according to manufacturer's written instructions, seismic codes at Project, and requirements in Section 260548 "Seismic Controls for Electrical Work."

3.3 CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding."

B. Connect wiring according to Section 260519 "Conductors and Cables."

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 ADJUSTING

A. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. ptimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 5 percent.

B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

END OF SECTION 262200

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

B. RMS: Root mean square.

1.4 SUBMITTALS

A. Product Data: For each type of panelboard, overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Enclosure types and details for types other than NEMA 250, Type 1.
b. Trim types and details.
c. Bus configuration, current, and voltage ratings.
d. Short-circuit current rating of panelboards and overcurrent protective devices.
e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

C. Manufacturer Seismic Qualification Certification: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Section 260548 "Seismic Controls for Electrical Work." Include the following:

1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Panelboard Schedules: For installation in panelboards.

E. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. If Section 017823 "Operation and Maintenance Data" is included in the project manual, in addition to items there, include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device.
3. Circuit breaker trip settings.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of panelboards and are typically based on Square D products. Products of other manufacturers are acceptable if they can be installed in the space indicated.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Six spares for each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Panelboards, Overcurrent Protective Devices, and Accessories:

a. Eaton Corporation; Cutler-Hammer Products.
b. General Electric Co.; Electrical Distribution & Protection Div.
c. Siemens Energy & Automation, Inc.
d. Square D.

2.2 MANUFACTURED UNITS

A. Enclosures: Flush- and surface-mounted cabinets, as scheduled in the drawings. NEMA PB 1, Type 1.

1. Rated for environmental conditions at installed location.
2. Front Hinged Trim: Entire front trim hinged to box with full-length piano hinge, and with standard door within hinged trim cover.
3. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
4. Directory Card: With transparent protective cover, mounted in metal frame, inside panelboard door.

B. Phase Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.

C. Ground and Neutral Bars:

1. Material: Copper.
2. Equipment Ground Bar: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
3. Neutral Bar: Adequate for feeder and branch-circuit neutral conductors.

D. Conductor Connectors: Suitable for use with conductor material.

1. Main and Neutral Lugs: Mechanical type.
2. Ground Lugs and Bus Configured Terminators: Mechanical or compression type.

E. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.

F. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices. These locations will be indicated as SPACE on the panel schedules in the drawings.

G. Fabricate and test panelboards to withstand seismic forces defined in Section 260548 "Seismic Controls for Electrical Work."

2.3 PANELBOARD SHORT-CIRCUIT RATING

A. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.4 DISTRIBUTION PANELBOARDS

A. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

B. Main Overcurrent Protective Devices: Circuit breaker.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

2.5 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

B. Main Overcurrent Protective Devices: Circuit breaker, where scheduled.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

2.6 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip-unit circuit breakers shall have RMS sensing; field-replaceable rating plug; and with the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.
    d. Ground-fault pickup level, time delay, and I^2t response.

4. GFCI Circuit Breakers: Single- and two-pole configurations

    a. 5-mA trip sensitivity for personnel protection.
    b. 30-mA trip sensitivity for equipment protection.

B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.

1. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
2. Multipole units enclosed in a single housing or factory-assembled to operate as a single unit.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
4. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
5. Shunt Trip: Where required or indicated, 120-V trip coil energized from separate circuit.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Mount top of trim 74 inches above finished floor, unless otherwise indicated.

C. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.

D. Install overcurrent protective devices and controllers. Set field-adjustable circuit-breaker trip ranges.

E. Panel breaker configurations shall be installed as indicated on the panel schedules or as noted. Breaker position revisions will not be accepted unless approved in writing by the Engineer.

F. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

G. Install filler plates in unused spaces.

H. For flush mounted panelboards and unless noted otherwise, stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.

I. Install overcurrent protective devices and instrumentation.

1. Set field-adjustable switches and circuit-breaker trip ranges.
2. Prepare documentation of circuit breaker trip settings for Owner record documents.

J. Comply with mounting and anchoring requirements specified in Section 260548 "Seismic Controls for Electrical Work."

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section 260553 "Electrical Identification".

B. Create a directory to indicate installed circuit loads. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with laminated-plastic nameplate mounted as specified in Section 260553 "Electrical Identification".

3.3 CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding."

B. Connect wiring according to Section 260519 "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.
3. Neutral–ground bond testing: After all fixtures, devices and equipment are installed and all connections completed to each panel, the CONTRACTOR shall disconnect the neutral feeder conductor from the neutral bar and take a megger reading between the neutral bar and grounded enclosure. If this reading is less than 25 mega-ohms, the CONTRACTOR shall disconnect the branch circuit neutral wires from the neutral bar. The CONTRACTOR shall then test each one separately to the panel until the low reading ones are found. The CONTRACTOR shall correct troubles, re-connect, and re-test until at least 25 mega-ohms from the neutral bar to the grounded panel can be achieved with only the neutral feeder disconnected.

B. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection stated in manufacturer's installation instructions for molded-case circuit breakers. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.5 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Single and duplex receptacles and ground-fault circuit interrupter receptacles.
2. Single- and double-pole snap switches and dimmer switches.
3. Device wall plates.

1.3 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Wiring Devices:

a. Bryant Electric, Inc./Hubbell Subsidiary.
b. Eagle Electric Manufacturing Co., Inc.
c. Hubbell Incorporated; Wiring Device-Kellems.
d. Leviton Mfg. Company Inc.
e. Lutron.
f. Pass & Seymour/Legrand; Wiring Devices Div.

2.2 RECEPTACLES

A. Straight-Blade-Type Receptacles: Comply with NEMA WD 1, NEMA WD 6, DSCC W-C-596G, and UL 498.

B. Straight-Blade and Locking Receptacles:

1. Heavy-Duty grade.
2. Arranged for back and side wiring with brass screws.
3. Grounding type with hex head ground screw terminal.
4. 15-amp and 20-amp, 125-Volt and 250-Volt receptacles in damp or wet locations shall be listed weather-resistant type.
5. Receptacles shall accommodate back and side wiring and shall be grounding type with separate single or double grounding screw terminals.

C. Tamper-Resistant Convenience Receptacles, 125 V, 15 and 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.

D. GFCI Receptacles:

1. Straight blade, feed-through type, Heavy-Duty grade, with integral NEMA WD 6, Configuration 5-20R duplex receptacle.
2. Comply with UL 498 and UL 943.
3. Design units for installation in a 2-3/4-inch- deep outlet box without an adapter.

2.3 SWITCHES

A. Toggle Switches: Comply with FS W-S-896 and UL 20.

1. Heavy-Duty grade, quiet type without the use of mercury switches.
2. Arranged for back and side wiring with brass screws.
3. Grounding type with hex head ground screw terminal.
4. Types:

a. Single-pole.
b. Two-pole.
c. Three-way.
d. Four-way.
e. Pilot light: Illuminated when switch is on.
f. Key operated: Factory supplied key in lieu of switch handle.
g. Double-throw, momentary-contact, center-Off: For use as equipment control.

B. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible frequency and EMI/RFI filters.

1. Control: Continuously adjustable slider; with single-pole or three-way switching to suit connections.

C. Timer Switches, Mechanical Spring-Wound:

1. Description: Switchbox-mounted, molded know with spiral time scale, 4 hours maximum duration.
2. UL listed.
3. Ratings: 120V, 20A, 1 HP.

2.4 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Size: All plates shall be oversized / jumbo with matching vertical dimension.
2. Plate-Securing Screws: Metal with head color to match plate finish.
3. Material for Finished Spaces: 0.035-inch- thick, satin-finished stainless steel.
4. Material for Unfinished Spaces: Galvanized steel.
5. Material for Wet Locations: Cast aluminum, weatherproof, "in-use" type. Receptacle box covers shall be weatherproof whether or not a cord & plug are inserted or not.
6. Toggle Switch Serving as a Disconnect: Wallplate shall be configured with brackets on both sides of the switch to accommodate a padlock to secure the switch in the Off position.

2.5 FINISHES

A. Color:

1. Wiring Devices Connected to Normal Power System: White, unless otherwise indicated or required by NFPA 70.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install devices and assemblies level, plumb, and square with building lines.

1. Installation height shall be to center of device box.

B. Install tamper-resistant receptacles at locations as required by the NEC and/or the local authority having jurisdiction.

C. Install wall dimmers to achieve indicated rating after derating for ganging according to manufacturer's written instructions.

D. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' written instructions.

E. Arrangement of Devices: Mount flush unless noted otherwise:

1. Receptacles over counters, backsplashes, etc. shall be mounted with long dimension horizontal.
2. Otherwise, unless noted differently, mount with long dimension vertical, and with grounding terminal of receptacles on top.
3. Group adjacent switches under single, multigang wall plates.

F. Remove wall plates and protect devices and assemblies during painting.

3.2 IDENTIFICATION

A. Comply with Section 260553 "Electrical Identification."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped / thermal printing with black-filled lettering on face of plate, and durable wire markers inside outlet boxes.

3.3 CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding."

B. Connect wiring according to Section 260519 "Conductors and Cables."

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections:

1. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.
2. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.

B. Remove malfunctioning units, replace with new units, and retest as specified above.

END OF SECTION 262726

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following individually mounted, enclosed switches and circuit breakers:

1. Fusible switches.
2. Nonfusible switches.
3. Enclosures.

1.3 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

B. HD: Heavy duty.

1.4 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current rating.
4. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

B. Manufacturer Seismic Qualification Certification: Submit certification that enclosed switches and circuit breakers, accessories, and components will withstand seismic forces defined in Section 260548 "Seismic Controls for Electrical System." Include the following:

1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Retain one of first two subparagraphs below to define the term "withstand" as it applies to this Project. Definition varies with type of building and occupancy and is critical to valid certification. Second definition is used for essential facilities where equipment must operate immediately after an earthquake.
3. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
4. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
5. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
6. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control test reports including the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. If Section 017823 "Operation and Maintenance Data" is included in the project manual, in addition to items there, include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FUSIBLE AND NONFUSIBLE SWITCHES

A. Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Siemens Energy & Automation, Inc.
4. Square D/Group Schneider.

B. Fusible Switch, 1200 A and Smaller: NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and defeatable door interlocks when the operating handle is in the "ON" position. Short-circuit withstand ratings of 100kA or 200kA require Class R or Class J rejection fuse block feature.

C. Nonfusible Switch, 1200 A and Smaller: NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and defeatable door interlocks when the operating handle is in the "ON" position.

D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.

2.3 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.

1. Outdoor Locations: NEMA 250, Type 3R.
2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.

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

3.2 INSTALLATION

A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.

B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.3 Comply with mounting and anchoring requirements specified in Section 260548 "Seismic Controls for Electrical System."

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section 260553 "Electrical Identification."

B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Section 260553 "Electrical Identification."

3.5 FIELD QUALITY CONTROL

A. Prepare for acceptance testing as follows:

1. Inspect mechanical and electrical connections.
2. Verify switch type and labeling verification.
3. Verify rating of installed fuses.
4. Inspect proper installation of type, size, quantity, and arrangement of mounting or anchorage devices complying with manufacturer's certification.

B. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection stated in manufacturer's installation instructions for switches and molded-case circuit breakers. Certify compliance with test parameters.
2. Test mounting and anchorage devices according to requirements in Section 260548 "Seismic Controls for Electrical Systems."
3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.6 CLEANING

A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.

B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION 262816

SECTION 264313 - SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes UL 1449 Type 2 surge protective devices for low-voltage power.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

B. Product Certificates: Signed by manufacturers of surge protective devices, certifying that products furnished comply with the following testing and labeling requirements:

1. UL 1283 certification.
2. UL 1449 listing and classification.
3. Nationally recognized testing laboratory certification of compliance with UL 1449.

C. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Failed test results and corrective action taken to achieve requirements.

D. Maintenance Data: For surge protection devices to include in maintenance manuals.

E. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain suppression devices and accessories through one source from a single manufacturer.

B. Product Options: Drawings indicate size and dimensional requirements.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. IEEE Compliance: Comply with:

1. IEEE C62.41.1, "Guide on the Surge Environment in Low-Voltage (1000V and less) AC Power Circuits".
2. IEEE C62.41.2, "Recommended Practice on Characterization of Surges in Low-Voltage (1000V and less) AC Power Circuits".

3. IEEE C62.45, "Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000V and less) AC Power Circuits".
4. IEEE C62.72, "Guide for the Application of Surge Protective Devices for Low-Voltage (1000V and less) AC Power Circuits".
5. IEEE C62.45, "Standard Test Specifications for Surge Protective Devices for Low-Voltage (1000V and less) AC Power Circuits".

E. NEC Compliance: Comply with NEC 285, "Surge Protective Devices".

F. UL Compliance: Comply with:

1. UL 1283, "Electromagnetic Interference Filters".
2. UL 1449, "Transient Voltage Surge Suppressors": latest edition.

1.5 PROJECT CONDITIONS

A. Placing into Service: Do not energize or connect service entrance equipment and panelboards to their sources until the surge protective devices are installed and connected.

1.6 COORDINATION

A. Verify voltage rating of system to be protected by surge protective device.

B. Coordinate location of field-mounted surge suppressors to allow adequate clearances for maintenance.

1.7 WARRANTY

A. General Warranty: 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. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of surge suppressors that fail in materials or workmanship within five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Current Technology, Inc.
2. ASCO.
3. Thor Systems, Inc.

2.2 SERVICE ENTRANCE SUPPRESSORS

A. Manufacturer Series:

1. Current Technology #TG3 Series.
2. ASCO #460 Series.
3. Thor Systems #TSri Series.

B. Include the following features and accessories:

1. LED indicator lights for power and protection status.
2. Surge Rating: 100kA per mode / 200KA per phase.
3. ANSI / UL 1449 VPR:

   a. 120/208V: 800V maximum (L-N, L-G, N-G), 1200V maximum (L-L).
   b. 277/480V: 1200V maximum (L-N, L-G, N-G), 2000V maximum (L-L).

4. Enclosures: NEMA 1.
5. Surge-event operations counter.

C. Connection Means: Permanently wired.

D. Protection modes:

1. Line to Neutral.
2. Line to Ground.
3. Neutral to Ground.

2.3 PANELBOARD SUPPRESSORS

A. Manufacturer Series:

1. Current Technology #CGP Series.
2. ASCO #440 Series.
3. Thor Systems #TSni Series.

B. Include the following features and accessories:

1. LED indicator lights for power and protection status.
2. Surge Rating: 50kA per mode 100kA per mode.
3. ANSI / UL 1449 VPR:

   a. 120/208V: 800V maximum (L-N, L-G, N-G), 1200V maximum (L-L).
   b. 277/480V: 1200V maximum (L-N, L-G, N-G), 2000V maximum (L-L).

4. Enclosures: NEMA 1.
5. Surge-event operations counter.

C. Connection Means: Permanently wired.

D. Protection modes:

1. Line to Neutral.
2. Line to Ground.
3. Neutral to Ground.

2.4 ENCLOSURES

A. NEMA 250, with type matching the enclosure of panel or device being protected.

PART 3 - EXECUTION

3.1 INSTALLATION OF SURGE PROTECTIVE DEVICES

A. Install devices at service entrance on load side, with ground lead bonded to service entrance ground. Use conductors between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length.

1. Provide multipole, 60-A circuit breaker as a dedicated disconnect for the suppressor, unless otherwise indicated.

B. Install devices for panelboards with conductors between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

1. Provide multipole, 30-A circuit breaker as a dedicated disconnect for the suppressor, unless otherwise indicated.

3.2 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:

1. After installing surge protective devices, but before electrical circuitry has been energized, test for compliance with requirements.
2. Complete startup checks according to manufacturer's written instructions.

B. Repair or replace malfunctioning units. Retest after repairs or replacements are made.

END OF SECTION 264313

SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes LED luminaires, materials, finishes, supports.

B. Related Requirements:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting contactors.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries, chargers, photometric performance data.
5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
6. Proposed Substitutes: Provide photometric data of proposed substitute comparing product to luminaire that is specified, as well as adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project, IES LM-79, and IES LM-80.

1.5 INFORMATIONAL SUBMITTALS

A. Sample warranty.

B. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. LED Drivers and modules: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires and lamps shall withstand the effects of earthquake motions and be labeled vibration and shock resistant.

1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 LUMINAIRE REQUIREMENTS

A. Standards:

1. Design Lights Consortium (DLC) qualified products list or ENERGY STAR certified.
2. UL 1598, Standard for Luminaires.
3. Recessed luminaires shall comply with NEMA LE 4.
4. UL Listing: Listed for damp or wet location as applicable.
5. 2.0 kV surge protection integral to the driver.

B. CRI minimum of 80 CCT.

C. Rated lamp life of 50,000 hours minimum to L70.

D. Lamps dimmable from 100 percent to 0 percent of maximum light output.

E. Internal driver.

2.3 EMERGENCY LIGHTING UNITS

A. General: Self-contained units complying with UL 924.

1. LED lamp heads.
2. Battery: Sealed, maintenance-free, nickel-cadmium or nickel metal hydride type with minimum 10-year nominal life and special warranty. Battery sized to provide emergency illumination for not less than 90 minutes.
3. Charger: Fully automatic, solid-state type with sealed transfer relay.
4. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
5. Protective Guard: Where indicated, clear polycarbonate guard protects lamp heads or fixtures.
6. Integral Time-Delay Relay: Holds unit on for fixed interval when power is restored after an outage; time delay permits high-intensity-discharge lamps to restrike and develop adequate output.

2.4 EXIT SIGNS

A. General: Comply with UL 924; for sign colors and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: Light-emitting diodes, 70,000 hours minimum of rated lamp life.

C. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

1. Battery: Sealed, maintenance-free, nickel-cadmium or nickel metal hydride type with special warranty. Battery sized to provide emergency illumination for not less than 90 minutes.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

2.5 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place. Label shall include the following lamp characteristics:

1. "USE ONLY" and include specific lamp type.
2. Lamp diameter, shape, size, wattage, and coating.
3. CCT and CRI for all luminaires.

2.6 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.7 LUMINAIRE SUPPORT

A. Comply with requirements in Section 260500 "Basic Electrical Materials and Methods" for channel and angle iron supports.

B. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gauge.

D. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gauge.

E. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaire Support:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

F. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls or a minimum 20-gauge backing plate attached to structure.

G. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

H. Ceiling-Grid-Mounted Luminaires:

1. Fixture is to be supported at two (2) opposite ends to the steel frame of the building using the same type of wire as used to support the lay-in ceiling track.
2. Support Clips:

a. Fasten fixtures to ceiling grid main runner members with manufacturer clips.

3. Fixtures of Sizes Less Than Ceiling Grid Pattern:

   a. Install as indicated on reflected ceiling plans or center in acoustical panel.
   b. Support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
   c. Fixture is to be supported at two (2) opposite ends to the steel frame of the building using the same type of wire as used to support the lay-in ceiling track.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories; and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify normal transfer to battery power source and retransfer to normal. Perform a test on each unit after it is permanently installed and charged for a minimum of 24 hours. Battery shall be tested for 90 minutes. The battery test shall demonstrate compliance with the requirements of NEC 700.12(F). Repair and/or replace any units that fail the test, then retest.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Corroded Fixtures: During warranty period, replace fixtures that show any signs of corrosion.

END OF SECTION 265119

SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Telecommunications mounting elements.
2. Backboards.
3. Telecommunications equipment racks.
4. Telecommunications equipment.
5. Grounding.

B. Related Sections:

1. Section 271300 "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
2. Section 271500 "Communications Horizontal Cabling" for voice and data cabling associated with system panels and devices.

C. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.

D. BICSI: Building Industry Consulting Service International.

E. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).

F. LAN: Local area network.

G. RCDD: Registered Communications Distribution Designer.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Floor-mounted cabinets and cable pathways shall withstand the effects of earthquake motions determined according to ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Equipment Racks: Include workspace requirements and access for cable connections.
3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

C. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

D. Grounding: Comply with ANSI-J-STD-607-A.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install equipment frames and cable trays until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and work above ceilings is complete.

1.7 COORDINATION

A. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.

1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
2. Record agreements reached in meetings and distribute them to other participants.
3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.

B. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

PART 2 - PRODUCTS

2.1 PATHWAYS

A. General Requirements: Comply with TIA/EIA-569-A.

B. Cable Support: NRTL labeled. Cable support brackets shall be designed to prevent degradation of cable performance and pinch points that could damage cable. Cable tie slots fasten cable ties to brackets.

1. Comply with NFPA 70 and UL 2043 for fire-resistant and low-smoke-producing characteristics.
2. Support brackets with cable tie slots for fastening cable ties to brackets.
3. Lacing bars, spools, J-hooks, and D-rings.
4. Straps and other devices.

C. Cable Trays:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cable Management Solutions, Inc.
b. Cablofil Inc.
c. Cooper B-Line, Inc.
d. Cope - Tyco/Allied Tube & Conduit.
e. GS Metals Corp.

2. Cable Tray Materials: Metal, suitable for indoors and protected against corrosion by electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than 0.000472 inch thick or hot-dip galvanizing, complying with ASTM A 123/A 123M, Grade 0.55, not less than 0.002165 inch thick.

a. Basket Cable Trays: Dimensions as indicated on the drawings, and 4" deep. Wire mesh spacing shall not exceed 2 by 4 inches.
b. Ladder Cable Trays: Nominal dimensions as indicated on the drawings, and a rung spacing of 9 inches.

D. Conduit and Boxes: Comply with requirements in Section 260533 "Raceway and Boxes".

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches.

B. Backboard Paint: White, interior latex paint.

2.3 EQUIPMENT FRAMES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ADC.
2. Aim Electronics; a brand of Emerson Electric Co.
3. AMP; a Tyco International Ltd. company.
4. Cooper B-Line, Inc.
5. Hubbell Premise Wiring.
6. KRONE Incorporated.
7. Leviton Voice & Data Division.
8. Middle Atlantic Products, Inc.
9. Nordex/CDT; a subsidiary of Cable Design Technologies.

10. Ortronics, Inc.
11. Panduit Corp.
12. Siemon Co. (The).

B. General Frame Requirements:

1. Distribution Frames: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
2. Module Dimension: Width compatible with EIA 310 standard, 19-inch panel mounting.
3. Finish: Manufacturer's standard, baked-polyester powder coat.

C. Floor-Mounted Racks: Modular-type, steel or aluminum construction, 2-post style.

1. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug, and a power strip.
2. Baked-polyester powder coat finish.

D. Cable Management for Equipment Frames:

1. Metal, with integral wire retaining fingers.
2. Baked-polyester powder coat finish.
3. Vertical cable management panels shall have front and rear channels, with covers.
4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

2.4 UNINTERRUPTIBLE POWER SUPPLIES

A. Self-contained, battery backup device that provides electrical power in the event of failure or sag in the normal power system.

B. Configuration: Rack mounted.

C. Ratings:

1. 3000 VA.
2. 208V, single phase input via NEMA L6-20R plug/cord.
3. 120V, single phase outputs via NEMA 5-20R outlets.

2.5 POWER STRIPS

A. Power Strips: Comply with UL 1363.

1. Rack mounting.
2. Six, 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles.
3. LED indicator lights for power and protection status.
4. LED indicator lights for reverse polarity and open outlet ground.
5. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
6. Cord connected with 15-foot line cord.
7. Rocker-type on-off switch, illuminated when in on position.
8. Peak Single-Impulse Surge Current Rating: 26 kA per phase.
9. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all 3 modes shall be not more than 330 V.

2.6 GROUNDING

A. Comply with requirements in Section 260526 "Grounding and Bonding." for grounding conductors and connectors.

B. Telecommunications Main Bus Bar:

1. Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide with 9/32-inch holes spaced 1-1/8 inches apart.
3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

C. Comply with ANSI-J-STD-607-A.

2.7 LABELING

A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Comply with BICSI's "Telecommunications Distribution Methods Manual" for layout of communications equipment spaces.

C. Comply with BICSI's "Information Technology Systems Installation Methods Manual" for installation of equipment in communications equipment spaces.

D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

E. Coordinate layout and installation of communications equipment in tracks and in room.

F. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

G. Backboards:

1. Install from 6 inches to 8 feet, 6 inches above finished floor. If plywood is fire rated, ensure that fire-rating stamp is visible after installation.
2. Paint backboards with two coats of paint, leaving fire rating stamp visible.
3. Comply with requirements for backboard installation in BICSI's "Information Technology Systems Installation Methods Manual" and TIA-569-D.

H. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies as indicated.

3.2 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping." Comply with TIA/EIA-569-A, Annex A, "Firestopping."

B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.3 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with ANSI-J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

1. Bond individual cable tray and ladder rack sections.
2. Bond individual equipment frames.

3.4 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements in Section 260553 "Electrical Identification."

B. See Section 271500 "Communications Horizontal Cabling" for additional identification requirements. See Evaluations for discussion of TIA/EIA standard as it applies to this Section.

C. Labels shall be preprinted or computer-printed type.

END OF SECTION 271100

SECTION 271300 - COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. OM3 50-micrometer, multimode, armored interlocking tight buffer plenum rated optical fiber cabling.
2. Cable connecting hardware, patch panels, and cross-connects.
3. Cabling identification products.

1.3 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. LAN: Local area network.

C. RCDD: Registered Communications Distribution Designer.

1.4 BACKBONE CABLING DESCRIPTION

A. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.5 PERFORMANCE REQUIREMENTS

A. General Performance: Backbone cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.6 SUBMITTALS

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

B. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

C. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field testing program development by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

D. Grounding: Comply with ANSI-J-STD-607-A.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical fiber flashlight or optical loss test set.
2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.10 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

PART 2 - PRODUCTS

2.1 OPTICAL FIBER CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Berk-Tek; a Nexans company.
2. CommScope, Inc.
3. Corning Cable Systems.
4. General Cable Technologies Corporation.
5. Mohawk; a division of Belden CDT.
6. Nordex/CDT; a subsidiary of Cable Design Technologies.
7. Optical Connectivity Solutions Division; Emerson Network Power.
8. Superior Essex Inc.
9. SYSTIMAX Solutions; a CommScope Inc. brand.

10. 3M.
11. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. Description: Multimode, OM3 50-micrometer, armored, 6-strand, nonconductive, tight buffer, plenum rated optical fiber cable.

1. Indoor Cable: Comply with ICEA S-83-596 for mechanical properties.
2. Comply with TIA/EIA-568-C.3 for performance specifications.
3. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70.
4. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
5. Minimum Modal Bandwidth: 500 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

C. Jacket:

1. Jacket Color: Aqua for OM3 50-micrometer cable.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-D.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

2.2 OPTICAL FIBER CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ADC.
2. American Technology Systems Industries, Inc.
3. Berk-Tek; a Nexans company.
4. Corning Cable Systems.
5. Dynacom Corporation.
6. Hubbell Premise Wiring.
7. Molex Premise Networks; a division of Molex, Inc.
8. Nordex/CDT; a subsidiary of Cable Design Technologies.
9. Optical Connectivity Solutions Division; Emerson Network Power.
10. Siemon Co. (The).

B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.

1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

C. Patch Cords: Factory-made, dual-fiber cables in 9' lengths.

D. Cable Connecting Hardware:

1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
2. Quick-connect, simplex and duplex, Type LC connectors. Insertion loss not more than 0.75 dB.

2.3 J-HOOKS

A. Sized suitably for the cable to be supported.

B. Configured with captive spring-loaded cable retaining latch.

2.4 GROUNDING

A. Comply with requirements in Section 260526 "Grounding and Bonding" for grounding conductors and connectors.

B. Comply with ANSI-J-STD-607-A.

2.5 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.6 SOURCE QUALITY CONTROL

A. Factory test cables on reels according to TIA/EIA-568-B.1.

B. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.

C. Cable will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 WIRING METHODS

A. Wiring Method: Install cables in raceways, cable trays, or supported by j-hooks.

1. Comply with requirements for raceways and boxes specified in Section 260533 "Raceway and Boxes."

B. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.2 INSTALLATION OF PATHWAYS

A. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

B. Comply with requirements in Section 260533 "Raceway and Boxes" for installation of conduits and wireways.

C. Install manufactured conduit sweeps and long-radius elbows whenever possible.

D. Pathway Installation in Communications Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
2. Install cable trays to route cables if conduits cannot be located in these positions.
3. Secure conduits to backboard when entering room from overhead.

4. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

E. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.3 INSTALLATION OF CABLES

A. Install one (1) six strand cable between the existing campus MDF and the new building IDF.

B. Comply with NECA 1.

C. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
4. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
5. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
6. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
7. In the communications equipment room, install a 10-foot- long service loop on each end of cable.
8. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

D. Optical Fiber Cable Installation:

1. Comply with TIA/EIA-568-B.3.
2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

3.4 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A.

B. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
3. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

C. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA 606-A, for the following:

1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Visually inspect optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Optical Fiber Cable Tests:

a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
b. Link End-to-End Attenuation Tests:

1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.

C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

D. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 271300

SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pathways.
2. UTP cabling.
3. Multiuser telecommunications outlet assemblies.
4. Cable connecting hardware, patch panels.
5. Telecommunications outlet/connectors.
6. Cabling system identification products.
7. Cable management system.

B. Related Sections:

1. Section 271300 "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. EMI: Electromagnetic interference.

C. IDC: Insulation displacement connector.

D. LAN: Local area network.

E. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.

F. RCDD: Registered Communications Distribution Designer.

G. UTP: Unshielded twisted pair.

1.4 HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.

1. TIA/EIA-568-C.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
2. Bridged taps and splices shall not be installed in the horizontal cabling.

B. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet in the horizontal cross-connect.

1.5 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-C.1, when tested according to test procedures of this standard.

1.6 SUBMITTALS

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

B. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

C. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field testing program development by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

D. Grounding: Comply with ANSI-J-STD-607-A.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test each pair of UTP cable for open and short circuits.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.10 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.11 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Patch-Panel Units: One of each type.
2. Connecting Blocks: One of each type.

PART 2 - PRODUCTS

2.1 PATHWAYS

A. General Requirements: Comply with TIA/EIA-569-A.

B. Cable Support: NRTL labeled for support of Category 6A cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

1. Support brackets with cable tie slots for fastening cable ties to brackets.
2. Lacing bars, spools, J-hooks, and D-rings.
3. Straps and other devices.

C. Conduit and Boxes: Comply with requirements in Section 260533 "Raceway and Boxes"

1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.

2.2 UTP CABLE

A. Manufacturers:

1. Design Basis: Hitachi Cable America, Inc. Supra 10G-XE.
2. Subject to compliance with requirements, pre-approved equivalent to the Design Basis products by one of the following:

a. Belden CDT Inc.; Electronics Division.
b. Berk-Tek; a Nexans company.
c. CommScope, Inc.
d. Draka USA.
e. Genesis Cable Products; Honeywell International, Inc.
f. KRONE Incorporated.
g. Mohawk; a division of Belden CDT.
h. Molex Premise Networks; a division of Molex, Inc.
i. Nordex/CDT; a subsidiary of Cable Design Technologies.
j. Superior Essex Inc.
k. SYSTIMAX Solutions; a CommScope, Inc. brand.
l. 3M.
m. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. Description: 100-ohm, 4-pair UTP, covered with a blue thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
3. Comply with TIA/EIA 568-C.2 Category 6A.

4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
    a. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
    b. Communications, Riser Rated: Type CMR, complying with UL 1666.

2.3 UTP CABLE HARDWARE

A. Manufacturers:
1. Design Basis: Hitachi Cable America, Inc.
2. Subject to compliance with requirements, pre-approved equivalent to the Design Basis products by one of the following:
    a. American Technology Systems Industries, Inc.
    b. Dynacom Corporation.
    c. Hubbell Premise Wiring.
    d. KRONE Incorporated.
    e. Leviton Voice & Data Division.
    f. Molex Premise Networks; a division of Molex, Inc.
    g. Nordex/CDT; a subsidiary of Cable Design Technologies.
    h. Panduit Corp.
    i. Siemon Co. (The).
    j. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-C.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Connecting Blocks: 110-style IDC for Category 6A. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

D. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
1. Number of Jacks per Field: One for each four-pair conductor group of cables, plus spares and blank positions adequate to suit specified expansion criteria.

E. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

F. Patch Cords: Factory-made, shielded, four-pair cables lengths; terminated with eight-position modular plug at each end.
1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6A performance.
2. Patch cords shall have latch guards to protect against snagging.
3. Provide two patch cords for each cable installed.
    a. One for patch panel end in IT Room.
    b. One for outlet end.
    c. Final lengths and quantities of each length for patch cords shall be coordinated with the Owner prior to ordering.

2.4 TELECOMMUNICATIONS OUTLET/CONNECTORS

A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.

B. Workstation Outlets:

1. Two-port-connector assemblies mounted in single faceplate.
2. Four-port-connector assemblies mounted in multigang faceplate.
3. See drawings for other outlet quantities for number of ports. Mount assemblies in multigang faceplate.
4. Metal Faceplate: Stainless steel, complying with requirements in Section 262726 "Wiring Devices."
5. For use with snap-in jacks accommodating any combination of UTP cords.
    a. Flush mounting jacks.
6. Legend:
    a. Machine printed, in the field, using adhesive-tape label.
    b. Snap-in, clear-label covers and machine-printed paper inserts.

2.5 GROUNDING

A. Comply with requirements in Section 260526 "Grounding and Bonding" for grounding conductors and connectors.

B. Comply with ANSI-J-STD-607-A.

2.6 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

B. Comply with requirements in Section 260553 "Electrical Identification."

2.7 SOURCE QUALITY CONTROL

A. Factory test UTP cables on reels according to TIA/EIA-568-B.1.

B. Factory test UTP cables according to TIA/EIA-568-C.2.

C. Cable will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and attics, where unenclosed wiring method may be used. Conceal raceway except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for raceways and boxes specified in Section 260533 "Raceway and Boxes."

B. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.2 INSTALLATION OF PATHWAYS

A. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

B. Comply with requirements in Section 260533 "Raceway and Boxes" for installation of conduits and wireways.

C. Install manufactured conduit sweeps and long-radius elbows whenever possible.

D. Pathway Installation in Communications Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
2. Install cable trays to route cables if conduits cannot be located in these positions.
3. Secure conduits to backboard when entering room from overhead.
4. Extend conduits 6 inches above finished floor.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

3.3 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA-568-C.0, TIA-568-C.1, and TIA-568-C.2.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
10. In the communications equipment room, install a 10-foot- long service loop on each end of cable.
11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-C.2.
2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.

D. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway a minimum of 12 inches above ceilings by cable supports not more than 60 inches apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. Group connecting hardware for cables into separate logical fields.

F. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.

3. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.

4. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
5. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.4 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with ANSI-J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 "Electrical Identification."

B. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

C. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.

D. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 30 feet.
4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
    a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
    b. Label each unit and field within distribution racks and frames.
5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
6. Where cables are intended for something other than data or telephone outlets, additional labels shall be installed at the patch panel and outlet faceplate to clarify the cable intent. These will include, but not be limited to:
    a. CCTV.
    b. ACCESS CONTROL.
    c. PA/INTERCOM.
    d. WIRELESS ACCESS POINT.

E. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.

1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Visually inspect UTP jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-C.1.
2. Visually confirm Category 6A, marking of outlets, cover plates, outlet/connectors, and patch panels.
3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

    a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

5. UTP Performance Tests:

    a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-C.2:

        1) Wire map.
        2) Length (physical vs. electrical, and length requirements).
        3) Insertion loss.
        4) Near-end crosstalk (NEXT) loss.
        5) Power sum near-end crosstalk (PSNEXT) loss.
        6) Equal-level far-end crosstalk (ELFEXT).
        7) Power sum equal-level far-end crosstalk (PSELFEXT).
        8) Return loss.
        9) Propagation delay.
        10) Delay skew.

C. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

D. End-to-end cabling will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets.

END OF SECTION 271500

SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.

1.2 SYSTEM DESCRIPTION

A. Microprocessor controlled, intelligent reporting fire detection and alarm system.

1.3 SUMMARY

A. Section Includes:

1. Manual fire-alarm boxes.
2. System smoke detectors.
3. Heat detectors.
4. Notification appliances.
5. Remote annunciator.
6. Addressable interface device.
7. Power supplies.
8. Local operator console.
9. Audio amplifier.

1.4 DEFINITIONS

A. AHJ: Authority Having Jurisdiction.

B. AHU: Air Handler Unit.

C. IR: Infrared.

D. LED: Light-emitting diode.

E. NICET: National Institute for Certification in Engineering Technologies.

F. NRTL: Nationally Recognized Testing Laboratory.

G. UV: Ultraviolet.

1.5 PERFORMANCE REQUIREMENTS

A. Comply with applicable provisions of the North Carolina State Building Code.

B. Comply with applicable provisions of NFPA 70, National Electrical Code.

C. Comply with applicable provisions of NFPA 72, National Fire Alarm Code.

D. Equipment supplied shall be specifically listed for its intended use and shall be installed in accordance with the manufacturer's instructions.

E. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.6 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Firms shall be regularly engaged in the manufacture of fire alarm systems of the types, sizes, and electrical characteristics required for this project.
2. The system shall comply with provisions of UL safety standards pertaining to fire detection and alarm systems. Products and components shall be Listed and Labeled.
3. Fire detection and alarm systems and accessories shall be FM approved.
4. Firms shall maintain factory authorized service organization. Firms shall maintain spare parts stock.

B. Designer for Preparation of Shop Drawings and Calculations Qualifications:

1. Personnel shall be trained and certified by manufacturer for system design required for this Project.
2. Personnel shall be certified by NICET as fire-alarm Level III (minimum) technician.

C. Installer Qualifications:

1. Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
2. Supervisor of installation shall be certified by NICET as fire-alarm Level II (minimum) technician.
3. Supervisor of installation shall be certified as an authorized representative of the equipment manufacturer.
4. Minimum of 5 years of experience installing fire detection and alarm systems similar in size and scope to this project.

D. Manufacturer's Field Service Technician Qualifications:

1. Personnel shall be trained and certified by manufacturer for installation of units specifically required for this Project within the most recent 36 months.
2. Personnel shall be certified by NICET as fire-alarm Level II (minimum) technician.
3. If not trained by the manufacturer within 36 months (as noted in 1 above), but within 48 months, NICET fire alarm Level III (minimum) technician certification is required.

E. Source Limitations for Fire-Alarm System and Components:

1. Obtain fire-alarm system equipment and components from a single source.
2. For facilities with existing functional systems in place, new components shall be compatible and listed for use with, and operate as, an extension of existing system.

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.7 SUBMITTALS

A. Qualification Data: Submittals without the following qualification data shall not be accepted.

1. Designer:

a. Manufacturer training certification.
b. NICET certification

2. Installer: Submit the following qualification data for all installers/technicians that will be onsite, including all installers/technicians performing system testing and commissioning.

a. Manufacturer training certification.
b. NICET certification.
c. Authorized representative of equipment manufacturer certification.
d. Experience documentation; 5 years of similar size and scope projects.

3. Manufacturer Field Service Technician:

a. Manufacturer training certification.
b. NICET certification.

B. Product Data:

1. Manufacturer data for each type of product, equipment, device, etc. proposed.
2. For devices, include milliamp (mA) draw and listed minimum voltage required to operate for each type of device.
3. For panels and power supplies, include voltage drop allowed for the panel and power supplies.
4. For panels and power supplies, include voltage drop for individual Notification Appliance Circuits (NAC).

C. Shop Drawings: For fire-alarm system to demonstrate compliance with project drawings and specifications. Include plans, elevations, sections, details, and attachments to other work.

1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
2. Provide floor plans with:

a. Final equipment and device locations, including address of each addressable device and notification appliance.
b. Wiring diagrams with proposed conduit routing and conductors/cables in each conduit section.
c. Distances for NAC circuitry sections.

3. Provide voltage drop calculations for notification appliance circuits. Voltage drop at EOL device shall not exceed 14% of the battery voltage. Worst case voltage at each notification appliance shall be no less than the minimum listed operating voltage.
4. Provide battery calculations.

a. Fire alarm system battery calculations.
b. Voice/alarm signaling system battery calculations.

5. System Response Matrix:

a. Indicate fire alarm system's actions (outputs) required for each type of alarm, supervisory, and trouble signal.
b. Indicate emergency voice/alarm communication system response to fire alarm system’s actions.

D. Installation Instructions: Manufacturer's detailed installation instructions for Fire Alarm Control Unit, duct mounted smoke detectors, flow switches, tamper switches, supervisory switches, and similar items which require mechanical installation.

E. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

F. Field quality-control reports.

G. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
3. System Status and Programming Report.
4. Record copy of site-specific software on CD and USB flash drive (thumb drive).
5. As-built documents.
    a. Provide duplicates of the shop drawing plans, wiring diagrams, and riser diagrams showing comprehensive and clear field revisions. Include loop numbers, device addresses, terminal numbers where connected to equipment, and wire color codes.
    b. Provide a drawing with submitted battery and voltage drop calculations. Include a field for entering actual metered values during system testing.
6. Technical literature for all control equipment, devices, isolation modules, relays, power supplies, alarm/supervisory signal initiating devices, etc. Include maintenance data and parts lists. Include circuit diagrams of all control panels, modules, annunciators, communications panels, etc.
7. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
    a. Frequency of testing of installed components.
    b. Frequency of inspection of installed components.
    c. Requirements and recommendations related to results of maintenance.
    d. Manufacturer's user training manuals.
8. Manufacturer's required maintenance related to system warranty requirements.
9. Abbreviated operating instructions, framed and mounted at fire-alarm control unit.

1.8 PROJECT CONDITIONS

A. An existing Notifier NFS2-640 Fire Alarm Control Panel is in Electrical Room 129, located in Building ‘D’.

1. Perform a full test of the existing system prior to starting work. Document any equipment or components not functioning as required by code. Report all deficiencies to the Owner and Architect.
2. All new devices and equipment shall be compatible with the existing system.

3. Field verify existing device quantities, power supplies, circuitry configurations, etc. in order to gather sufficient information to provide accurate submittal information for new voltage drop and battery calculations.

B. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide 24-hour fire watch personnel:

1. Notify Architect/Engineer/Owner no fewer than two weeks in advance of proposed interruption of fire-alarm service.
2. Do not proceed with interruption of fire-alarm service without Owner's written permission.

1.9 SEQUENCING AND SCHEDULING

A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted.

1.10 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Manual Fire Alarm Boxes: 2% of installed quantity, but no fewer than 1 unit of each type.
2. Addressable Control Relays: 4% of installed quantity, but no fewer than 1 unit of each type.
3. Indoors Speaker/Strobes: 4% of installed quantity, but no fewer than 1 unit of each type.
4. Indoor Speakers: 4% of installed quantity, but no fewer than 1 unit of each type.
5. Indoor Strobes: 4% of installed quantity, but no fewer than 1 unit of each type.
6. Monitor Modules (Addressable Interface): 4% of installed quantity, but no fewer than 1 unit of each type.
7. Isolation Modules: 4% of installed quantity, but no fewer than 1 unit of each type.
8. Addressable Heat Detectors: 4% of installed quantity, but no fewer than 1 unit of each type.
9. Smoke Detectors, Fire Detectors: 6% of installed quantity, but no fewer than 1 unit of each type.
10. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but no fewer than 1 unit of each type.
11. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
12. Keys and Tools: One extra set for access to locked and tamper-proofed components.
13. Fuses: Two of each type and rating installed in the system.

1.11 WARRANTY

A. Provide parts and labor warranty of one year from the date of final inspection and/or acceptance by the Owner.

PART 2 - PRODUCTS

2.1 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:

1. Manual stations.
2. Heat detectors.
3. Smoke detectors.
4. Duct smoke detectors.

5. Automatic sprinkler system water flow.

B. Fire-alarm signal shall initiate the following actions:

1. Record events in the system memory.
2. Continuously operate alarm notification appliances until initiating device and control unit have been reset.
3. Identify alarm at fire-alarm control unit with flashing LED, audible piezo-electric signal, and LCD display of alarm point and location.
4. Identify alarm at fire-alarm remote annunciator with flashing LED, audible piezo-electric signal, and LCD display of alarm point and location.
5. Transmit an alarm signal to the remote alarm receiving station.
6. Release fire and smoke doors held open by magnetic door holders.
7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode. Typically, shutdown of all HVAC equipment will be initiated.
8. Activate voice/alarm communication system in the new building.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. Low-air-pressure switch of a dry-pipe sprinkler system.
3. Emergency Responder Radio Communications System monitored points.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Ground or a single break in fire-alarm control unit internal circuits.
4. Break in standby battery circuitry.
5. Failure of battery charging.
6. Abnormal position of any switch at fire-alarm control unit or annunciator.
7. Loss of primary power or abnormal ac voltage at fire-alarm control unit.
8. HVAC bypass defeat switch in bypass position.

E. System Trouble and Supervisory Signal Actions:

1. Initiate annunciation at fire-alarm control unit and remote annunciators.
2. Provide adjustable time delay capability of 0 to 60 minutes to delay transmission of the trouble signals. The delay for loss of primary power or abnormal ac voltage shall be 1 to 3 hours.

2.2 FIRE-ALARM CONTROL UNIT

A. Circuits:

1. Notification Appliance Circuits (NAC):

a. NFPA 72 Class B.
b. End of line (EOL) resistors shall be installed for FACU supervision of circuit integrity. Locate EOL resistors as follows:

1) Where accessible to fire alarm system maintenance personnel.
2) Where maintenance or testing at the EOL resistor location will not be disruptive to the normal use of the facility.
3) Where not easily accessible to the normal building occupants.
4) Where no higher than 9' AFF or lower than 7' AFF.
5) Not in stairwells or restrooms.
6) Not in exterior devices.

c. NAC circuits shall not exceed 75% of maximum load current allowed.

2. Signaling Line Circuits (SLC): NFPA 72 Class A, no "T" taps, and a minimum of 20% spare addresses.
3. Initiating Device Circuits (IDC): NFPA 72 Class A.
4. Digital electronic signals shall utilize check digits or multiple polling to prevent a single ground or open on any NAC, SLC, or IDC from causing system malfunction, loss of operating power, or the ability to report an alarm.
5. Isolation Modules:

   a. Isolation modules shall automatically isolate wire-to-wire shorts on an SLC circuit.
   b. Install isolation modules at the following locations:

      1) In or adjacent to the FACU at each end of addressable loops.
      2) After each 20 initiating devices and control points on an addressable loop.
      3) For addressable loops with less than 20 devices and control points, install isolators at the middle of the loop in addition to those at the FACU.
      4) At the point where an addressable loop extends outside of the building.
      5) In terminal cabinets on each floor where addressable loops cover more than one floor level.

   c. Isolation modules shall be readily accessible, not located above ceilings, and clearly labeled. Record drawings shall indicate isolator module locations.
   d. Provide an LED that flashes to indicate the isolation module is operational and that burns steady to indicate that a short circuit condition has been detected and isolated.

6. Wiring Methods:

   a. All fire alarm circuitry shall be in 3/4" minimum metal conduit or metal clad fire alarm Type MC cable where concealed. Use surface metal raceway where exposed. Junction boxes and covers not in finished areas shall be painted red. PVC conduit may be used underground, in concrete, or in locations subject to severe corrosion.
   b. SLC addressable loop circuits shall be wired with type FPL/FLLR/FPLP fire alarm cable, 18 AWG minimum, low capacitance, copper, twisted pair. Cable jacket shall have a red jacket with red and black conductor insulation. For underground circuits, use type TC or PLTC cable (PE insulated).
   c. Speaker audio circuits shall be wired with twisted, shielded pair, copper audio cable.
   d. All other circuits shall be wired with 14 AWG minimum, stranded copper, type THHN/THWN conductors. Color codes follow:

      1) Initiating Circuits, General: Red(+) / White(-).
      2) Initiating Circuits, Smoke Only: Violet(+) / Gray(-).
      3) Notification Appliance / alarm initiating circuits: Blue(+) / Black(-).
      4) AHU Shutdown Circuits: Yellow(+) / Brown(-).
      5) Door Control Circuits (magnet power): Orange(+) / Orange(-).
      6) Separate 24 VDC operating power (for equipment): Yellow(+) / Brown(-).
      7) Circuits from zone adapter modules (ZAMs) to monitored devices: Violet(+) / Gray(-).

   e. Conduits that penetrate exterior walls shall be sealed with non-hardening electrical putty to prevent condensation infiltration.
   f. Splices are allowed only at device terminals or on terminal blocks in cabinets.
   g. For multistory buildings, circuits shall be routed through terminal cabinets at each floor. Cabinets shall be hinged cover enclosures with terminal blocks for circuitry connections. Cabinets shall typically be accessible at floor level. If the building layout prevents installation for floor level access; with approval of the Owner and Engineer, a terminal cabinet may be located above a suspended ceiling. Its location shall be clearly and permanently identified with a placard legible from the floor.

h. Terminal block screws shall have pressure wire connectors of the self-lifting or box lug type.
i. Permanent wire markers shall be used to label connections at the FACU, other control equipment, power supplies, and in terminal cabinets.
j. Branch circuit breakers supplying 120 VAC to system equipment shall be physically protected with a breaker handle lock and identified with a 1/4" permanent red dot applied to the breaker handle or exposed body area. The red identification shall not damage the overcurrent protective devices or obscure the manufacturer's markings.

B. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory.

C. AHU Shutdown Defeat Toggle Switch: A supervised toggle switch shall be provided in/adjacent to the Fire Alarm Control Unit, or as a key operated function in a Remote Annunciator. If installed at the Remote Annunciator, provide an engraved label at the FACU with AHU Shutdown Defeat Switch location. When placed in the Shutdown Defeat position, a system "trouble" signal shall be initiated.

D. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

E. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.
2. 120V power supply entry point to the FACU enclosure shall be where designated by the manufacturer.
3. 120V branch breaker shall be physically protected with a handle lock and identified with a 1/4" diameter permanent red dot applied to the breaker handle or exposed body area.

F. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries:

a. Gel-cell, sealed, plate nickel cadmium, maintenance free.
b. Minimum of 60 hours standby capacity plus:

1) 5 minutes of horn/strobe full alarm load.
2) 15 minutes of voice evacuation full alarm load.

2. Charger: Dual-rate charging techniques for fast battery recharge.

G. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

H. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators.

1. One-way Emergency Voice-Alarm (PA Type) System

a. Must be compatible with existing Notifier AFP-3030 fire alarm panel.

2. One-way Voice/Alarm digital audio circuits

    a. Twisted pair copper conductors (AWG 18 minimum) in jacketed cable, or fiber optic cable.
    b. Analog audio circuits are to be wired with AWG 18 minimum twisted pair copper conductors in shielded cable. Cable jacket color is to be gray, with red (+) and black (-) conductor insulation. Shielded cables but be continuously connected from the amplifiers to the end of line. Tape the shield splice at each speaker and handset to insulate the ground. Single point ground the shield at the amplifier or control unit unless prohibited by the system manufacturer.

        1) Belden 8790
        2) West Penn 293
        3) Approved Equal.

3. Communications equipment shall be housed in an adjacent cabinet. All connections between the remote annunciator and the voice communications panel shall be made via cables or harness assemblies which have been prewired by the system manufacturer.
4. Indicated number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711 and be listed by an NRTL.

    a. Allow the application of and evacuation signal to indicated number of zones and, at same time, allow voice paging to the other zones selectively or in any combination.
    b. Programmable tone and message sequence selection.
    c. Standard digitally recorded messages for "Evacuation" and "All Clear."
    d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification appliance circuits of fire-alarm control unit.

5. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.
6. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.
7. Voice/Alarm Emergency Power

    a. Batteries

        1) Gel-cell, sealed, plate nickel cadmium, maintenance free.
        2) Minimum of 60 hours standby capacity plus 15 minutes of voice evacuation full alarm.

2.3 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes:

1. Comply with UL 38.
2. Dual-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
3. Positive, visual indication of operation.
4. Station Test and Reset: Key-operated switch.
5. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

2.4 SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall typically be two-wire type for connection to an SLC. Four-wire type detectors may be required if connecting to an existing four-wire system.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
4. Integral Visual-Indicating Lights: Provide both alarm and power LEDs, flashing under normal conditions. LEDs shall burn steady, controlled by the FACU, to indicate an alarm condition.
5. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring. Provide terminals in the fixed base for connection of a remote alarm LED.
6. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
8. Test Means: Provide a means to simulate an alarm condition and report to the FACU. Test shall be initiated at the detector (activation of a magnetic switch) or initiated remotely on command from the FACU when in "test" condition.

B. Photoelectric Smoke Detectors:

1. Use photoelectric / light scattering principal to measure smoke density and send data to the FACU representing analog level of smoke density.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

2.5 HEAT DETECTORS

A. General Requirements for Heat Detectors:

1. Comply with UL 521.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
3. Integral Visual-Indicating Lights: Provide both alarm and power LEDs, flashing under normal conditions. LEDs shall burn steady, controlled by the FACU, to indicate an alarm condition.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring. Provide terminals in the fixed base for connection of a remote alarm LED.
5. Use electronic sensor to measure thermal conditions caused by fire and send data to the FACU representing analog level of such thermal conditions.

B. Heat Detector, Combination Type:

1. Actuated by either a fixed temperature of 135 deg For a rate of rise that exceeds 15 deg Fper minute unless otherwise indicated.
2. Fixed-temperature sensing shall be independent of rate-of-rise sensing.
3. Mounting: Twist-lock base interchangeable with smoke-detector bases.

4. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 194 deg F.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.

2.6 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, equipped for mounting as indicated and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections. Comply with requirements for both visual and audible notification appliances.

B. Visible Notification Appliances (Strobes):

1. Xenon strobe lights complying with UL 1971, 24-V dc nominal.
2. Rated Light Output: 15/30/75/110 cd, selectable in the field.
3. Flashing shall be in a temporal pattern, synchronized with other units. Maximum pulse duration: 0.2 seconds.
4. Clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" shall be engraved in minimum 1-inch high letters on the lens.
5. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
6. Strobe Leads: Factory connected to screw terminals.
7. Mounting Faceplate: Factory finished, color to match existing.

C. Voice/Tone Notification Appliances (Speakers):

1. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.
2. Speakers shall operate at 70.7V dc nominal.
3. High-Range Units: Rated 1/2 to 15 Watt (W).

a. Include taps at 1/2 W, 0.9 W, 1.8 W, 7 1/2 W, and 15W.

4. Low-Range Units: Rated 1 to 2 W.

a. Include taps at 1/4 W, 1/2 W, 1W, and 2W.

5. Matching Transformers: Tap range matched to acoustical environment of speaker location.
6. Provide back boxes for all speakers.

2.7 ADDRESSABLE INTERFACE DEVICES

A. Monitor Modules:

1. For use in providing a system address for alarm-initiating devices for wired applications with normally open dry contacts.
2. Provide an LED that flashes under normal conditions, indicating that the monitor module is operational and in regular communication with the FACU.
3. Modules installed in non-conditioned spaces shall be tested, listed, and marked for continuous duty across the range of temperatures and humidity expected at their installed locations.
4. Notifier FMM-101 mini-modules shall not be used.

B. Control Modules:

1. For use in auxiliary control functions, operating as a dry contact relay.
2. Typical equipment control functions would include direct signals to: an elevator controller to initiate elevator recall, to a circuit-breaker shunt trip for power shutdown, to HVAC equipment to initiate shutdown, or to a lighting control system for lighting control scenario under fire alarm conditions.
3. For use in supervising and controlling the operation of one NAC.
4. Provide an LED that flashes under normal conditions, indicating that the monitor module is operational and in regular communication with the FACU.

2.8 REMOTE ANNUNCIATOR / INDICATOR LIGHTS (RAIL)

A. Provide 24V dc RAILs with an associated key-type switch for testing of the annunciated device.

2.9 AUXILIARY POWER SUPPLIES

A. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module.

1. Alarm current draw of entire supplied circuitry loads shall not exceed 80 percent of the power-supply module rating.
2. 120V branch breaker shall be physically protected with a handle lock and identified with a 1/4" diameter permanent red dot applied to the breaker handle or exposed body area.

B. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries:

a. Gel-cell, sealed, plate nickel cadmium, maintenance free.
b. Minimum of 60 hours standby capacity plus:

1) 5 minutes of horn/strobe full alarm load.
2) 15 minutes of voice evacuation full alarm load.

c. Add battery capacity for a 25% safety factor.

2. Charger: Dual-rate charging techniques for fast battery recharge.
3. Battery cabinet enclosures shall be twice the size of the batteries contained.

C. Auxiliary power supplies shall be individually monitored by the FACU and protected by a smoke detector.

D. Coordinate installation location with the Owner and Engineer. Do not install above ceilings or in non-conditioned spaces.

2.10 SURGE PROTECTION

A. AC Input:

1. Mount in listed enclosure adjacent to branch circuit panelboard. Wind small coil (5 to 10 turns) in branch circuit conductor just downstream of the suppressor connection.
2. Install feed through branch circuit transient suppressor (Ditek #DTK-120S20A, Leviton #51020-WM/DIN, or approved equivalent that is UL 1449 2nd Edition Listed).

B. DC Circuits Extending Outside Building:

1. Mount inside the building, near the point of entry to or exit from each building in a labeled enclosure.

2. Provide "pi"-type filter on each conductor, consisting of primary arrestor, series impedance, and fast-acting secondary arrestor that clamps at 30-40V.
3. A minimum of 36" of conductor length shall be provided between the "pi"-type filter and the first system device in the building.
4. Acceptable models: Citel America #B280-24V, Ditek #DTK-2MHLP24B, Northern Technologies #DLP-42, Simplex #2081-9027/9028, Transtector #TSP8601.

2.11 WATER FLOW SWITCHES

A. Flow switches shall be integral, mechanical, non-coded, non-accumulative retard type.

B. Flow switches shall have an alarm transmission delay that is adjustable from 0 to 60 seconds. Initial settings shall be 30 to 45 seconds.

C. Flow switches shall be located a minimum of one foot from any fitting that changes the direction of flow and a minimum of 3 feet from a valve, as required by NFPA 13.

D. Flow switches shall be furnished and installed by the Mechanical/Sprinkler Contractor. The Electrical/Fire Alarm Contractor shall make electrical connections.

2.12 VALVE SUPERVISORY SWITCHES

A. Supervisory switch mechanisms shall be contained in weatherproof housings with 3/4" tapped conduit entrance fittings and hardware for attachment to the valves. Switch housings shall be finished in red, baked enamel paint.

B. Mount switches to not interfere with normal operation of the valves. Adjust switches to operate within two revolutions toward the closed position of the valve control, or when the stem of the valve has moved no more than one-fifth of the distance from its normal position.

2.13 REMOTE ANNUNCIATOR

A. Description: Annunciator functions utilizing an alphanumeric display and LED indicating lights shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual control functions shall match those of fire-alarm control unit; including acknowledge, silence, reset, and test for alarm supervisory, and trouble signals.

1. Mounting: Flush cabinet, NEMA 250, Type 1.
2. Alarm signal with alarm resound feature.
3. Communication via two-wire EIA-485 interface.
4. The fire alarm system shall be capable of supporting a minimum of four remote annunciators.

2.14 LOCAL OPERATING CONSOLE (LOC)

A. Description: For applications that require full control of the voice audio system from remote locations within a facility; for live All Call or vectored paging of both emergency and non-emergency events and pre-recorded message activation

1. Compatible with the Emergency Voice Evacuation Panel for fire protection applications and mass notification.
2. Built-in microphone with push-to-talk feature that can be used for ALL CALL paging.
3. Switch control for panel messages.
4. Function controls such as Global HVAC shutdown.
5. Simple and straightforward user interface.

6. Keyed lock cabinet design to prevent unauthorized access.
7. UL 864 (Emergency Voice Evacuation for Fire) listed.
8. Exact location of the LOCs shall be coordinated with the Owner and AHJ prior to installation.

2.15 DEVICE GUARDS

A. For device protection in gymnasiums, multi-purpose rooms, and other spaces where exposed to physical damage.

B. Wire Guards: Welded wire mesh of size and shape for the manual station, smoke detector, notification appliance, or other device requiring protection.

1. Heavy gauge steel wire.
2. Finish: Coated with corrosion resistant polyester, color to match the protected device.
3. Guards for beam detector transmitters and receivers shall be configured with openings to accommodate detector function

C. Protective Shield:

1. Clear, UV stabilized, polycarbonate cover for strobes.

2.16 SNAP EDGE FRAMES

A. Description: Mountable Front Load Easy Open Snap Frame

1. Outside edges flip open for quick document changes.
2. Non-glare plastic cover.
3. Design Basis: U-Line #S-2132 Series.
4. For use with operator’s instructions and device map.

2.17 REMOTE POWER CONTROL DEVICE

A. Description: Stand-alone plug, cord, and controlled outlet assembly for interfacing a fire alarm control module dry contact to s sound system amplifier power cord.

1. Ratings: 125 VAC, 20A.
2. NEMA 5-20P plug, 6 foot cord, and NEMA 5-20R duplex receptacle.
3. Power supply and relay housed in assembly with the duplex receptacle.
4. Design Basis: Lowell Manufacturing # RPC-20-CD.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Comply with NFPA 72 for installation of fire-alarm equipment.

B. Equipment and Device Mounting:

1. Install fire-alarm control unit with tops of cabinets not more than 72 inches above the finished floor.
2. Install equipment and devices securely attached to walls, ceilings, floors, building structure. Hardware and supports shall be suitable for the load supported. Ceiling mounted devices shall not be supported solely by suspended ceilings.

3. Comply with requirements for seismic-restraint devices specified in Section 260548 "Seismic Controls for Electrical Systems."

C. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.

1. Connect new equipment to existing control panel in existing part of the building.
2. Connect new equipment to existing monitoring equipment at the supervising station.
3. Expand, modify, and supplement existing control and/or monitoring equipment as necessary to extend existing control and/or monitoring functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.

D. Smoke- or Heat-Detector Spacing:

1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
3. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.
4. When installed in a room, orient so that the alarm LED is visible from the nearest door to the corridor.

E. Detector Protection:

1. Unless suitably protected from dust, paint, etc.; detectors shall not be installed until final construction clean-up is complete. If contaminated, detectors shall be replaced.
2. Where accidental damage or deliberate abuse is anticipated, provide a protective guard that is listed for use with the detector and is acceptable to the AHJ.

F. Audible Alarm-Indicating Devices: Unless ceiling mounted, install not less than 6 inches below the ceiling. Install horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

G. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn; and unless ceiling mounted, install at least 6 inches below the ceiling.

H. Device Location-Indicating Lights: Locate in public space near the device they monitor.

I. Annunciator: Install with top of panel not more than 72 inches above the finished floor.

J. Control Selector Switches:

1. Toggle switches with LED status indicator lights.
2. Hand in "up" position with amber LED. Auto in "center" position with green LED. Off in "down" position with red LED.

3.2 CONNECTIONS

A. Fire and Life Safety Doors:

1. Where any exit or exit access doors are locked to delay egress, they must immediately unlock upon any fire alarm signal or loss of 24V-dc fire alarm system power.
2. Power failure to smoke and fire doors shall cause their mechanisms to default to egress mode with normal mechanical latching.
3. Smoke or fire doors shall drop the door hold open magnet within 60 seconds of AC power loss, or their load shall be included in standby battery calculations.

4. Rolling steel fire doors shall automatically reset when returned to their normal / raised position. Program the fire alarm system to limit which initiation devices release these doors; typically, the smoke detector and/or waterflow alarms in adjacent spaces. Label the FACU appropriately with an information placard regarding rolling steel fire door operation.

B. Make addressable connections with a supervised interface device to the following devices and systems and any others indicated on the drawings. Install the interface device less than 3 feetfrom the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Supervisory connections at Emergency Responder Radio Coverage System.
2. Supervisory connections at sprinkler system flow and valve supervisory switches. Water flow alarms shall be configured by sprinkler zone, not to exceed one floor.
3. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.

C. Sprinkler system supervisory circuits for monitoring flow, valve position, air pressure, water temperature, etc. shall initiate distinct audible and visual indications at the FACU. The audible signal shall be a pulsing piezo-electric alarm. Provide an engraved label adjacent to the bell/alarm indicating "SPRINKLER STATUS ABNORMAL".

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Electrical Identification."

B. Detectors, appliances, and modules shall be labeled with unique numbers that are indicated on as-built drawings and permanently mounted on device bases. Labels shall be legible from floor level. Detectors shall be labeled uniquely and sequentially starting at the FACU with both SLC and device designations. Labels shall be printed black lettering on clear background and attached to the device base.

C. Junction and pull box covers shall be labeled to indicate the circuits or function of the conductors contained in the boxes. Labels shall be neatly applied with black lettering on clear background.

D. Conductors shall be labeled with permanent wire markers at connections at the FACU, other control equipment, power supplies, and terminal cabinets.

E. Floor plans of the fire alarm system installation shall be provided at the FACU and new building remote annunciator.

1. Provide a locked box adjacent to the FACU for plan book storage. Key to match FACU. Label lock box.
2. Floor plans shall include device locations and addresses. Indicate equipment, module, and EOL locations.
3. Provide a legend for symbols used.

F. NFPA 72 Record of Completion documentation shall be kept inside the lock box, or its kept location shall be permanently indicated inside the FACU on an engraved label.

G. At all equipment with a 120 VAC power source, provide an engraved label indicating panelboard ID, branch circuit number, and panelboard location. At the FACU, provide an additional engraved label inside the FACU.

3.4 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.5 FIELD QUALITY CONTROL

A. Final field tests shall be witnessed by authorities having jurisdiction.

B. Manufacturer's Field Service: Engage a factory-authorized service technician to make connections to the FACU; to program the system; to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Tests and Inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.
    a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
    b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
2. Conductor Testing: All conductors shall be tested for grounds, opens and shorts prior to termination at panels and installation of detector heads. Conductors shall be megger tested for a minimum of 10 megohms from conductor to ground and conductor to conductor. Provide record of test results to Engineer in advance of acceptance inspection.
3. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
4. Test 100% of new alarm initiating devices, all software functions, all other system functions including DACT communication, and verify system operational matrix. Notify Owner and Engineer 2 weeks in advance of this test to permit witness observation.
5. Print a System Status and Programming Report with settings for each alarm indicating device, the current sensitivity of each analog addressable smoke detector, and detailed system operational matrix.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion", NFPA 72, Figure 1-6.2.1 in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72. Submit "Fire Alarm System Record of Completion" to Engineer for delivery to Owner.
7. After 100% system test and submission of "Fire Alarm System Record of Completion", schedule an AHJ acceptance inspection, a minimum of 2 days after completion of system testing.
8. For AHJ acceptance inspection, perform sampling testing as directed by AHJ for detectors and functional tests. Provide 2-way radios, ladders, smoke source, and other materials needed for testing the system.

D. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

E. Fire-alarm system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.6 TRAINING / DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel for a minimum of 4 hours to adjust, operate, and maintain fire-alarm system. Training schedule must be coordinated to meet the Owner's schedule. Training location will be provided by the Owner.

B. As a minimum, training shall cover:

1. System software multiple access levels via password protection for accommodating Owner capability for disabling individual alarm inputs or normal outputs for alarms without modifying the system programming or affecting operation of the remainder of the system.
2. Overall system concepts, capabilities, and functions. Training shall be of sufficient detail so that the Owner shall be able to remove any device from service and return to service without the need for the Manufacturer's approval or assistance.
3. Methods and means of troubleshooting and replacement of all field wiring devices.
4. Methods and means of troubleshooting the main FACU and field devices for programming, bussing systems, internal panel and unit wiring, circuitry, and interconnections.
5. Preventative maintenance service techniques and schedules, including historical data trending of alarm and trouble records.
6. Training documentation and actual system software used for training shall be provided in digital form and left with the Owner at the completion of training.

C. Provide two bound copies of training information.

END OF SECTION 283111

SECTION 285000 – EMERGENCY RADIO COMMUNICATION ENHANCEMENT SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.

B. North Carolina State Highway Patrol document with information for Viper radio system call signs and locations of tower sites accessible within Brunswick County (attached for reference after this Section).

1.2 SUMMARY

A. Section Includes:

1. In-building radio signal amplification system.
2. A system shall be provided to cover the new building.

B. Related Sections include the following:

1. Section 260500 "Basic Electrical Materials and Methods" for supports, anchors, and identification products.
2. Section 260519 "Conductors and Cables" for power supply circuitry.
3. Section 260526 "Grounding and Bonding".
4. Section 260533 "Raceways and Boxes".
5. Section 260548 "Seismic Controls for Electrical Work" for seismic restraints and bracing of raceways, boxes, enclosures, and cabinets.
6. Section 283111 "Digital, Addressable Fire Alarm System" for monitoring interface requirements.

1.3 DEFINITIONS

A. AHJ Authority Having Jurisdiction

B. BDA Bi-Directional Amplifier: Device used to amplify band-selective or multi-band RF signals in the uplink, to the base station and in the downlink from the base station to subscriber devices for enhanced signals and improved coverage

C. DAS Distributed Antenna System

D. FCC Federal Communications Commission

E. RF Radio Frequency

1.4 ACTION SUBMITTALS

A. RF Surveys / Shop Drawings: Measurement drawings of each floor of the building which indicate relative RF field strength for each frequency and band of interest. Submit to both the AHJ and the Engineer.

1. Initial signal strength mapping. Perform an initial site survey to measure signal strength before construction starts.
2. Pre-final signal strength mapping. Perform a site survey to measure signal strength near substantial completion of the building.

B. Shop Drawings:

1. Include plans and details for code compliant, UL Listed, DAS system design for emergency responder radio coverage.

C. Product Data:

1. Include bill of materials for all BDA / DAS equipment and components.
2. Manufacturer product data sheets and cut sheets for all equipment and components.

D. Manufacturer Seismic Qualification Certification: Submit certification that poles, accessories, and components will withstand seismic forces defined in Section 260548 "Seismic Controls for Electrical Work." Include the following:

1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified after the seismic event."

2. Dimensioned Drawings: Identify, locate, and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.5 INFORMATIONAL SUBMITTALS

A. Sample Warranty: Manufacturer's standard warranty.

1.6 CLOSEOUT SUBMITTALS

A. RF Survey / Shop Drawings: Final installed measurement drawings of each floor of the building which indicate relative RF field strength for each frequency and band of interest.

B. Operation and Maintenance Data: For all system equipment and components to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components that fail in materials or workmanship within a specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Provide an in-building radio signal amplification system to provide complete coverage in the building for the public safety agencies. System shall meet the requirements of:

1. The local AHJ.
2. FCC.
3. The North Carolina Fire Code.
4. NFPA 72, National Fire Alarm and Signaling Code.
5. NFPA 1221, Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems.
6. UL 2524, Standard for In-building 2-Way Emergency Radio Communication Enhancement Systems.

B. Seismic Performance: System equipment and components shall withstand the effects of earthquake motions.

PART 3 - EXECUTION

3.1 RF FIELD SURVEYS

A. Perform initial field survey to determine that a system is required due to inadequate radio signal coverage.

B. Perform pre-design field surveys to determine signal strength data required to perform designs.

3.2 EXAMINATION

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

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

3.3 INSTALLATION

A. Install system equipment and components.

B. Coordinate infrastructure needs for system installation.

C. Grounding:

1. Ground and bond coax cable shield and associated metallic conduits.
2. Ground and bond coax cable surge suppressor and associated metallic conduits.

3.4 IDENTIFICATION

A. Identify and mark equipment and components with engraved labels as specified in Section 260553 "Electrical Identification".

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to:

1. Test and adjust equipment and components.
2. Perform startup and commissioning of system.

B. Tests and Inspections:

1. Perform final testing for the local inspection authority, including final signal strength mapping.
2. Perform final testing and demonstration with the AHJ.
3. Submit final signal strength mapping results shop drawings.

END OF SECTION 285000

Contact	
NORTH CAROLINA STATE HIGHWAY PATROL WAYNE E EBERHARD 4231 MAIL SERVICE CENTER RALEIGH, NC 27699-4231 ATTN Wayne E Eberhard	P:(919)948-7854 F:(919)662-4444 E:WAYNE.EBERHARD@NCDPS.GOV

Call Signs and Locations of Tower Sites Accessible Within Brunswick County

WQRB685 Bolivia, NC

WQUA258 Southport, NC

WQFQ491 Pea Landing, Ash NC

WQTB690 Supply, NC

WPUT648 Delco, NC

WQXV212 Nakina, NC

WQTA409 Wilmington, NC

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FCC Callsign WQRB685 (NORTH CAROLINA STATE HIGHWAY PATROL)

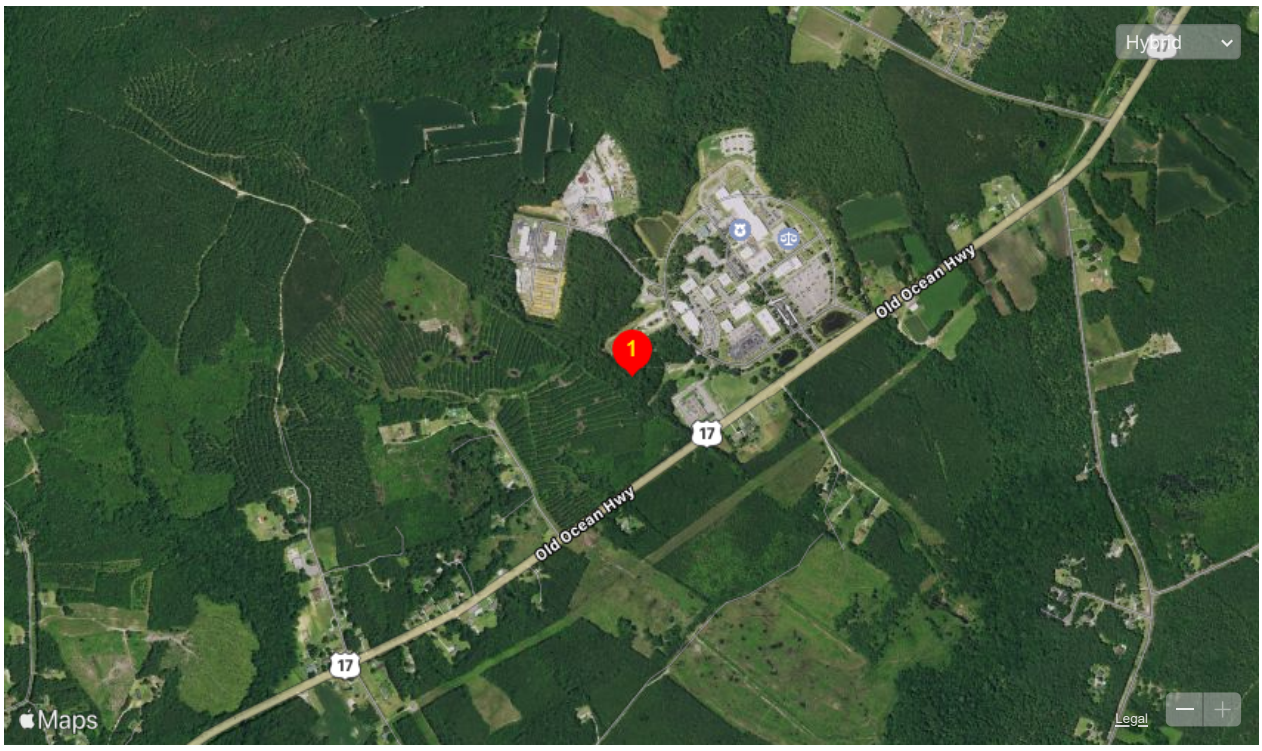
Licensee Name:	NORTH CAROLINA STATE HIGHWAY PATROL
License:	WQRB685
FRN:	0001913888
Status:	Active (Effective: 10/14/2016 - Expires: 04/10/2023)
County:	BRUNSWICK
State:	NC
Radio Service:	YE: Public Safety/Spec Emerg and Public Safety Ntl Plan, 806-817/851
Notes:	LAW ENFORCEMENT AND PUBLICE SAFETY ACTIVITIES ON TRUNKED RADIO



Access Radio Online
Listen to Live Radio with Easy Radio Play

Easy Radio Player

#	Tower ID	Type	Ant Height	Struc Height	Elevation	Address
1	1064532	GTOWER	152.4	152.4	12.8	HP-1031, BOLIVIA, 85 GOVERNMENT CENTER DRIVE
2			0.0	0.0	0.0	



Hot Hot

Loc #	Frequency	Emission	Class	Units	Pag	Pwr	Lat	Long	City	County	State
1	851.08750000	8K30F1W	FB2C	1	0	100.000	34.05500	-78.16722	BOLIVIA	BRUNSWICK	NC
1	851.08750000	9K80D7W	FB2C	1	0	100.000	34.05500	-78.16722	BOLIVIA	BRUNSWICK	NC
1	851.73750000	9K80D7W	FB2C	1	0	100.000	34.05500	-78.16722	BOLIVIA	BRUNSWICK	NC
1	851.73750000	8K30F1W	FB2C	1	0	100.000	34.05500	-78.16722	BOLIVIA	BRUNSWICK	NC
1	852.17500000	8K30F1W	FB2C	1	0	100.000	34.05500	-78.16722	BOLIVIA	BRUNSWICK	NC
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1	852.37500000	9K80D7W	FB2C	1	0	100.000	34.05500	-78.16722	BOLIVIA	BRUNSWICK	NC
1	852.62500000	9K80D7W	FB2C	1	0	100.000	34.05500	-78.16722	BOLIVIA	BRUNSWICK	NC
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1	852.87500000	9K80D7W	FB2C	1	0	100.000	34.05500	-78.16722	BOLIVIA	BRUNSWICK	NC
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1	856.68750000	8K30F1W	FB2C	1	0	100.000	34.05500	-78.16722	BOLIVIA	BRUNSWICK	NC
2	806.08750000	8K30F1W	MO	950	0	35.000					
2	806.08750000	9K80D7W	MO	950	0	35.000					
2	806.73750000	9K80D7W	MO	950	0	35.000					
2	806.73750000	8K30F1W	MO	950	0	35.000					
2	807.17500000	8K30F1W	MO	950	0	35.000					
2	807.17500000	9K80D7W	MO	950	0	35.000					
2	807.37500000	9K80D7W	MO	950	0	35.000					
2	807.37500000	8K30F1W	MO	950	0	35.000					
2	807.62500000	8K30F1W	MO	950	0	35.000					
2	807.62500000	9K80D7W	MO	950	0	35.000					
2	807.87500000	8K30F1W	MO	950	0	35.000					
2	807.87500000	9K80D7W	MO	950	0	35.000					
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2	808.37500000	8K30F1W	MO	950	0	35.000					
2	808.87500000	8K30F1W	MO	950	0	35.000					
2	808.87500000	9K80D7W	MO	950	0	35.000					
2	811.68750000	8K30F1W	MO	950	0	35.000					
2	811.68750000	9K80D7W	MO	950	0	35.000					

FCC ULS Listing for this callsign

FCC Data Last Updated On: 10-17-2019 04:39

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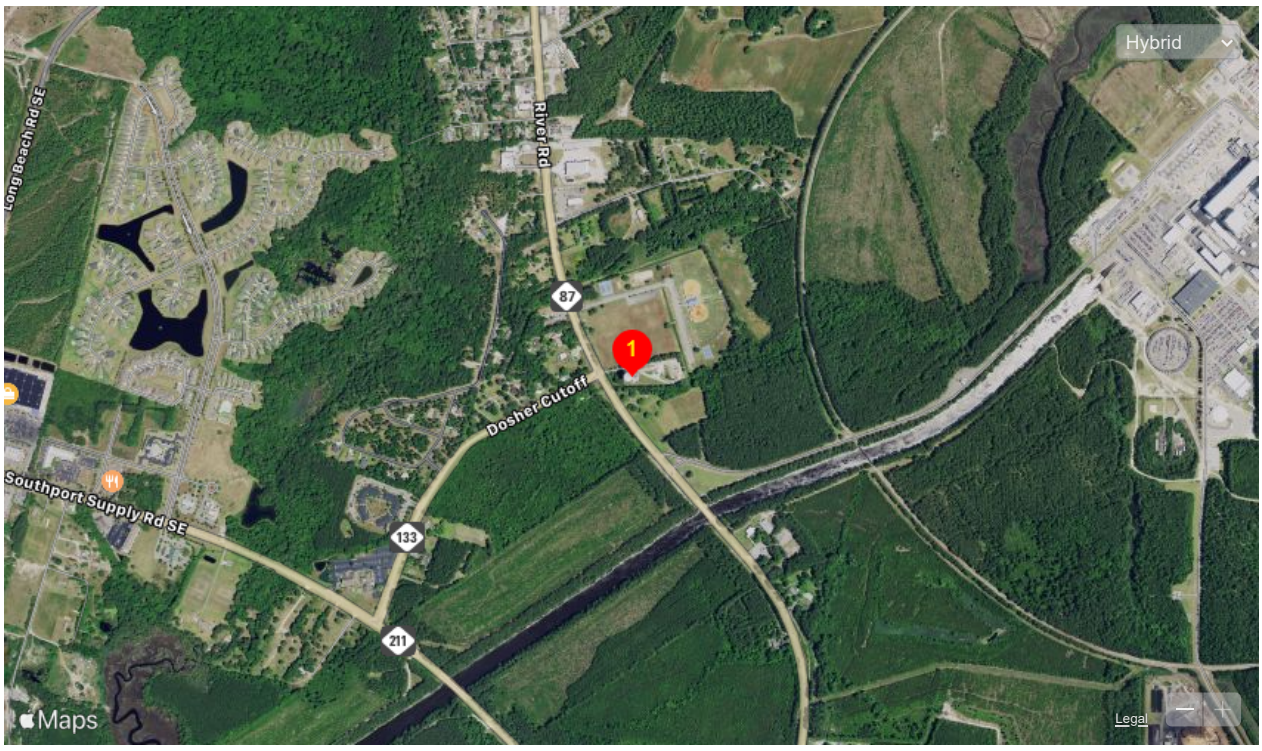
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FCC Callsign WQUA258 (North Carolina State Highway Patrol)

Licensee Name:	North Carolina State Highway Patrol
License:	WQUA258
FRN:	0001913888
Status:	Active (Effective: 07/20/2016 - Expires: 05/19/2024)
County:	BRUNSWICK
State:	NC
Radio Service:	SY: Trunked Public Safety 700MHz
Notes:	LAW ENFORCEMENT AND PUBLIC SAFETY ACTIVITIES ON 700 MHZ.



#	Tower ID	Type	Ant Height	Struc Height	Elevation	Address
1	1299443	TANK	46.5	47.8	7.6	HP-1263, SOUTHPORT WT, 8400 RIVER ROAD 28461
2			0.0	0.0	0.0	



Hot

Loc #	Frequency	Emission	Class	Units	Pag	Pwr	Lat	Long	City	County	State
1	769.31875000	9K80D7W	FB2C	1	0	100.000	33.95414	-78.02758	SOUTHPORT	BRUNSWICK	NC
1	769.31875000	8K30F1W	FB2C	1	0	100.000	33.95414	-78.02758	SOUTHPORT	BRUNSWICK	NC
1	769.61875000	8K30F1W	FB2C	1	0	100.000	33.95414	-78.02758	SOUTHPORT	BRUNSWICK	NC
1	769.61875000	9K80D7W	FB2C	1	0	100.000	33.95414	-78.02758	SOUTHPORT	BRUNSWICK	NC
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1	771.69375000	8K30F1W	FB2C	1	0	100.000	33.95414	-78.02758	SOUTHPORT	BRUNSWICK	NC
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1	773.89375000	9K80D7W	FB2C	1	0	100.000	33.95414	-78.02758	SOUTHPORT	BRUNSWICK	NC
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2	799.31875000	8K30F1W	MO	4800	0	30.000					
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2	799.61875000	9K80D7W	MO	4800	0	30.000					
2	800.81875000	9K80D7W	MO	4800	0	30.000					
2	800.81875000	8K30F1W	MO	4800	0	30.000					
2	801.69375000	9K80D7W	MO	4800	0	30.000					
2	801.69375000	8K30F1W	MO	4800	0	30.000					
2	801.94375000	8K30F1W	MO	4800	0	30.000					
2	801.94375000	9K80D7W	MO	4800	0	30.000					
2	802.36875000	9K80D7W	MO	4800	0	30.000					
2	802.36875000	8K30F1W	MO	4800	0	30.000					
2	802.74375000	9K80D7W	MO	4800	0	30.000					
2	802.74375000	8K30F1W	MO	4800	0	30.000					
2	802.99375000	8K30F1W	MO	4800	0	30.000					
2	802.99375000	9K80D7W	MO	4800	0	30.000					
2	803.44375000	9K80D7W	MO	4800	0	30.000					
2	803.44375000	8K30F1W	MO	4800	0	30.000					
2	803.89375000	8K30F1W	MO	4800	0	30.000					
2	803.89375000	9K80D7W	MO	4800	0	30.000					

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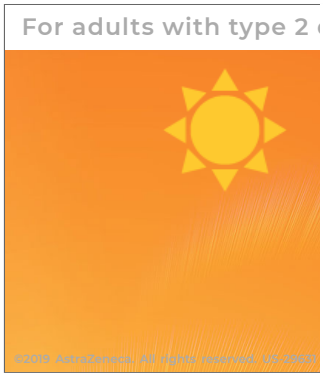
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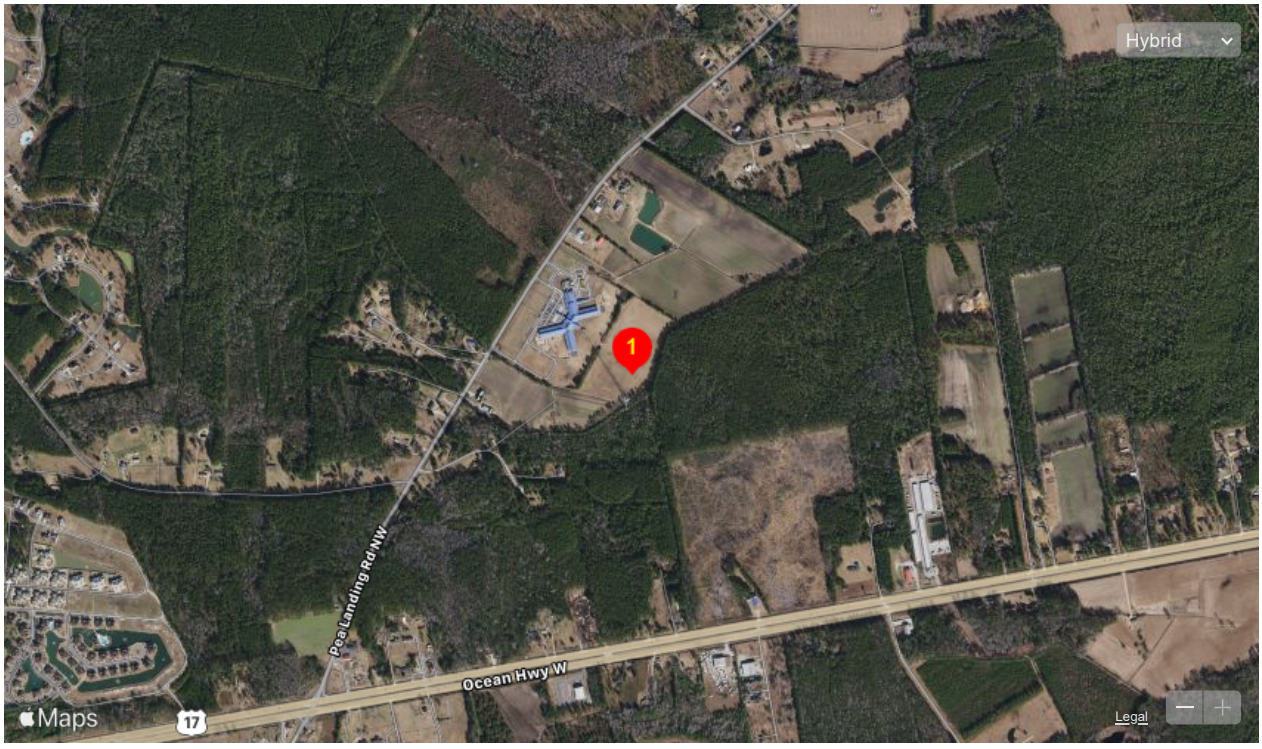
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FCC Callsign WQFQ491 (NORTH CAROLINA STATE HIGHWAY PATROL)

Licensee Name:	NORTH CAROLINA STATE HIGHWAY PATROL
License:	WQFQ491
FRN:	0001913888
Status:	Active (Effective: 07/08/2016 - Expires: 09/08/2026)
County:	BRUNSWICK
State:	NC
Radio Service:	YE: Public Safety/Spec Emerg and Public Safety Ntl Plan, 806-817/851
Notes:	POLICE ACTIVITY OVER TRUNKED RADIO CHANNELS



#	Tower ID	Type	Ant Height	Struc Height	Elevation	Address
1	1253659	LTOWER	121.9	125.0	12.1	HP-1202, PEA LANDING, 250 PEA LANDING ROAD
2			0.0	0.0	0.0	



Hot

Loc #	Frequency	Emission	Class	Units	Pag	Pwr	Lat	Long	City	County	State
1	851.03750000	8K30F1W	FB2C	1	0	100.000	33.94650	-78.54611	THOMASBORO	BRUNSWICK	NC
1	851.03750000	20K0F1E	FB2C	1	0	100.000	33.94650	-78.54611	THOMASBORO	BRUNSWICK	NC
1	851.03750000	9K80D7W	FB2C	1	0	100.000	33.94650	-78.54611	THOMASBORO	BRUNSWICK	NC
1	851.03750000	20K0F3E	FB2C	1	0	100.000	33.94650	-78.54611	THOMASBORO	BRUNSWICK	NC
1	851.55000000	8K30F1W	FB2C	1	0	100.000	33.94650	-78.54611	THOMASBORO	BRUNSWICK	NC
1	851.55000000	20K0F1E	FB2C	1	0	100.000	33.94650	-78.54611	THOMASBORO	BRUNSWICK	NC
1	851.55000000	9K80D7W	FB2C	1	0	100.000	33.94650	-78.54611	THOMASBORO	BRUNSWICK	NC
1	851.55000000	20K0F3E	FB2C	1	0	100.000	33.94650	-78.54611	THOMASBORO	BRUNSWICK	NC
1	851.85000000	20K0F1E	FB2C	1	0	100.000	33.94650	-78.54611	THOMASBORO	BRUNSWICK	NC
1	851.85000000	9K80D7W	FB2C	1	0	100.000	33.94650	-78.54611	THOMASBORO	BRUNSWICK	NC
1	851.85000000	20K0F3E	FB2C	1	0	100.000	33.94650	-78.54611	THOMASBORO	BRUNSWICK	NC
1	851.85000000	8K30F1W	FB2C	1	0	100.000	33.94650	-78.54611	THOMASBORO	BRUNSWICK	NC
1	852.15000000	20K0F3E	FB2C	1	0	100.000	33.94650	-78.54611	THOMASBORO	BRUNSWICK	NC
1	852.15000000	8K30F1W	FB2C	1	0	100.000	33.94650	-78.54611	THOMASBORO	BRUNSWICK	NC
1	852.15000000	20K0F1E	FB2C	1	0	100.000	33.94650	-78.54611	THOMASBORO	BRUNSWICK	NC
1	852.15000000	9K80D7W	FB2C	1	0	100.000	33.94650	-78.54611	THOMASBORO	BRUNSWICK	NC
1	852.38750000	8K30F1W	FB2C	1	0	100.000	33.94650	-78.54611	THOMASBORO	BRUNSWICK	NC
1	852.38750000	20K0F1E	FB2C	1	0	100.000	33.94650	-78.54611	THOMASBORO	BRUNSWICK	NC
1	852.38750000	9K80D7W	FB2C	1	0	100.000	33.94650	-78.54611	THOMASBORO	BRUNSWICK	NC
1	852.38750000	20K0F3E	FB2C	1	0	100.000	33.94650	-78.54611	THOMASBORO	BRUNSWICK	NC
1	852.71250000	20K0F1E	FB2C	1	0	100.000	33.94650	-78.54611	THOMASBORO	BRUNSWICK	NC
1	852.71250000	9K80D7W	FB2C	1	0	100.000	33.94650	-78.54611	THOMASBORO	BRUNSWICK	NC
1	852.71250000	20K0F3E	FB2C	1	0	100.000	33.94650	-78.54611	THOMASBORO	BRUNSWICK	NC
1	852.71250000	8K30F1W	FB2C	1	0	100.000	33.94650	-78.54611	THOMASBORO	BRUNSWICK	NC
1	853.67500000	8K30F1W	FB2C	1	0	100.000	33.94650	-78.54611	THOMASBORO	BRUNSWICK	NC
1	853.67500000	20K0F1E	FB2C	1	0	100.000	33.94650	-78.54611	THOMASBORO	BRUNSWICK	NC
1	853.67500000	9K80D7W	FB2C	1	0	100.000	33.94650	-78.54611	THOMASBORO	BRUNSWICK	NC
1	853.67500000	20K0F3E	FB2C	1	0	100.000	33.94650	-78.54611	THOMASBORO	BRUNSWICK	NC
2	806.03750000	9K80D7W	MO	750	0	35.000					
2	806.03750000	20K0F3E	MO	750	0	35.000					
2	806.03750000	8K30F1W	MO	750	0	35.000					
2	806.03750000	20K0F1E	MO	750	0	35.000					
2	806.55000000	20K0F3E	MO	750	0	35.000					
2	806.55000000	8K30F1W	MO	750	0	35.000					
2	806.55000000	20K0F1E	MO	750	0	35.000					
2	806.55000000	9K80D7W	MO	750	0	35.000					
2	806.85000000	8K30F1W	MO	750	0	35.000					
2	806.85000000	20K0F1E	MO	750	0	35.000					
2	806.85000000	9K80D7W	MO	750	0	35.000					
2	806.85000000	20K0F3E	MO	750	0	35.000					
2	807.15000000	20K0F1E	MO	750	0	35.000					
2	807.15000000	9K80D7W	MO	750	0	35.000					
2	807.15000000	20K0F3E	MO	750	0	35.000					
2	807.15000000	8K30F1W	MO	750	0	35.000					
2	807.38750000	20K0F3E	MO	750	0	35.000					
2	807.38750000	8K30F1W	MO	750	0	35.000					
2	807.38750000	20K0F1E	MO	750	0	35.000					
2	807.38750000	9K80D7W	MO	750	0	35.000					
2	807.71250000	8K30F1W	MO	750	0	35.000					
2	807.71250000	20K0F1E	MO	750	0	35.000					
2	807.71250000	9K80D7W	MO	750	0	35.000					
2	807.71250000	20K0F3E	MO	750	0	35.000					

2	808.67500000	9K80D7W	MO	750	0	35.000					
2	808.67500000	20K0F3E	MO	750	0	35.000					
2	808.67500000	8K30F1W	MO	750	0	35.000					
2	808.67500000	20K0F1E	MO	750	0	35.000					

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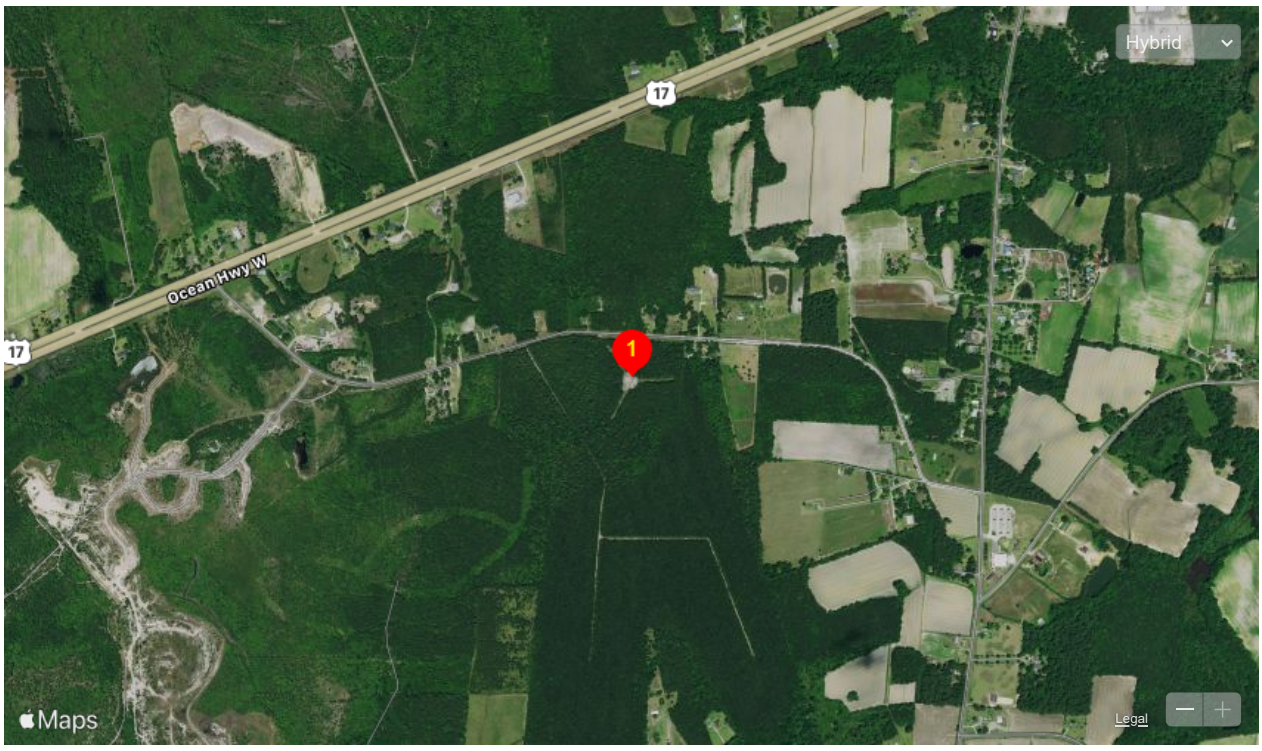
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FCC Callsign WQTB690 (NORTH CAROLINA STATE HIGHWAY PATROL)

Licensee Name:	NORTH CAROLINA STATE HIGHWAY PATROL
License:	WQTB690
FRN:	0001913888
Status:	Active (Effective: 06/20/2017 - Expires: 12/30/2023)
County:	BRUNSWICK
State:	NC
Radio Service:	YE: Public Safety/Spec Emerg and Public Safety Ntl Plan, 806-817/851
Notes:	APPLICANT IS A GOVERNMENT ENTITY WHICH PROVIDES COMMUNICATIONS ESSENTIAL TO ITS OFFICIAL ACTIVITIES.

Great Brands. Gr

#	Tower ID	Type	Ant Height	Struc Height	Elevation	Address
1	1008872	GTOWER	143.9	149.4	14.1	HP-1273, SUPPLY, 329 CUMBEE ROAD SW
2			0.0	0.0	0.0	





Loc #	Frequency	Emission	Class	Units	Pag	Pwr	Lat	Long	City	County	State
1	851.16250000	8K30F1W	FB2C	1	0	100.000	33.99667	-78.31278	SUPPLY	BRUNSWICK	NC
1	851.16250000	9K80D7W	FB2C	1	0	100.000	33.99667	-78.31278	SUPPLY	BRUNSWICK	NC
1	851.58750000	8K30F1W	FB2C	1	0	100.000	33.99667	-78.31278	SUPPLY	BRUNSWICK	NC
1	851.58750000	9K80D7W	FB2C	1	0	100.000	33.99667	-78.31278	SUPPLY	BRUNSWICK	NC
1	852.08750000	9K80D7W	FB2C	1	0	100.000	33.99667	-78.31278	SUPPLY	BRUNSWICK	NC
1	852.08750000	8K30F1W	FB2C	1	0	100.000	33.99667	-78.31278	SUPPLY	BRUNSWICK	NC
1	852.58750000	8K30F1W	FB2C	1	0	100.000	33.99667	-78.31278	SUPPLY	BRUNSWICK	NC
1	852.58750000	9K80D7W	FB2C	1	0	100.000	33.99667	-78.31278	SUPPLY	BRUNSWICK	NC
1	853.08750000	9K80D7W	FB2C	1	0	100.000	33.99667	-78.31278	SUPPLY	BRUNSWICK	NC
1	853.08750000	8K30F1W	FB2C	1	0	100.000	33.99667	-78.31278	SUPPLY	BRUNSWICK	NC
1	853.61250000	8K30F1W	FB2C	1	0	100.000	33.99667	-78.31278	SUPPLY	BRUNSWICK	NC
1	853.61250000	9K80D7W	FB2C	1	0	100.000	33.99667	-78.31278	SUPPLY	BRUNSWICK	NC
2	806.16250000	9K80D7W	MO	800	0	35.000					
2	806.16250000	8K30F1W	MO	800	0	35.000					
2	806.58750000	8K30F1W	MO	800	0	35.000					
2	806.58750000	9K80D7W	MO	800	0	35.000					
2	807.08750000	8K30F1W	MO	800	0	35.000					
2	807.08750000	9K80D7W	MO	800	0	35.000					
2	807.58750000	9K80D7W	MO	800	0	35.000					
2	807.58750000	8K30F1W	MO	800	0	35.000					
2	808.08750000	8K30F1W	MO	800	0	35.000					
2	808.08750000	9K80D7W	MO	800	0	35.000					
2	808.61250000	9K80D7W	MO	800	0	35.000					
2	808.61250000	8K30F1W	MO	800	0	35.000					

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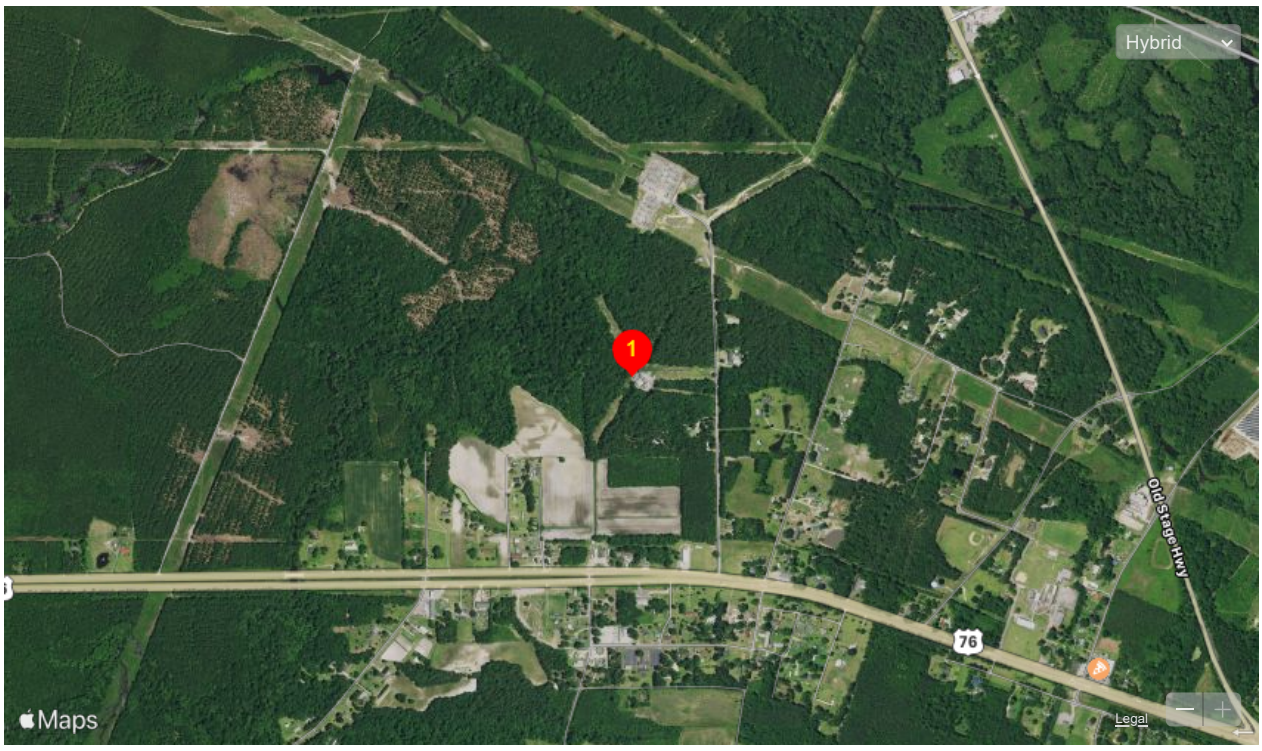


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FCC Callsign WPUT648 (NORTH CAROLINA STATE HIGHWAY PATROL)

Licensee Name:	NORTH CAROLINA STATE HIGHWAY PATROL
License:	WPUT648
FRN:	0001913888
Status:	Active (Effective: 06/30/2016 - Expires: 04/30/2022)
County:	COLUMBUS
State:	NC
Radio Service:	YE: Public Safety/Spec Emerg and Public Safety Ntl Plan, 806-817/851
Notes:	POLICE ACTIVITIES ON TRUNKED RADIO CHANNELS

#	Tower ID	Type	Ant Height	Struc Height	Elevation	Address
1	1014589	GTOWER	293.2	310.9	8.8	HP-1068, DELCO, 521 TV TOWER ROAD
2			0.0	0.0	0.0	



Hot

Loc #	Frequency	Emission	Class	Units	Pag	Pwr	Lat	Long	City	County	State
1	851.25000000	8K30F1W	FB2C	1	0	100.000	34.32128	-78.22833	RIEGELWOOD	COLUMBUS	NC
1	851.25000000	9K80D7W	FB2C	1	0	100.000	34.32128	-78.22833	RIEGELWOOD	COLUMBUS	NC
1	851.46250000	8K30F1W	FB2C	1	0	100.000	34.32128	-78.22833	RIEGELWOOD	COLUMBUS	NC
1	851.46250000	9K80D7W	FB2C	1	0	100.000	34.32128	-78.22833	RIEGELWOOD	COLUMBUS	NC
1	851.75000000	9K80D7W	FB2C	1	0	100.000	34.32128	-78.22833	RIEGELWOOD	COLUMBUS	NC
1	851.75000000	8K30F1W	FB2C	1	0	100.000	34.32128	-78.22833	RIEGELWOOD	COLUMBUS	NC
1	852.23750000	8K30F1W	FB2C	1	0	100.000	34.32128	-78.22833	RIEGELWOOD	COLUMBUS	NC
1	852.23750000	9K80D7W	FB2C	1	0	100.000	34.32128	-78.22833	RIEGELWOOD	COLUMBUS	NC
1	852.73750000	8K30F1W	FB2C	1	0	100.000	34.32128	-78.22833	RIEGELWOOD	COLUMBUS	NC
1	852.73750000	9K80D7W	FB2C	1	0	100.000	34.32128	-78.22833	RIEGELWOOD	COLUMBUS	NC
1	853.25000000	9K80D7W	FB2C	1	0	100.000	34.32128	-78.22833	RIEGELWOOD	COLUMBUS	NC
1	853.25000000	8K30F1W	FB2C	1	0	100.000	34.32128	-78.22833	RIEGELWOOD	COLUMBUS	NC
1	853.51250000	8K30F1W	FB2C	1	0	100.000	34.32128	-78.22833	RIEGELWOOD	COLUMBUS	NC
1	853.51250000	9K80D7W	FB2C	1	0	100.000	34.32128	-78.22833	RIEGELWOOD	COLUMBUS	NC
1	853.75000000	8K30F1W	FB2C	1	0	100.000	34.32128	-78.22833	RIEGELWOOD	COLUMBUS	NC
1	853.75000000	9K80D7W	FB2C	1	0	100.000	34.32128	-78.22833	RIEGELWOOD	COLUMBUS	NC
2	806.25000000	9K80D7W	MO	5000	0	35.000					
2	806.25000000	8K30F1W	MO	5000	0	35.000					
2	806.46250000	8K30F1W	MO	5000	0	35.000					
2	806.46250000	9K80D7W	MO	5000	0	35.000					
2	806.75000000	8K30F1W	MO	5000	0	35.000					
2	806.75000000	9K80D7W	MO	5000	0	35.000					
2	807.23750000	9K80D7W	MO	5000	0	35.000					
2	807.23750000	8K30F1W	MO	5000	0	35.000					
2	807.73750000	8K30F1W	MO	5000	0	35.000					
2	807.73750000	9K80D7W	MO	5000	0	35.000					
2	808.25000000	8K30F1W	MO	5000	0	35.000					
2	808.25000000	9K80D7W	MO	5000	0	35.000					
2	808.51250000	9K80D7W	MO	5000	0	35.000					
2	808.51250000	8K30F1W	MO	5000	0	35.000					
2	808.75000000	9K80D7W	MO	5000	0	35.000					
2	808.75000000	8K30F1W	MO	5000	0	35.000					

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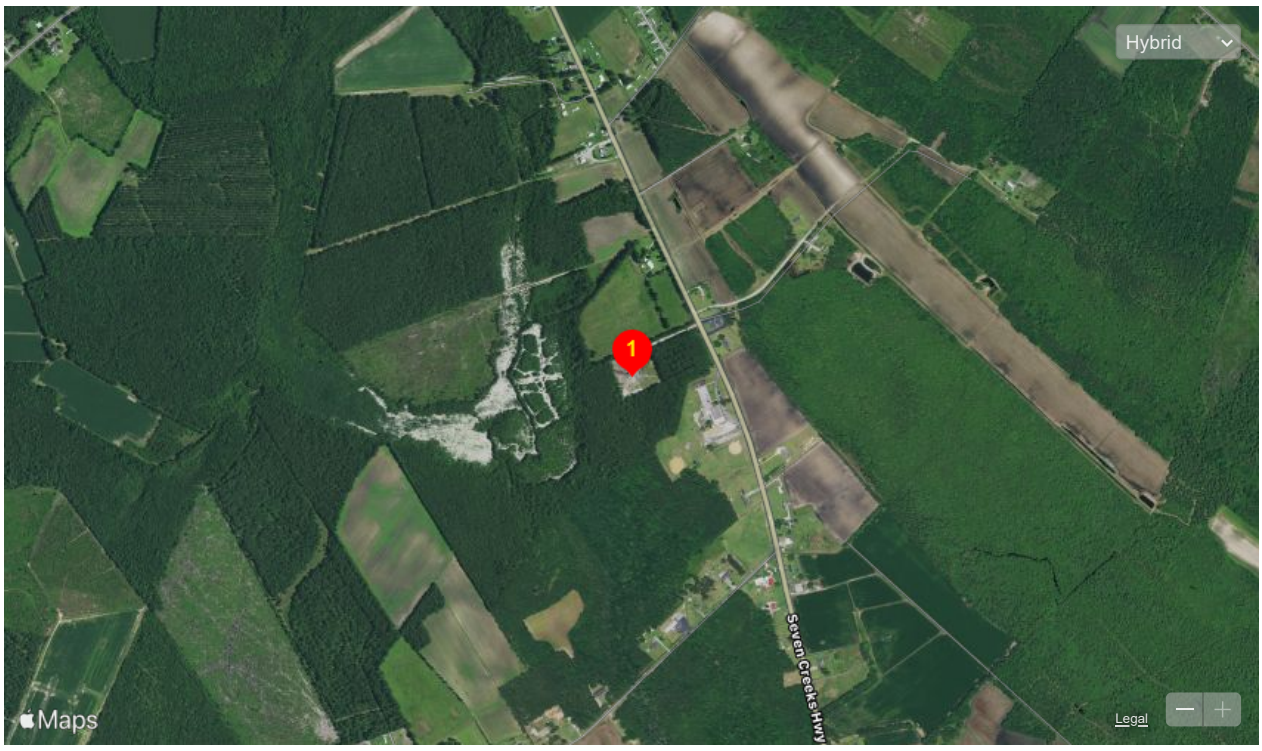
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FCC Callsign WQXV212 (NORTH CAROLINA STATE HIGHWAY PATROL)

Licensee Name:	NORTH CAROLINA STATE HIGHWAY PATROL
License:	WQXV212
FRN:	0001913888
Status:	Active (Effective: 06/17/2016 - Expires: 06/17/2026)
County:	COLUMBUS
State:	NC
Radio Service:	SY: Trunked Public Safety 700MHz
Notes:	LAW ENFORCEMENT AND PUBLIC SAFETY ACTIVITIES ON TRUNKED RADIO



#	Tower ID	Type	Ant Height	Struc Height	Elevation	Address
1	1298551	LTOWER	115.8	121.6	13.4	HP-1182, NAKINA, 9822 SEVEN CREEKS HIGHWAY 28455
2			0.0	0.0	0.0	



Hot

Loc #	Frequency	Emission	Class	Units	Pag	Pwr	Lat	Long	City	County	State
1	769.80625000	9K80D7W	FB2C	1	0	100.000	34.10883	-78.65669	NAKINA	COLUMBUS	NC
1	769.80625000	8K30F1W	FB2C	1	0	100.000	34.10883	-78.65669	NAKINA	COLUMBUS	NC
1	770.28125000	8K30F1W	FB2C	1	0	100.000	34.10883	-78.65669	NAKINA	COLUMBUS	NC
1	770.28125000	9K80D7W	FB2C	1	0	100.000	34.10883	-78.65669	NAKINA	COLUMBUS	NC
1	770.75625000	8K30F1W	FB2C	1	0	100.000	34.10883	-78.65669	NAKINA	COLUMBUS	NC
1	770.75625000	9K80D7W	FB2C	1	0	100.000	34.10883	-78.65669	NAKINA	COLUMBUS	NC
1	771.05625000	9K80D7W	FB2C	1	0	100.000	34.10883	-78.65669	NAKINA	COLUMBUS	NC
1	771.05625000	8K30F1W	FB2C	1	0	100.000	34.10883	-78.65669	NAKINA	COLUMBUS	NC
1	771.30625000	8K30F1W	FB2C	1	0	100.000	34.10883	-78.65669	NAKINA	COLUMBUS	NC
1	771.30625000	9K80D7W	FB2C	1	0	100.000	34.10883	-78.65669	NAKINA	COLUMBUS	NC
1	771.58125000	9K80D7W	FB2C	1	0	100.000	34.10883	-78.65669	NAKINA	COLUMBUS	NC
1	771.58125000	8K30F1W	FB2C	1	0	100.000	34.10883	-78.65669	NAKINA	COLUMBUS	NC
2	799.80625000	8K30F1W	MO	4800	0	30.000					
2	799.80625000	9K80D7W	MO	4800	0	30.000					
2	800.28125000	9K80D7W	MO	4800	0	30.000					
2	800.28125000	8K30F1W	MO	4800	0	30.000					
2	800.75625000	8K30F1W	MO	4800	0	30.000					
2	800.75625000	9K80D7W	MO	4800	0	30.000					
2	801.05625000	9K80D7W	MO	4800	0	30.000					
2	801.05625000	8K30F1W	MO	4800	0	30.000					
2	801.30625000	8K30F1W	MO	4800	0	30.000					
2	801.30625000	9K80D7W	MO	4800	0	30.000					
2	801.58125000	8K30F1W	MO	4800	0	30.000					
2	801.58125000	9K80D7W	MO	4800	0	30.000					

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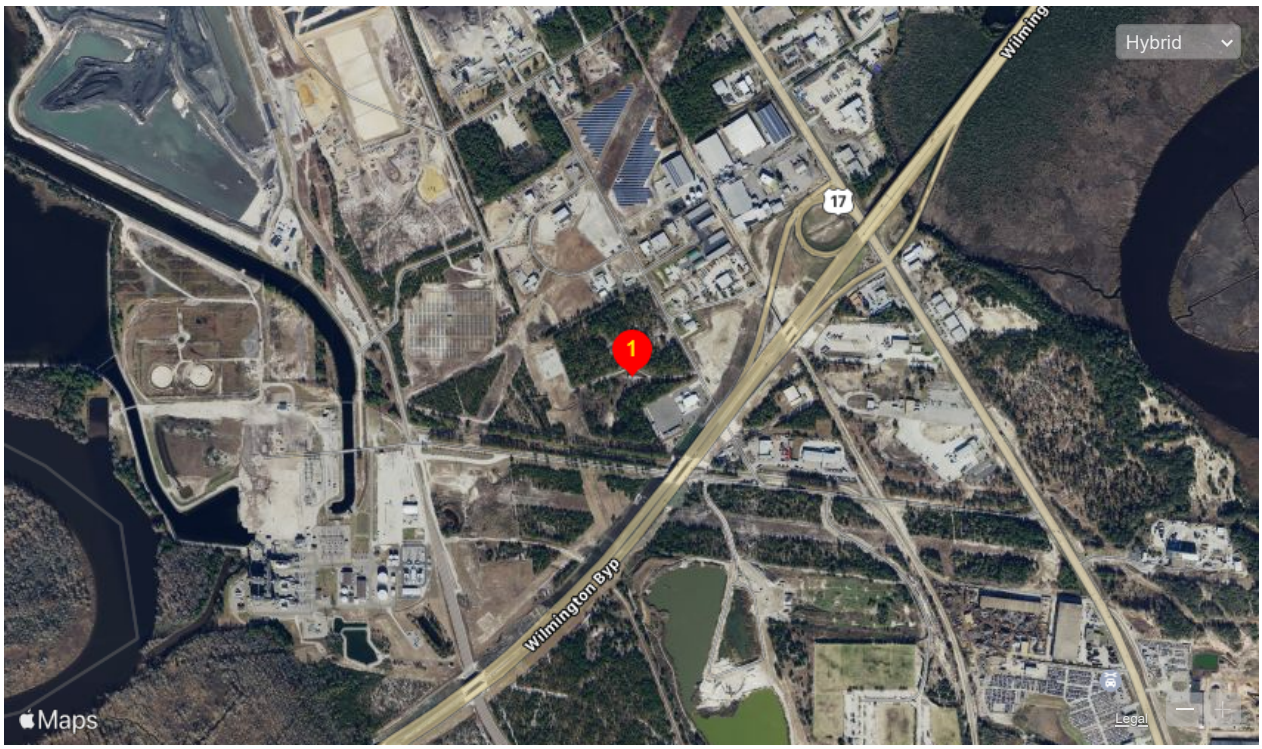


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FCC Callsign WQTA409 (NORTH CAROLINA STATE HIGHWAY PATROL)

Licensee Name:	NORTH CAROLINA STATE HIGHWAY PATROL
License:	WQTA409
FRN:	0001913888
Status:	Active (Effective: 02/06/2014 - Expires: 12/18/2023)
County:	NEW HANOVER
State:	NC
Radio Service:	YE: Public Safety/Spec Emerg and Public Safety Ntl Plan, 806-817/851
Notes:	APPLICANT IS A GOVERNMENT ENTITY WHICH PROVIDES COMMUNICATIONS ESSENTIAL TO ITS OFFICIAL ACTIVITIES.

#	Tower ID	Type	Ant Height	Struc Height	Elevation	Address
1	1012165	GTOWER	176.7	180.4	3.9	HP-1100, FLEMINGTON, 3405 FREDERICKSON ROAD
3			0.0	0.0	0.0	



▷ ×

Loc #	Frequency	Emission	Class	Units	Pag	Pwr	Lat	Long	City	County	State
1	851.12500000	8K30F1W	FB2C	1	0	100.000	34.28583	-77.97528	WILMINGTON	NEW HANOVER	NC
1	851.12500000	20K0F1E	FB2C	1	0	100.000	34.28583	-77.97528	WILMINGTON	NEW HANOVER	NC
1	851.12500000	9K80D7W	FB2C	1	0	100.000	34.28583	-77.97528	WILMINGTON	NEW HANOVER	NC
1	851.12500000	20K0F3E	FB2C	1	0	100.000	34.28583	-77.97528	WILMINGTON	NEW HANOVER	NC
1	851.37500000	20K0F1E	FB2C	1	0	100.000	34.28583	-77.97528	WILMINGTON	NEW HANOVER	NC
1	851.37500000	9K80D7W	FB2C	1	0	100.000	34.28583	-77.97528	WILMINGTON	NEW HANOVER	NC
1	851.37500000	20K0F3E	FB2C	1	0	100.000	34.28583	-77.97528	WILMINGTON	NEW HANOVER	NC
1	851.37500000	8K30F1W	FB2C	1	0	100.000	34.28583	-77.97528	WILMINGTON	NEW HANOVER	NC
1	851.63750000	20K0F3E	FB2C	1	0	100.000	34.28583	-77.97528	WILMINGTON	NEW HANOVER	NC
1	851.63750000	8K30F1W	FB2C	1	0	100.000	34.28583	-77.97528	WILMINGTON	NEW HANOVER	NC
1	851.63750000	20K0F1E	FB2C	1	0	100.000	34.28583	-77.97528	WILMINGTON	NEW HANOVER	NC
1	851.63750000	9K80D7W	FB2C	1	0	100.000	34.28583	-77.97528	WILMINGTON	NEW HANOVER	NC
1	851.81250000	8K30F1W	FB2C	1	0	100.000	34.28583	-77.97528	WILMINGTON	NEW HANOVER	NC
1	851.81250000	20K0F1E	FB2C	1	0	100.000	34.28583	-77.97528	WILMINGTON	NEW HANOVER	NC
1	851.81250000	9K80D7W	FB2C	1	0	100.000	34.28583	-77.97528	WILMINGTON	NEW HANOVER	NC
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1	852.06250000	9K80D7W	FB2C	1	0	100.000	34.28583	-77.97528	WILMINGTON	NEW HANOVER	NC
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1	853.12500000	9K80D7W	FB2C	1	0	100.000	34.28583	-77.97528	WILMINGTON	NEW HANOVER	NC
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3	806.37500000	8K30F1W	MO	1050	0	35.000					
3	806.37500000	20K0F1E	MO	1050	0	35.000					
3	806.37500000	9K80D7W	MO	1050	0	35.000					
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3	806.63750000	9K80D7W	MO	1050	0	35.000					
3	806.63750000	20K0F3E	MO	1050	0	35.000					
3	806.63750000	8K30F1W	MO	1050	0	35.000					

3	806.81250000	9K80D7W	MO	1050	0	35.000					
3	806.81250000	20K0F3E	MO	1050	0	35.000					
3	806.81250000	8K30F1W	MO	1050	0	35.000					
3	806.81250000	20K0F1E	MO	1050	0	35.000					
3	807.06250000	20K0F3E	MO	1050	0	35.000					
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3	807.06250000	20K0F1E	MO	1050	0	35.000					
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FCC ULS Listing for this callsign

FCC Data Last Updated On: 10-17-2019 04:39

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Technical Specification 010.01

AS-BUILT (RECORD) DRAWINGS

1.0 General

a) It is the intent of this specification to provide information to the Engineer and utility contractor concerning requirements for acceptable record drawings for all projects with infrastructure permitted in the County's name.

b) This includes developer installed infrastructure that will be legally dedicated to the County for ownership, operation, and maintenance.

c) Record drawings are an important component of a project and are a requirement of the Substantial Completion process, the Final Acceptance (Deed of Dedication) process, County Capital Improvement Program (CIP) projects, and are used to update the County GIS mapping so an up-to-date and accurate water and sewer system map is maintained per regulatory requirements and is available for use by County staff.

2.0 Record Drawings

a) The utility contractor is responsible for employing an Engineer and / or Land Surveyor licensed in the State of North Carolina to provide accurate record drawings to the County upon completion of construction. The record drawings must be sealed, signed, and dated by the Engineer or Land Surveyor.

b) The record drawings shall be provided to the County as: One set of paper drawings and a CD containing both AutoCAD (Version 2007 or later) and Adobe PDF format files. The PDF files must be **of each individual plan sheet of the record drawings**.

c) Record drawings shall conform to the as-built checklist and will accurately identify the location of all properties, rights-of-way, and easements utilized for the installation of all installed facilities. Record drawings will utilize offsets and benchmarks as necessary to correctly and accurately identify the location of all facilities within the properties, rights-of-way, or easements, and will also indicate any and all encroachments which exist. All aboveground structures such as manholes, fire hydrants, valve boxes, meter boxes, electrical services, pump stations, air release valves, etc., will also be clearly identified.

d) Horizontal control shall be per the State Plane Coordinate System (NAD 83).

e) Vertical control shall be per NAVD 88.

AS-BUILT (RECORD) DRAWING CHECK LIST

Plan sheet size: 24" x 36" (Arch D) with Engineer's seal and / or Surveyor's seal as applicable

Each sheet of the record drawings, including the cover sheet, shall have the NCDENR PWSS water permit number and / or the NCDENR DWQ sewer permit number for the project on the sheet

Drawings shall be prepared at a scale of 1" = 50' (horizontal) and 1" = 5' (vertical)

Indexed cover sheet with : Location of plan-profile sheets by sheet number, name of project and/or subdivision, owner's name, address, phone number, engineer's name, address, phone number, surveyor's name, address, phone number, date, north arrow, scale, site map of project site shown as an inset (minimum size 3" x 3")

Total linear feet of mains shown on cover sheet as:

Water Mains _____ Force mains_____ Gravity sewer mains_____

Gravity sewer: Shown in both plan and profile view with all manhole inverts accurately field located and labeled in profile view and a manhole name and/or number assigned to each manhole.

Manhole rim and invert elevations shall be accurately located and shown

If applicable clearly indicate and label all five (5) foot diameter manholes

All mains and manholes shall have stationing numbers for ease of reference

Plans shall show individual services for gravity sewer cleanouts, water meter boxes, and low pressure sewer services and shall be accurately located and shown on the plans as follows:

Gravity sewer cleanout – open circle
Water meter service – open box
Low pressure sewer – open oval

Clearly indicate all gravity sewer service laterals and indicate their size (4 inch or 6 inch)

Gravity sewer cleanouts shall be located by measuring from the nearest downstream manhole along the sewer main upstream to a point which lies on a line that is perpendicular to the sewer main and connects said point and the cleanout – for example, 150 / 15R (150' from downstream manhole and 15' over to the right side of main)

Water taps and meters larger than the standard (1) inch lateral with (¾) inch meter shall be clearly identified with the size of the service lateral and water meter

Drawings shall indicate water and sewer phases and their relationship to other subdivision phases (if applicable)

Use complete and accurate material descriptions, for example, pipe material (PVC, DIP, HDPE, Fusible PVC, etc.), pipe diameter, DR # of pipe, pressure class of any DIP, length, slope (for gravity sewer), AWWA and / or NSF

Show station or distance to beginning and end of all changes in pipe material and pipe deflections

Show all existing and required vertical and horizontal separations between sewer mains and water mains and also between water mains / sewer mains and stormwater pipes

Show existing grade elevations and proposed finish grade elevations

Show all water supply wells within a one-hundred (100) foot radius of any gravity sewer main or pressure force main

If any vented manholes were used [eg, rims less than (2) feet above 100 year flood elevation] then show the vented manhole and vent and also indicate a watertight ring and cover

Show location of air release valves, gate valves, plug valves, butterfly valves, fire hydrants, etc., along all water mains and sewer force mains

Show lot numbers, lot lines, easement lines, right-of-way lines, and street names

For horizontal directional drills and jack-and-bores the drilling logs are to be incorporated with the record drawings

Technical Specification 011.01

DEWATERING

1.0 General Dewatering Requirements for Utility Work

a) All ground water which may be found in the trenches and any water which may get into them from any cause whatsoever shall be pumped or bailed out so that the trench shall be dry during all pipe laying periods.

b) All water pumped from the trenches shall be disposed of in compliance with the applicable local regulations of the appropriate governing body, and in accordance with all issued permits for the project.

c) If dewatering operations cause a turbidity problem due to suspended sands or silts in the water it shall be the utility contractor's responsibility to utilize adequate methods to prevent unacceptable turbidity discharges, such as the use of a filtration sock or other methods.

d) Any damage to property, or notices of violation from NCDENR, shall be the utility contractor's responsibility to correct to the satisfaction of the Engineer at no cost to Brunswick County. All fines imposed by NCDENR shall be paid by the utility contractor.

e) The contractor shall be required to well point, pump, or provide other measures necessary to keep the trench dry during pipe laying operations.

f) The use of large amounts of crushed stone is not an approved dewatering method.

g) Dewatering operations shall be maintained until all backfilling and compaction is completed or as directed by the Engineer or County staff.

h) No water shall be permitted to reach any poured concrete until it has sufficiently hydrated to a minimum strength such that water will not affect the cured concrete strength.

i) The contractor shall provide and place all necessary flumes or other channels of adequate size to carry temporarily all streams, brooks, stormwater or other water which may flow along or across the lines of the pipe line. All flumes or channels thus utilized shall be tight so as to prevent leakage into the trenches.

Technical Specification 012.01

TRENCH BOXES, SHEETING, AND SHORING

1.0 Sheeting and Shoring

a) Trench boxes, sheeting, shoring, and bracing shall be utilized as needed by the utility contractor during the installation of utility infrastructure in order to protect human life, prevent accidents, maintain trench integrity during pipeline laying operations, prevent damage to buildings or other structures along the line of construction, and to ensure a quality installation.

b) The contractor is responsible for all aspects of using trench boxes, sheeting, and shoring during the project. Care must be taken not to damage in any way water mains, water service pipes, drain pipes, sanitary or stormwater sewers, sewer service pipes, gas mains, oil mains, electric conduits or other structures encountered on the line of the work during trench excavation.

c) Special conditions of an NCDOT Encroachment Permit may require the use of sheeting and shoring while working in the DOT rights-of-way. The Engineer is responsible for the design and approval of any sheeting and shoring required by NCDOT.

d) Only shoring authorized by the Engineer and approved by the Engineer shall be left in place. For shoring left in the public right-of-way the utility contractor must also obtain NCDOT approval.

e) Whenever timber or other sheeting is driven to a depth below the elevation of the top of the pipe, that portion of the sheeting below the elevation of the top of the pipe shall not be disturbed or removed. Whenever timber or other sheeting is driven for the protection of trench walls in water-bearing soil, no portion of such sheeting below a level of 4 feet over the top of the pipe shall be removed.

Technical Specification 013.01

EXCAVATING, GRADING, TRENCHING, & BACKFILLING

1.0 General

a) The utility contractor shall furnish all labor, equipment, and materials for all excavation, grading, trenching, and backfilling associated with the installation of water, sewer, pump stations, drainage structures, curb and gutter, streets, sidewalks, driveways, slopes, storm drainage, and other associated infrastructure within the limits of the project work area. All work done shall be in accordance with the approved plans and specifications.

2.0 Existing Conditions and Utility Locations

a) It is the utility contractor's responsibility to perform all site inspections to familiarize himself with the scope of work involved and the existing conditions at the project site.

b) The contractor is responsible for locating all existing underground utilities in the area of work. If utilities are to remain in place then the contractor shall provide adequate means of protection during earthwork, excavating, trenching, and backfilling operations.

c) Should unlocated, or incorrectly located, piping or other utilities be encountered during excavation the utility owner shall be notified immediately. The utility contractor shall cooperate with the County and other respective utility companies to protect and keep respective services and facilities in operation. The contractor shall also repair any damaged utilities to the satisfaction of the utility owner.

d) Barricade all open excavations occurring as part of this work and post with warning signs and /or lights. Continuously operate all warning lights as recommended by the Authority Having Jurisdiction (AHJ). The utility contractor shall also protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

3.0 Technical Standards

a) ASTM C33 ---- Standard specification for concrete aggregates
b) ASTM D2487 - Classification of soils for engineering purposes.

4.0 Soil Classifications

a) Use soils free of debris, roots, wood, scrap material, vegetation, refuse, soft unsound particles, organic matter, refuse, frozen materials, rocks and lumps greater than 4 inches in diameter and other deleterious matter.

b) For the purpose of this specification, soils to be used as fill material are grouped into five classes according to soil properties and characteristics:

Class I: Angular, 1/4 to 1-1/2 inch, graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, and crushed stone, crushed gravel, and crushed shells

Class II: Coarse sands and gravels with maximum practical size of 1-1/2 inch, including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class.

Class III: Fine sand and clayey gravels, including fine sands, sand-clay mixtures, and gravel-clay mixtures. Soil Types GM, GC, SM, and SC are included in this class.

Class IV: Silt, silty clays, and clays, including inorganic clays and silts of medium to high plasticity and liquid limits. Soil Types MH, ML, CH, and CL are included in this class. **These materials are not recommended for bedding**, **haunching, or initial backfill.**

Class V: This class includes the organic soil, OL, OH, PT as well as soils containing frozen earth, debris, rocks, larger than 40 mm (1-1/2 in.) in diameter, and other foreign materials. **These materials are not recommended for bedding, haunching, or initial backfill.**

5.0 Trench Excavation, Pipe Bedding, Backfilling, and Compaction for Utility Systems

a) Trenching of utilities as a method of installation is not allowed in Brunswick County

b) Trench Excavation

1) Excavation shall be accomplished in accordance with the grades and lines as established by the Engineer or Surveyor and as required by the work to be performed. Excavation shall include the removal and replacement of all asphalt, concrete, curb, rock, earth, fences, trees (as applicable), shrubs, and other materials. The contractor will exercise care to prevent undercutting lower than the required subgrade. All materials from excavation, considered as suitable by this specification, shall be used as fill wherever required, and the contractor shall arrange his work so that this usage of excavated materials will be possible. Unsuitable and surplus materials from the excavation, if any, shall be disposed of by the contractor at his expense. All areas of the site shall be graded and maintained at all times to prevent surface runoff from draining into the excavations and to prevent ponding of water therein.

2) Excavated materials not required for topsoil, fill or backfill shall be removed from the site of the work by the contractor, but none shall be deposited on private property without written consent of the property owner. For County capital improvement projects any agreements between the contractor and private property owners must be provided to the County also.

3) All excavations shall be in compliance with all current OSHA requirements and it is the utility contractor's responsibility to ensure that the project work is in compliance with all OSHA requirements.

4) All piping shall be installed at a minimum depth of 36 inches unless otherwise approved by Brunswick County. Installations shallower than 36 inches, if approved, will require the use of ductile iron pipe.

5) Trenches for piping shall be excavated true to line and grade as shown on the approved plans.

6) Trench widths at and below the top of the pipe shall be the minimum necessary for proper installation. Trench banks above the top of the pipe shall be as vertical as practicable. Overdepth excavation shall be backfilled with Class I material and compacted.

7) The utility contractor shall provide, at his expense and as directed by the Engineer, especially bedding material or concrete encasement as may be necessary due to over-width excavation.

8) Trench depth to the lines and grades shown on the drawings. Where elevations are not shown, trench to a depth sufficient to provide at least 36 inches of cover above the top of pipe, unless otherwise specified. Grade all trenches to provide a constant slope free of sags and high spots. Recesses shall be excavated where required to accommodate bells and joints.

9) Keep trenches free of water. Include cost of dewatering in unit price bid for pipe. No separate payment for dewatering will be made by the County.

10) Properly brace sheet and support trench walls as soil conditions require and in strict conformance with the approved plans, all pertinent laws, and OSHA regulations. Provide adequate bracing and shoring to protect adjacent improvements. Contractor shall provide certification for all premanufactured trench bracing devices prior to any excavation activities.

c) Pipe Bedding

1) Gravity Sewer Mains – Refer to Brunswick County gravity sewer pipe bedding Standard Detail:

Class A bedding: For gravity mains less than twenty (20) feet deep undercut trench bottom six (6) inches minimum below pipe and fill with size #57 stone up to and including the springline of the pipe.

Class B bedding: For gravity mains greater than twenty (20) feet deep undercut trench bottom six (6) inches minimum below pipe and fill with size #57 stone to six (6) inches above the pipe.

2) Pressure Mains, Water or Sewer- it is not necessary to bed pressure mains unless unusually wet or mucky field conditions are encountered. Pressure mains shall be installed in properly excavated trenches on the native soil of the trench. If wet or mucky field conditions are encountered then size #57 stone shall be used to provide a firm bedding but only at the direction of the Engineer or County staff.

3) Service Pipe – bedding is not required on water and sewer service laterals unless unusual conditions are encountered in the field. In these cases the Contractor shall bed the service pipe per direction from the Engineer or County staff.

d) Initial and Final backfilling

1) After properly installing the pipe and bedding, if required, trench backfill shall progress as rapidly as pipe laying will permit.

2) Backfill materials shall be of suitable material and be capable of being compacted to a minimum of ninety-eight (98) percent ASTM D698 (Standard Proctor) maximum density at optimum moisture content.

3) Initial and Final backfill shall be of the Type 1 or Type II material as follows:

a) Type 1 Material: Excavated material from the trench or materials from other sources which are free from large clods, roots or stones larger than 1 inch may be used as initial backfill in trenches (see Pipe Trench Detail).

b) Type 2 Material: Excavated material from the trench or materials from other sources which are free from large clods, roots or stones larger than 8 inches may be used as final backfill in trenches but shall not be used in the final twelve (12) inches of fill (see Pipe Trench Detail).

4) Backfill around the pipe by placing in layers no more than six (6) inches in depth. Backfill shall be compacted with light tamps for the full width of the trench to provide adequate support for the bottom and sides of the pipe. Backfill shall be carried up evenly on both sides of the trench excavation. Particular care is required in backfilling gravity sewer pipe to prevent excessive pipe deflection.

e) Compaction

1) When existing plans and grades require the use of fill to reach the required elevation, the contractor shall deposit suitable material from previously excavated areas or use borrow material. Such material shall be free from debris, roots, trash, stones, or other harmful substances, and shall be spread in successive layers of loose material not more than six (6) inches in depth.

2) Each layer shall be spread uniformly by motor grader or other approved device and rolled with an approved tamping or three-wheeled power roller until thoroughly compacted to a minimum of ninety-eight (98) percent ASTM D698 (Standard Proctor) maximum density at optimum moisture content. Rolling with rubber tired vehicles or track type equipment will not be allowed.

6.0 Crushed Stone

a) Crushed stone shall be size # 57 washed stone only

7.0 Concrete

a) Concrete placed for cradles, thrust blocks, or encasement shall be 3,000 psi minimum strength at twenty-eight (28) days hydration.

8.0 Foundation

a) Foundation shall be required in wet, yielding and mucky locations. Foundation shall be constructed by removal of wet, yielding or mucky material and its replacement with sufficient Class I material to correct the instability. Foundation shall only be installed with the approval of the Engineer or Brunswick County staff. Undercutting and filling with stone will not be allowed or paid for in order to control water in the excavation trench.

9.0 Undercutting

a) Undercutting, unless authorized by the Engineer, shall be replaced and compacted at the contractor's expense. If the material, after excavation to subgrade, is found to be soft, spongy or unfit for use as subgrade, such unsuitable material shall be removed to a depth as directed by the Engineer and the subgrade shall be brought to proper elevation by filling with suitable material from the excavation or from an approved borrow site.

10.0 Borrow Material

a) The Contractor will supply all borrow material necessary and will provide all labor and equipment necessary to dig and haul such borrow material. Any and all

borrow material utilized shall be of suitable quality and meet the requirements of this technical specification.

11.0 Excess Water Control

a) Grade and maintain all areas of the site to preclude surface runoff into excavations and prevent any water accumulation in the excavation.

b) Excavations should be kept free of surface water and/or groundwater. Provide and maintain at all times the necessary means and devices to prevent water from entering the excavations and for removing all water entering the excavations during pipe laying operations. Dewatering shall continue until structure is backfilled and compacted.

c) Include cost of dewatering in the unit cost for pipe. Separate payment will not be made for dewatering operations by Brunswick County.

12.0 Contaminated Soils – Excavation, Removal, and Remediation

a) In the event that contaminated soils are suspected or encountered the contractor shall stop digging in the suspect area and immediately notify both the Engineer and Brunswick County staff.

b) It shall be the utility contractor's responsibility to hire a soils testing firm to examine the suspect area for type and density of contamination. Should testing confirm the presence of contaminated soils, the following steps shall be taken:

1) Excavate contaminated material in a manner consistent with all jurisdictional regulations.

2) Immediately remove contaminated material from the site. Contaminated materials may not be stockpiled for any amount of time.

3) Material is to be disposed of at a permitted facility. Tickets must be produced to the Engineer and County staff accounting for every cubic yard of material removed.

4) Per direction of the Engineer and / or Brunswick County, the pipe material shall be changed to pressure class 350 DIP with Nitrile gaskets.

5) The trench is to be bedded and backfilled with select fill per Brunswick County specifications herein.

13.0 Field Quality Control

a) Field inspection, sampling and testing will be performed as required at either the direction of the Engineer or Brunswick County

b) If required, an independent soils engineering and testing laboratory shall perform sufficient tests and inspection procedures, to the satisfaction of the Engineer and

the County, both in the field and lab to ensure that the provisions of this specification are met. The testing shall be paid by the utility contractor. The testing lab shall be approved by the Engineer and / or Brunswick County.

Technical Specification 018.01

WATER DISTRIBUTION SYSTEM

1.0 General

a) It is the intent of this specification to ensure that all water system infrastructure constructed within the service area of the Brunswick County Public Utilities Department meets or exceeds all local, state, and federal rules and regulations as applicable. This specification also provides technical guidance to contractors and engineers to ensure that all water system infrastructure is properly constructed, tested, chlorinated, and placed in service to protect the public.

2.0 Materials and Requirements for Water Mains

a) General

1) To the maximum extent possible all materials shall be manufactured in the United States. This includes all pipe, valves, fittings, hydrants, meter boxes, etc.

2) All pipe material shall be marked with the manufacturer, type, class, thickness, and date of production in lettering legible to the Engineer and County staff.

3) The engineer is responsible for reviewing all shop submittals for approval. County staff may assist as needed to answer any questions concerning material suitability.

4) All piping material must have a minimum pressure rating of one and one-half (1.5) times the normal working pressure of the pipe.

5) All pipes, valves, hydrants, fittings, etc., must conform to the applicable AWWA standards.

6) Water mains shall be constructed of AWWA C900 PVC, minimum DR-18, except when DIP, HDPE, or Fusible PVC mains are required.

7) All pipes shall be shipped with gaskets installed inside the pipe bell.

8) Water main installation shall conform to AWWA C600: Standard for Installation of Ductile Iron Pipe (DIP), or AWWA C605: Standard for Installation of Polyvinyl Chloride (PVC) pipe

b) Ductile Iron Pipe (DIP)

1) All sizes of pipe shall be manufactured to a nominal laying length of 18'-0" to 20'-0”, except to make adjustments for bends, tees, and other fittings.

2) DIP shall conform to ANSI / AWWA C150 / A21.50 and ANSI / AWWA C151 / A21.51, with interior cement mortar lining and an exterior asphaltic coating for corrosion resistance.

3) Cement mortar linings shall conform to ANSI A21.4 / AWWA C104.

4) DIP that has an interior lining of Protecto 401 (or equivalent) for use in sewer systems shall not be permitted on potable water systems.

5) Joints shall be the push-on or mechanical joint type conforming to ANSI / AWWA C111 / A21.11 as modified by ANSI / AWWA C151 / A21.51.

6) Fittings and specials shall be cast or ductile iron conforming to ASNI 21.10 and shall be rated for one hundred and fifty (150) pounds per square inch minimum pressure.

7) Wall thickness shall be in accordance with Table 51.1 of ANSI/AWWA C151/A21.51 with working pressure of one hundred and fifty (150) psi. Final pipe class shall be determined based on specific structural calculations as they relate to conditions encountered during design. Brunswick County reserves the right to designate the final pipe thickness.

a) (4) inch – (12) inch diameter pipe: minimum pressure class 350

b) (14) inch – (20) inch diameter pipe: minimum pressure class 250

c) (24) inch pipe: minimum pressure class 200

d) Flanged pipe shall be minimum pressure Class 53

8) Rubber gaskets and lubricant shall conform to ANSI/AWWA C111/A21.11.

9) No metric sized pipe shall be permitted.

10) In corrosive, contaminated, and dredged soils, DIP and all fittings shall be wrapped in a polyethylene encasement per ANSI / AWWA A21.5 / C105 *Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids*. All fasteners shall be stainless steel Type 304, minimum grade.

11) Acceptable products are American Cast Iron Pipe Company, Griffin Pipe Company, U.S. Pipe Company, or approved equal.

c) Polyvinyl Chloride Pipe (PVC)

1) All sizes of pipe shall be manufactured to a nominal laying length of 18'-0" to 20'-0" except to make adjustments for bends, tees, and other fittings.

2) Two (2) inch PVC mains shall be SDR-21, gasketed pipe, in accordance with ASTM D2241 and shall bear the seal of the National Sanitation Foundation (NSF).

3) Four (4) inch through twelve (12) inch PVC mains shall be AWWA C900 Class 150 (DR-18) and shall bear the seal of the NSF. Joints shall conform to ASTM D3139 or ASTM D3212.

4) Fourteen (14) inch through thirty-six (36) inch PVC mains shall be AWWA C900 Class 235 (DR-18) and shall bear the seal of the NSF. Joints shall conform to ASTM D3139 or ASTM D3212.

5) PVC mains shall be manufactured with PVC material conforming to PVC 1120.

6) Fittings shall be molded PVC with joints similar to the PVC pipe. Fabricated fittings using solvent welded joints are not acceptable. Fittings may also be DIP fittings listed and approved for use with PVC pipe and shall have a cement mortar lining on the interior and an asphaltic coating on the exterior for corrosion resistance.

7) All PVC water mains shall be factory dyed industry standard blue.

8) Push on joints shall conform to ASTM D3139 with an elastomeric gasket and the joint pressure rating shall not be less than the pipe pressure rating.

9) In corrosive, contaminated, and dredged soils, all fittings shall be wrapped in a polyethylene encasement per ANSI / AWWA A21.5 / C105 *Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids*. All fasteners shall be stainless steel Type 304, minimum grade.

10) Acceptable products are Diamond Plastics Corporation, J M Eagle Manufacturing Company, National, Certainteed, North American, or approved equal.

d) Fusible Polyvinyl Chloride (Fusible PVC)

1) Fusible PVC pipe shall be in the four (4) inch to thirty-six (36) inch diameter range.

2) Fusible PVC shall be AWWA C900 with National Sanitation Foundation (NSF) certifications NSF– 61 and NSF – 14.

3) Fusible PVC shall conform to ASTM cell classification 12454.

4) Fusible PVC shall have a minimum safety factor of two (2.0).

5) Fusible PVC shall be joined by the thermal butt fusion method in accordance with ASTM F-1674 and D-638.

6) Four (4) through twenty-four (24) inch Fusible PVC (DIPS) shall be minimum DR-18.

7) Thirty (30) inch Fusible PVC (DIPS) shall be DR-25.

8) Thirty-six (36) inch Fusible PVC (DIPS) shall be DR-32.5.

9) All Fusible PVC water mains shall be factory dyed industry standard blue.

10) Fittings and specials shall be as stated in Section (4.0) of this specification.

11) Acceptable products are Fusible PVC ™ by Underground Solutions, Inc.

e) <u>High Density Polyethylene Pipe (HDPE)</u>

1) HDPE mains shall be high density polyethylene conforming to AWWA C906 with PE 4710 materials and shall conform to ASTM F714 specification for HDPE pipe.

2) HDPE shall be joined by the thermal butt fusion method in accordance with ASTM D3261.

3) HDPE shall be minimum DR-9 rated at a minimum two hundred (250) pounds per square inch.

4) All HDPE water mains shall have a factory standard blue stripe on the pipe.

5) Fittings and specials for HDPE mains shall be per the HDPE manufacturer's recommendations and shall be submitted as shop submittals by the utility contractor to the engineer for review and approval prior to use. All fittings and specials shall conform to ASTM D3350 for fittings materials.

6) HDPE used for horizontal directional drills (HDD) shall have the pipe diameter increased in order to maintain equivalent inside diameter as the open cut installed pipe it connects to.

7) Acceptable products are Mono-Line Pipe System by Joseph T. Ryerson and Sons, Inc.; Driscopipe 1000 by Phillips Products, Inc.; Sclairpipe by Dupont of Canada; JM Manufacturing Company Inc. or approved equal.

3.0 Materials and Requirements for Water Services

a) Water services that are less than fifty (50) percent of the outside diameter of the supplying main may utilize a wide band body tapping saddle. All other water service connections shall use a tapping sleeve.

b) (1) inch service lines and tapping saddles

1) Service line piping shall be minimum one (1) inch diameter for (3/4) and (1) inch water meters and shall be HDPE tubing, SDR 9, 200 psi, conforming to ASTM D2737 / AWWA C901. No joints are allowed on a service line between the main service tap and the meter stop.

In proven contaminated soils the service line shall be Type K copper with rated and approved gaskets for contaminated soils.

2) Service saddles shall be wide band body service saddles, ACIPCO, US Pipe, McDonald, Mueller, Smith Blair, Ford, JCM, Romac, or approved equal. All fasteners shall be minimum high strength alloy steel.

3) Size of tap shall match that of the service line (1-inch minimum tap).

4) The corporation stop shall have AWWA inlet threads, ball type, outlet connection to be CTS /OD, conductive compression type (grip nut). Size of corporation stop shall match that of service line (1-inch minimum). Corporation stops shall be Mueller B 25028, Ford –Ball Corp FB 1100 or 1000, McDonald – Ball Corp 4704 –BT, or approved equal.

c) (1.5) inch and (2) inch service lines and tapping saddles

1) Services shall be two (2) inch diameter for one and one-half (1.5) inch and two (2) inch water meters and shall be HDPE tubing, SDR 9, 200 psi, conforming to ASTM D2737 / AWWA C901. No joints are allowed on a service line between the main service tap and the meter stop.

In proven contaminated soils the service line shall be Type K copper with rated and approved gaskets for contaminated soils

2) Service saddles shall be wide band body service saddles, McDonald 3800 series, Mueller H 13000 or DR 2S series, Smith Blair 317, Ford FC 202, JCM 406, Romac 202, or approved equal. All fasteners shall be minimum high strength alloy steel.

3) Tapping valve shall be a two (2) inch, resilient wedge gate valve, Mueller A 2360, or approved equal, installed with a valve box and concrete collar per County Standard Detail.

4) Large meter boxes with meter setters are required for one and one-half (1.5) inch and two (2.0) inch water meters and shall be provided by the

contractor and shall accommodate the Sensus AMR/AMI water meter. The contractor shall submit the proposed large meter box and lid to the Engineer for approval prior to installing the meter box.

d) (3) inch and (4) inch service lines

1) Service lines shall be four (4) inch diameter for three (3) inch and four (4) inch water meters and may be HDPE, DIP, or PVC material conforming to technical specifications for these materials per Section (3.0) of this Specification. Water meters three (3) inch and larger shall be installed in a meter vault per County Water Standard Details – Large Meter Vaults.

2) Tapping sleeves are required per County Standard Details. Tapping saddles are not allowed on any services larger than two (2) inch. See Section (12) of this specification for tapping sleeve information. All fasteners shall be minimum high strength alloy steel.

e) Services for water meters larger than four (4) inch shall be sized to match the installed meter size.

f) All services shall be installed as shown on the approved plans and the tap shall be made perpendicular to the main and run straight to the meter box or vault. Variations from this requirement due to field conditions are only by approval of the County in advance of installation.

g) Locating wire is required on water services and water mains. See Section (14) of this specification for locating wire information.

h) Service taps shall be made at the 10:00 o'clock or 2:00 o'clock position on the water main. Service taps shall be staggered from one side of the main to the other with a minimum distance of eighteen (18) inches between taps. Taps are to be a minimum twenty (20) inches apart if made on the same side of the main.

i) Services shall not be installed by the contractor until all the mains have passed hydrostatic testing, cleaning, and chlorination results are satisfactory and provided to County staff.

j) No taps are allowed on a fire hydrant leg.

k) No taps are allowed where rodding is in place.

l) No burned taps are allowed.

m) No taps are allowed on horizontally directionally drilled (HDD) pipe.

n) Brunswick County Public Utilities is standardizing on the Sensus AMR / AMI water meter. Water meters shall be Sensus AMR / AMI, or approved equal, and shall be provided with the MXU unit and touch read pad.

o) Water meter boxes for standard 5/8" x 3/4"' water meters shall be:

Single Meter Boxes:

Ford	LYLV141-243-TP-NL
McDonald	776-208PC2G437
Mueller	H-1462-K

1) Or approved equal – all boxes must accommodate the Sensus water meter with AMI/AMR technology to include the MXU unit and touch read pad
2) Water meter boxes for meters larger than 5/8" x 3/4" shall be provided by the contractor and sized appropriately for the meter being installed

Double Meter Boxes:

Ford	DGHC118-C14439-002-NL
McDonald	773N208BCGP 434TCX001

1) Or approved equal – all boxes must accommodate (2) Sensus ¾-inch water meters with AMI/AMR technology to include the MXU units and touch read pad.

p) All new residential subdivisions that have county public sewer shall install a double water meter box, or two single gang meter boxes, on the one (1) inch service lateral on each lot to accommodate an irrigation meter for separate billing purposes – refer to county water standard detail for water services.

q) Water meters shall be in non-traffic areas. Driveways shall not be formed around meter boxes and the nearest distance from the meter box to the driveway shall be no less than eighteen (18) inches.

r) Large water meter vaults shall be per the County Standard Details for meter vaults. Quazite or GlasMasters polymer concrete enclosures, minimum Tier 22 rating for both the box and lid, are an approved "or equal" to a standard concrete vault. Contact County Engineering with any questions concerning large water meter vaults.

4.0 Materials and Requirements for Fittings and Specials

a) Fittings and specials shall be class (54) ductile iron per ANSI / AWWA A21.11 / C111, ANSI / AWWA A21.53 / C153, and ANSI / AWWA A21.51 / C151, minimum class 350 for (18) inch and smaller fittings and minimum class 250 for (20) inch and larger fittings.

b) Profiles of fittings and specials may have special dimensions as required by the pipe manufacturer.

c) Ductile iron fittings and specials shall be cement mortar lined per ANSI / AWWA A21.4 / C104 and have an asphaltic coating on the exterior for corrosion resistance.

d) No metric sized fittings shall be permitted.

e) All fittings to be shipped with gaskets, glands, nuts, and bolts unless specified otherwise. Nuts and bolts shall be high strength alloy steel.

5.0 Materials and Requirements for Restrained Joints, Piping, and Fittings

a) Restrained joints are required to prevent movement of system piping caused by forces in or on buried piping, tees, valves, branches, bends, plugs, etc.

b) Restrained joints shall be installed as shown on the approved plans, standard details, or as directed by county staff or the Engineer.

c) Concrete thrust blocking shall be installed as shown on the approved plans, standard details, or as directed by county staff or the Engineer.

d) All carrier pipe installed inside a casing shall be pressure class 350 ductile iron pipes per county standard details with restrained joints.

e) All restrained joint systems shall have a pressure rating equal to or greater than that of the pipe on which they are installed.

f) Restraint type gaskets that provide internal restraint by means of stainless steel inserts embedded within the gasket are not permitted for use in Brunswick County.

g) Ductile Iron Pipe (DIP)

1) Install restraints in strict accordance with the manufacturer's recommendations.

2) All ductile iron horizontal directional drill and bore-and-jack installations shall use boltless, integral, positive locking restraint systems that allow for joint deflection and disassembly should the need arise. The restrained joint system shall be a manufacturer's standard restrained joint system such as American (Flex-Ring or Lok-Ring), U S Pipe (TR-Flex), or Griffin (Snap-Lok), or approved equal.

Note: the aforementioned boltless, integral, positive locking restraint systems are also acceptable for use in open cut pipe installations.

3) External bell restraint harness shall have ductile iron glands. The dimensions of the gland shall be such that it can be used with the standard mechanical joint bell. Twist off nuts with preset factory torque setting

shall be used to ensure proper actuation of the restraint device. All nuts, bolts, and fasteners shall be high strength alloy steel. Mechanical joint restraints shall conform to ANSI/AWWA A21.11/C111 and ANSI/AWWA A21.53/C153, latest revision.

The restrained joint system shall be a manufacturer's standard restrained joint system manufactured by EBAA Iron, Inc., Smith-Blair, Inc., JCM, Inc., or approved equal.

4) Restraint for valves and fittings shall have ductile iron glands. Twist off nuts with preset factory torque setting shall be used to ensure proper actuation of the restraint device. All nuts, bolts, and fasteners shall be high strength alloy steel. Mechanical joint restraints shall conform to ANSI/AWWA A21.11/C111 and ANSI/AWWA A21.53/C153, latest revision.

The restrained joint system shall be a manufacturer's standard restrained joint system manufactured by EBAA Iron, Inc., Smith-Blair, Inc., JCM, Inc., or approved equal.

5) Stainless steel rodding and fasteners, Type 304 minimum, is acceptable per county standard details. Manufacturer's restraint system and/or glands are preferred in lieu of rodding.

h) Polyvinyl Chloride Pipe (PVC)

1) Install restraints in strict accordance with the manufacturer's recommendations.

2) External bell restraint harness shall have ductile iron glands. The dimensions of the gland shall be such that it can be used with the standard mechanical joint bell. Twist off nuts with preset factory torque setting shall be used to ensure proper actuation of the restraint device. All nuts, bolts, and fasteners shall be high strength alloy steel. Mechanical joint restraints shall conform to ANSI/AWWA A21.11/ C111 and ANSI/AWWA A21.53/C153, latest revision.

The restrained joint system shall be a manufacturer's standard restrained joint system manufactured by EBAA Iron, Inc., Smith-Blair, Inc., JCM, Inc., or approved equal.

3) Restraint for valves and fittings shall have ductile iron glands. Twist off nuts with preset factory torque setting shall be used to ensure proper actuation of the restraint device. All nuts, bolts, and fasteners shall be high strength alloy steel. Mechanical joint restraints shall conform to ANSI/AWWA A21.11/C111 and ANSI/AWWA A21.53/C153, latest revision.

The restrained joint system shall be a manufacturer's standard restrained joint system manufactured by EBAA Iron, Inc., Smith-Blair, Inc., JCM, Inc., or approved equal.

4) Stainless steel rodding and fasteners, Type 304 minimum, is acceptable per county standard details. Manufacturer's restraint system and/or glands are preferred in lieu of rodding.

6.0 Materials and Requirements for Pipe Couplings – 4 inches and larger

a) Provide couplings where needed to make piping connections.

b) Provide full-length, mechanical joint, ductile iron solid sleeve with twelve (12) inch minimum length.

c) Provide ductile iron cut-in sleeve with mechanical restrained joints where installing fittings in an existing line.

7.0 Materials and Requirements for Fire Hydrants

a) Hydrants shall be the dry barrel type with breakaway flange, shall open left only, conforming to AWWA Standard C502, latest revision, with a six (6) inch mechanical joint connection on the inlet end, minimum four and one-half (4.5) inch valve opening, and two (2.5) inch hose connections and one (4.5) inch pumper connection, all with American National Standard fire hose coupling threads.

b) Hydrants shall have breakaway barrel and operating stem with barrel length for three (3) foot main cover, six (6) inch bottom hub, and one and one-half (1.5) inch solid operating nut with O-ring seals.

c) Main valve seat shall have bronze to bronze threads into the hydrant shoe. Hydrant shall be grease lubricated with a thrust bearing to reduce operating torque or may be oil lubricated.

d) Hydrants shall be rated at one-hundred –fifty (150) psi working pressure and three-hundred (300) psi test pressure.

e) Hydrants shall be shop painted chrome yellow Tnemenc paint (or approved equal) and shall be touched up after installation and given one (1) field coat of chrome yellow enamel. If the hydrant is painted with color other than chrome yellow from the manufacturer, there shall be three (3) field coats of chrome yellow paint applied by the contractor after installation.

f) Hydrant shall be dry bonnet type and be provided with a drain outlet for draining when the valve is closed and shall be provided with washed stone per County Standard Detail to ensure adequate drainage.

g) All fire hydrants installed on water mains 12-inch and smaller shall be installed as shown on County Standard Detail W-1 using a swivel hydrant tee on the main and DIP and/or MJ GradeLok restrained joint (Mega-A-Lug or equal) piping between the hydrant gate valve and the hydrant. Mega-A-Lug is preferred in lieu of rodding. Thrust blocks are required per detail.

h) All fire hydrants installed on water mains larger than 12-inch shall be installed with a level invert tee on the main and DIP and/or MJ GradeLok restrained joint (Mega-A-Lug or equal) piping between the hydrant gate valve and the hydrant. Mega-A-Lug is preferred in lieu of rodding. Thrust blocks are required per detail.

i) Hydrants shall be installed plumb one-eight (1/8) inch per foot, and set so that the pumper nozzle is eighteen (18) inches minimum above the final finished grade.

j) Contractor shall be allowed one (1) barrel extension as required to maintain pumper nozzle at eighteen (18) inches above final finished grade and the fire hydrant shall not be left too high such that the breakaway will not work properly.

k) Hydrants shall be Mueller, Clow, American Darling, or approved equal.

8.0 Materials and Requirements for Building Fire Sprinkler Systems

a) Backflow prevention devices are required on all fire lines and sprinkler systems to prevent cross- contamination of the County's water transmission and distribution system. Refer to the Brunswick County Public Utilities Department's *Cross-Connections and Backflow Protection Policy* for additional information.

b) A lockable post indicator valve (PIV) is required at the right-of-way or easement line on all fire lines to delineate ownership of the fire line between the County and the property owner. The top of the PIV shall be thirty-six (36) inches above finished grade. Refer to County Standard Details for fire lines.

c) Backflow prevention devices shall be installed at the right-of-way or easement line immediately adjacent and downstream of the PIV. With County approval the backflow prevention device may be installed inside a building's mechanical room where the sprinkler riser is located.

e) Where a building utilizes a sprinkler system, or has a Fire Department Connection (FDC), then the required level of backflow protection is a Reduced Pressure Zone (RPZ) backflow preventer.

f) Fire hydrants shall not be installed on private fire lines.

9.0 Materials and Requirements for Water System Valves

a) General Information for all Valves

1) Valves shall be installed on all system branches from feeder mains, on hydrant legs, at each end of horizontal directional drills per standard

detail, per a), b) and c) as follows, or as directed by county staff or the engineer:

a) Install three (3) valves at crosses

b) Install two (2) valves at tees

c) Install one (1) valve on a fire hydrant leg

2) For distribution mains isolation valves are required at approximately every one-hundred (100) feet per one (1) inch diameter of the installed main up to a maximum distance of two thousand (2,000) feet between valves. For example, for an eight (8) inch diameter main install a main line isolation valve every eight hundred (800) feet. Place mail line isolation valves in close proximity to fire hydrants. Also adjust main line isolation valve placement to take into account subdivision entrances, driveways, fences, street intersections, other underground utilities, etc, or as directed by county staff. Restrained joint pipe is required on the first joint in each direction from a main line valve as per county standard detail

3) For transmission mains - defined as twelve (12) inch and larger - install an isolation valve approximately every two hundred (200) feet per one (1) inch diameter of the installed main up to a maximum distance of five thousand (5,000) feet between valves. Place main line isolation valves near fire hydrants. Also adjust main line isolation valve placement to take into account subdivision entrances, driveways, fences, street intersections, other underground utilities, etc, or as directed by county staff. Restrained joint pipe is required on the first joint in each direction from a main line valve per county standard detail.

4) Place main line isolation valves on the downstream side of the fire hydrant tee per the direction of water flow.

5) Valves shall be located per the approved plans, at the proper elevation, and operable. Hard to operate or inoperable valves and fire hydrants are not acceptable and shall be repaired or replaced prior to system hydrostatic pressure testing.

6) All valves shall open left – no right hand open valves are allowed.

7) Valves shall be rodded to the cross or tee if within ten (10) feet of the cross or tee.

8) All valves shall have a metal screw type valve box with lid marked WATER and a concrete collar (in non-traffic areas) installed per the County Standard Detail for valves and valve boxes. Masonry blocking shall be used to support the valve box such that it does not rest on the bonnet of valve – refer to county standard details. Valve lid shall be painted blue.

9) Maximum depth of the valve stem nut shall be five (5) feet. If valve stem nut is deeper than five (5) feet below grade then a valve operating nut extension kit, manufactured by the same company that produced the valve, must be installed by the utility contractor.

b) Gate Valves

1) All valves shall be in conformance with the latest revision of all reference standards of AWWA C509 / 515: *"Resilient Seated Gate Valves for Water Supply Service".*

2) Four (4) inch through twelve (12) inch mains: use resilient wedge gate valves or ¼ turn stainless steel ball valves. No valves smaller than four (4) inch diameter are allowed.

3) All valves shall open left (counter clock wise) – no right hand valves allowed.

4) Valves shall have a two (2) inch metal operating nut with arrow indicating direction of opening.

5) Valves shall be designed for a working pressure of not less than one hundred fifty (150) psi unless specifically approved by county staff or the Engineer.

6) Valves shall be equipped with a non-rising stem. Valves installed in vaults or manholes shall be provided with hand wheel actuators.

7) All valves shall have a screw type valve box and a four (4) inch thick concrete collar in non-traffic areas per county standard detail.

8) Resilient Seated Wedge Gate Valves:

a) Iron body, bronze mounted, double disc, parallel seat type, factory tested to three hundred (300) psi, valve ends to be constructed for use with mechanical joints or push on joints.

b) Bonnet and body flanges shall be fully machined to assure proper sealing of the gasket.

c) Shall have O-Ring sealed stems with one O-Ring located below the thrust collar and with two O-Rings located above the thrust collar. The thrust collar between the two lower O-Rings shall be factory filled with a lubricant to provide permanent lubrication of the thrust collar area.

d) Provide integrally cast bronze or stainless-steel thrust collar.

e) An antifriction thrust washer shall be provided both above and below the thrust collar for ease of operation.

f) Acceptable product: Mueller, M & H, American Flow Control, Clow, or approved equal.

c) Butterfly Valves

1) Butterfly valves shall be installed on water mains sixteen (16) inch diameter and larger.

2) Butterfly valves shall meet the requirement of AWWA C504, latest revision.

3) Valves shall have mechanical joints.

4) Operating stem and nut shall be two (2) inch and open left only.

5) Resilient and elastomer seats are to be synthetic rubber (EPDM).

6) Shafts to be turned, ground and polished, constructed of 18-8 Type 304 stainless steel.

a) Shafts to be of one-piece design.

b) Attach disc to shaft with stainless steel tapered pins and locking nuts.

7) Provide operators with not less than maximum operator torque, as determined in accordance with Appendix A of AWWA C504, to operate valves under actual line pressures and velocities:

a) Provide worm and gear, or traveling nut type, self-locking to prevent the valve disc from creeping or fluttering when it is in any intermediate position between open and closed.

b) Gear operators to be permanently lubricated, totally enclosed, with adjustable stops for the open and closed position.

c) All exterior fasteners shall be minimum high strength alloy steel.

8) Epoxy coated inside and outside conforming to AWWA C550.

9) Rated for a one hundred fifty (150) psi working pressure.

10) Acceptable product: Mueller, American Darling, Pratt, or approved equal.

d) Tapping Valves – less than 30 inches

1) Tapping valves smaller than thirty (30) inches shall conform to the following:

a) Resilient seated wedge type conforming to AWWA C509 / C515.

b) Epoxy coated inside and outside conforming to AWWA C550.

c) Both ends shall be flanged with tapping boss by mechanical joint conforming to ANSI B16.1, Class 125 and ANSI / AWWA C111 / A21.11 respectively.

d) Rated for two hundred fifty (250) psi working pressure.

e) All exterior fasteners shall be minimum high strength alloy steel

f) Acceptable Product: Mueller T-2360 -16, AVK Series 25, or proved equal.

e) Tapping valves (30) inches and larger

1) Bronze seat, double disk type, conforming to AWWA C500, or resilient seated wedge conforming to AWWA C515.

2) Epoxy coated inside and out conforming to AWWA C550.

3) Equipped with four (4) inch by-pass valves.

4) Ends shall be flanged with tapping boss by mechanical joint conforming to ANSI B16.1, Class 125 and ANSI/AWWA C111/A21.11 respectively.

5) Rated for (200) psi working pressure.

6) Acceptable product: Mueller t-2360 -16, AVK Series 25 or approved equal.

10.0 Materials and Requirements for Valve Boxes and Concrete Collars

a) Install per county standard details at each water valve.

b) Cast iron or ductile iron, screw type, with flared base, length as required for the buried valve, Valve Box Adaptor II, by Adaptor Inc., or approved equal.

c) The word “WATER” shall be cast in the cover.

d) The contractor shall spray paint the cover blue after installation.

e) Install precast concrete ring around valve box in unpaved non-traffic areas per county standard detail.

11.0 Materials and Requirements for Valve Markers

a) Valve markers shall be installed in rights-of-way and utility easements as shown on the County Standard Details

b) Valve markers in public rights-of-way shall be concrete, extend thirty-six (36) inches above finished grade, with the cast MV (main valve), AV (air release valve), or BO (blow off) facing the nearest street. Valve markers in utility easements shall be fiberglass and extend sixty (60) inches above finished grade. Refer to county standard details for additional information.

c) Valve markers are not required for fire hydrant leg isolation valves.

d) Valve markers shall be painted blue for water mains.

e) Concrete valve markers shall have a bronze, stamped, insert on top of marker per county standard detail.

12.0 Materials and Requirements for Tapping Sleeves (services larger than 2 inch)

a) Tapping sleeves shall have outlet flange counter bored to accept a mating tapping valve for true alignment of the tapping sleeve, tapping valve, and tapping machine.

b) Sleeves shall be stainless steel, split type, with gasket and flanged outlet.

c) Sleeve fasteners shall be minimum high strength alloy steel.

d) Provide for a minimum working pressure of one hundred fifty (150) psi.

e) Provide (¾) inch NPT test plug on the tapping sleeve.

f) Air test of tapping sleeve – minimum fifty (50) psig for five (5) minutes - shall be witnessed by county staff prior to the contractor performing tapping operations on county water mains. No taps are allowed without county staff present.

g) Acceptable tapping sleeves are:

1) Romac, Ford, and Mueller for mains four (4) inches through twenty-four (24) inches diameter.

2) Dresser, Cascade, and JCM for mains thirty (30) inches and larger.

13.0 Materials and Requirements for Curb Stops and Water Meter Boxes

a) All new residential subdivisions that have public sewer shall install a double water meter box on each lot to accommodate an irrigation meter.

b) See Section 3.0 (o) of this specification for approved water meter boxes.

c) All single gang water meter boxes will have an in-line curb stop valve and an in-line check valve per county standard detail.

d) All irrigation meters, and all non-residential water meters, must have an approved backflow prevention device installed per county standard detail.

e) Brunswick County is standardizing on the Sensus AMR / AMI water meter. All water meter boxes used in the service area of Brunswick County Public Utilities must accommodate the Sensus AMR / AMI water meter.

14.0 Materials and Requirements for Locating Wire, Marking Tape, and Marker Balls

a) Tape shall be three (3) inches wide, blue in color, bearing continuous message "CAUTION WATER LINE BURIED BELOW". Tape shall be made of plastic or other permanent material, and shall be buried continuously above the water main at a depth of eighteen (18) inches below finished grade.

b) All water mains shall have a #12 AWG, high strength copper clad steel conductor (HS-CCS) such as Copperhead Superflex, Pro Trace High Flex, or approved equal, with HDPE insulation, and rated for direct burial. Listed and approved underground connectors shall be used for all splices. The wire shall be brought up in valve boxes per County Standard Detail. In any event, the wire shall be brought up into a valve box at 1,000 feet maximum intervals to provide wire access points. The wire shall be taped to the top of the water main at minimum ten (10) feet intervals.

c) The contractor shall be required to perform a signal strength test of the installed tracer wire at the end of the project with county staff present. Refer to county standard details for tracer wire information.

d) Individual water services shall have tracer wire installed from the main to the meter box.

d) In addition to the tracing wire, electronic marker balls shall be installed on the water main in accordance with Brunswick County Technical Specification TS 035.01: *Electronic Markers for Water and Sewer Pressure Mains.*

15.0 Separation of Water Mains and Sewer Mains

a) Horizontal and Vertical Separation

1) Minimum horizontal separation between water mains and sanitary sewer shall be ten (10) feet. The distance shall be measured edge of pipe to edge of pipe.

2) Should ten (10) foot separation not be feasible, then the water main may be located closer to the sewer main provided that:

a) It is laid in a separate trench,

b) It is laid in the same trench with the water main located at one side on a bench of undistributed earth,

c) In either of the above cases, crown elevation of the sewer shall be at least eighteen (18) inches below invert elevation of the water line.

3) Sewers crossing water mains shall be laid to provide a minimum vertical separation of eighteen (18) inches between the invert of the water main and the crown elevation of the sewer main. The crossing shall be arranged perpendicularly so that the sewer main joints will be equidistant and at least ten (10) feet from the crossing in each direction.

4) If it is impossible to maintain the required horizontal and vertical separation as described above or anytime sewer must be laid above a water main, then both the water main and sewer main must be encased in ferrous sleeves. Sleeves shall have sealed ends. If the water main is ferrous with joints equivalent to water main standards, then the water main does not have to be encased within an additional sleeve

5) Mechanical joints will be required for the transition in the sewer main at water main / sewer main crossings. Fernco couplings are not permitted to be used. Special structural support for the water and sewer mains may be required.

16.0 Hydrostatic Testing

a) Conduct hydrostatic testing in accordance with AWWA C600 (DIP) or AWWA C605 (PVC) as applicable. Conduct tests on each line or valved section of line. Water mains shall be tested to one-hundred and fifty (150) percent of the pipe working pressure, but in no case shall the hydrostatic test pressure be less than (150) psig for a minimum of two (2) hours and shall be witnessed and certified by county staff and / or the Engineer.

b) Slowly fill the main to expel air from the main through the air release valves, fire hydrants, blow offs, or other appurtenances. If permanent air release valves are

not located at all high points, the contractor shall install corporation cocks at such points so that air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed, and the test pressure applied. At the end of the pressure test, the corporation cocks shall be removed and plugged.

c) Hydrostatic pressure testing shall not be made until seven (7) days after installation of piping to be tested is backfilled, and a minimum forty-eight (48) hour notice to county staff is required.

d) Directionally drilled pipe must be pressure tested after any manufacturer's required pipe relaxation period, as applicable, to ascertain the successful completion of the directional drill. All directionally drilled piping shall be tested again with the complete system and witnessed by county staff and /or the engineer.

e) A suitable test pump, furnished by the contractor, shall be connected to the line by means of a tap in the line, or other suitable methods, and the proper test pressure slowly applied to the line.

17.0 Water Main Flushing and Chlorination

a) Conduct disinfection in accordance with AWWA C651 and 15A NCAC 18C .1003 before placing a newly installed water main in service:

1) Upon completion of construction thoroughly flush the water main to remove all sediment, stone, and other foreign matter.

2) Hydrostatically pressures test the water main per Section (16) of this specification.

3) The water main shall be disinfected by the addition and thorough dispersion of a chlorine solution in concentrations sufficient to produce a chlorine residual of at least fifty (50) milligrams per liter (or ppm) in the water throughout the water main system.

4) All installed valves or other appurtenances shall be operated several times while line is filled with chlorinating agent to ensure proper filling of the entire system.

5) The chlorine solution shall remain in contact with the interior surfaces of the piping system for a minimum period of twenty-four (24) hours.

6) At end of retention period flush the system with potable water. At least (10) ppm of chlorine shall remain in the water at the extreme end of the system.

7) If the initial disinfection procedure fails to produce satisfactory laboratory results the system must be disinfected again as needed by the contractor until satisfactory results are obtained.

8) Originals of the laboratory test results shall be provided to county staff.

b) Acceptance:

1) Provide separate samples for each sample location free of coliform bacteria:

a) Contractor shall submit water samples to an approved laboratory for testing.

b) Contact County Engineering or Public Utilities for assistance and verification of sampling – a minimum forty-eight (48) hour notice is required.

c) The sample results shall include the free chlorine residual at the time the samples were collected.

d) All sample locations are to be given an identifying label.

e) The certified laboratory results shall indicate the absence of coliform bacteria in the water samples.

2) At a minimum, sample locations shall be as required by NCDENR and the following:

a) The tie-in location of new and existing water lines.

b) The end of all dead-end lines.

c) At intervals of no more than (1,200) feet for all new lines longer than (1,200) feet in length.

c) Disposal of Chlorinated Water

1) The contractor is cautioned that the spent chlorine solution must be disposed of in such a way as not to be detrimental to animal, plant, or fish life.

18.0 Operation of Brunswick County Water System Valves and Fire Hydrants

a) No county valves or hydrants shall be operated by the contractor without prior approval of county staff.

b) All hydrant and blow-off operations shall be done in a manner so that private property is not impacted and there shall be no flooding of streets, driveways, or roadways or any other traffic problems created.

c) The contractor shall contact county staff prior to performing system flushing or blow-off operations with a minimum forty-eight (48) hour notice.

Technical Specification 020.01

GRAVITY SANITARY SEWER SYSTEM

1.0 General

a) It is the intent of this specification to ensure that all gravity sewer system infrastructure constructed within the service area of the Brunswick County Public Utilities Department meets or exceeds all local, state, and federal rules and regulations as applicable. It is also the intent of this specification to provide the technical guidance needed to the utility contractor to ensure that county gravity sewer system infrastructure is properly constructed, tested, and placed in service. Service laterals shall be installed where shown on the drawings or as directed by the county's representative. Excavation, trenching, and backfilling is covered in TS 013.01: "Excavating, Grading, Trenching, and Backfilling".

2.0 References

a) ASTM D1784 - Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

b) ASTM D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 20.

c) ASTM D2241 - Poly (Vinyl Chloride) (PVC) Pressure-rated pipe (SDR Series).

d) ASTM D2152 - Test Method for Degree of Fusion of Extruded Poly (Vinyl Chloride) (PVC) Pipe and Molded Fittings by Acetone Immersion.

e) ASTM D2321 - Underground Installation of Flexible Thermoplastic Sewer Pipe.

f) ASTM D2412 - External Loading Properties of Plastic Pipe by Parallel-Plate Loading.

g) ASTM D2444 - Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight).

h) ASTM D3034 - Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

i) ASTM D3212 - Elastomeric push-on joints for plastic pipe.

j) AWWA C600 - Installation of Ductile - Iron water mains and appurtenances.

k) AWWA C900 - PVC Pressure Pipe 4 inch through 12 inch.

l) AWWA C905 - PVC Pressure Pipe 14 inch through 36 inch.

m) ASTM D2672 - Bell-End Poly (Vinyl Chloride) (PVC) Pipe.

n) ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

o) ASTM F478 - Precast Concrete Manhole Risers and Tops.

p) ASTM C497 - Concrete Pipe, Manhole Sections, or Tile.

q) ASTM F679 - Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

r) ASTM A746 - Ductile Iron Gravity Sewer Pipe.

s) ASTM F794 - Poly (Vinyl Chloride) (PVC) Ribbed Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

t) AWWA C600 - Standard for Installation of Ductile Iron Pipe Mains and Appurtenances

3.0 Materials and Requirements for Gravity Sewer Mains

a) General

1) To the maximum extent possible all materials shall be manufactured in the United States. This includes all pipe, valves, fittings, hydrants, meter boxes, etc.

2) All pipe material shall be marked with the manufacturer, type, class, thickness, and date of production in lettering legible to county staff.

3) The engineer is responsible for reviewing all shop submittals for approval. County staff may assist to answer any questions concerning shop submittals.

4) All pipes, manholes, fittings, etc., must conform to AWWA standards.

5) Gravity sewer mains shall be constructed of PVC piping and shall be SDR-35, SDR-26, or DR-18. Ductile iron pipe (DIP) may only be used with express written permission of Brunswick County Public Utilities or Engineering Department.

6) All pipes shall be shipped with gaskets installed inside the pipe bell.

7) PVC sewer mains shall be factory dyed industry standard green.

b) Ductile Iron Pipe (DIP)

1) All sizes of pipe shall be manufactured to a nominal laying length of 18'-0" or 20'-0”, except to make adjustments for bends, tees, and other fittings.

2) DIP shall conform to ANSI / AWWA C150 / A21.50 and ANSI / AWWA C151 / A21.51, with an exterior asphaltic coating for corrosion resistance, and an interior lining of Protecto 401 (or equivalent) unless otherwise shown or specified.

3) Joints shall be the push-on or mechanical joint type conforming to ANSI / AWWA C111 / A21.11 as modified by ANSI / AWWA C151 / A21.51.

4) Rubber gaskets and lubricant shall conform to ANSI/AWWA C111/A21.11.

5) No metric sized pipe shall be permitted.

6) If DIP is required, and the soils are found to be corrosive, then all DIP and fittings shall be wrapped in a polyethylene encasement per ANSI / AWWA A21.5 / C105 *Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids*.

7) Acceptable products are American Cast Iron Pipe Company, Griffin Pipe Company, U.S. Pipe Company, or approved equal.

c) Polyvinyl Chloride Pipe (PVC)

1) Sewer mains with depth of earth cover three (3) feet to twelve (12) feet:

a) Eight (8) inch through twelve (12) inch PVC mains, unless specified as DIP, shall be SDR-35 or better conforming to ASTM D3034. Joints shall conform to ASTM D3139 or ASTM D3212.

b) Fourteen (14) inch through thirty-six (36) inch PVC mains, unless specified as DIP, shall be AWWA C905 Class 235 (DR-18). Joints shall conform to ASTM D3139 of ASTM D3212.

2) Sewer mains with depth of earth cover thirteen (13) feet to twenty (20) feet:

a) Eight (8) inch through twelve (12) inch PVC mains, unless specified as DIP, shall be SDR-26 or better conforming to ASTM D3034. Joints shall conform to ASTM D3139 or ASTM D3212.

b) Fourteen (14) inch through thirty-six (36) inch PVC mains, unless specified as DIP, shall be AWWA C905 Class 235 (DR-18). Joints shall conform to ASTM D3139 of ASTM D3212.

3) Sewer mains with depth of earth cover greater than twenty (20) feet:

a) Pipes installed at depths greater than twenty (20) feet shall be constructed of C900 per manufacture's recommendations based on depth and soils classification. At a minimum DR-18 shall be used

at depths of 20 feet or greater. DIP may be allowed with the express written permission of Brunswick County Utilities or Engineering Department.

4) All PVC mains shall be manufactured with PVC material conforming to PVC 1120.

5) Fittings shall be molded PVC with joints similar to the PVC pipe. Fabricated fittings using solvent welded joints are not acceptable. Fittings may also be DIP fittings listed and approved for use with PVC pipe and shall have an asphaltic coating on the exterior for corrosion resistance, and an interior lining of ceramic epoxy Protecto 401 (or equivalent), unless otherwise shown or specified.

6) Acceptable products are Diamond Plastics Corporation, J M Eagle Manufacturing Company, National, Certainteed, North American, or approved equal.

d) Installation

1) Contractor shall install PVC gravity sewer mains in accordance with ASTM D2321. Ductile iron mains shall be installed in accordance with AWWA C600. Both types of material installations shall adhere to excavation, trenching, and backfilling standards as covered in TS 013.01: *"Excavating, Grading, Trenching, and Backfilling".*

2) Pipe shall be installed starting from the lowest point and shall be laid with the spigot ends pointing in the direction of flow.

3) Gravity sewer trenches shall be kept free of standing water during installation by use of a pump. If deemed necessary prior to or during construction, well point systems should be used for dewatering.

4) If a segment of gravity sewer main has two separate pipe requirements due to depth of cover, the greater quality of pipe shall be used for the entire segment.

Example: A segment of gravity pipe contains a section with cover greater than twelve (12) feet, requiring it to be minimum SDR-26, as well as a segment with cover less than twelve (12) feet, otherwise allowing for a minimum of SDR-35; Both shall be installed using the better material – minimum SDR-26.

5) All mains shall have locating tape, and shall be as follows:

a) Tape shall be three (3) inches wide, green in color, bearing continuous message "CAUTION SEWER LINE BURIED BELOW".

b) Tape shall be made of plastic or other permanent material.

c) Tape shall be buried continuously above the gravity sewer main at a depth of eighteen (18) inches below finished grade.

6) No sewer line of any type shall pass through any storm drain structure unless first approved by county staff.

7) When a transition is required from a PVC sewer main to ductile iron pipe sewer main, mechanical joints will be used. Mechanical joints shall conform to AWWA C111. Bolts shall be high strength low alloy steel per AWWA C111.

8) When installing a gravity main above or below a water main or storm drain, all minimum separations and material requirements must be met, as outlined below:

a) When a gravity sewer main crosses underneath a water main, eighteen (18) inch minimum separation must be achieved between the invert of the water main and the crown of the sewer main. If this separation cannot be achieved, both the gravity sewer main and water main shall encased within ferrous sleeves for a distance of ten (10) feet in both directions of the crossing. Sleeves shall have sealed ends. If the water main is a ferrous material with joints equivalent to water standards, then the water main does not have to be encased within an additional sleeve.

b) When a gravity sewer main crosses over top of a water main, both materials shall be encased within ferrous sleeves for a distance of ten (10) feet in both directions of the crossing. Sleeves shall have sealed ends.

c) When a gravity sewer main crosses underneath a storm drain, twenty-four (24) inch minimum separation must be achieved. If this separation cannot be achieved, the gravity main shall be constructed in a manner concurrent with Brunswick County standard detail S-15.

d) When a gravity sewer main crosses over top of a storm drain, twenty-four (24) inch minimum separation must be achieved. If this separation cannot be achieved, the gravity main shall be encased within a ferrous sleeve for a distance of ten (10) feet in both directions of the crossing. Sleeves shall have sealed ends.

4.0 Materials and Requirements for Sewer Services

a) General

1) Pipe and fittings for four (4) inch and six (6) inch gravity sewer services shall be constructed of SCH 40 PVC pipe conforming to ASTM D178 with solvent welded joints.

2) Sewer services shall be installed in accordance with county standard details.

3) All services shall be single services. No double services are to be installed.

b) Installation

1) All gravity sewer services are to be installed using a wye angled downstream of the main.

2) The service wye should be turned to the top quadrant of the gravity main – approximately (45) degrees from the top centerline of the main. In no case, shall the service laterals be stacked vertically over the gravity main.

3) Gravity sewer services shall be installed perpendicular to the gravity main.

4) Wherever possible, gravity services shall be tied into a manhole.

5) Services shall be installed so that they meet minimum clearances from existing and proposed utilities, such as eighteen (18) inch minimum separation below a water main.

6) The minimum vertical ground cover over a gravity sewer lateral shall be twenty-four (24) inches (thirty-six (36) inches if in NCDOT right-of-way).

7) Sewer services shall terminate with a wye to a surface cleanout complete with square nut cap, cast iron box, and cover marked “C/O” or “SEWER”. The invert of the wye shall be capped with a watertight plug for future plumbing connection. See county standard details.

8) Install a 4”x4”x 6’ treated timber marker at the property or easement line behind the service cleanout for location of the service. The timber shall be installed with 2’ buried and 4’ visible above final grade.

9) Services shall be installed at a minimum grade of 1/8 inch per foot. Service termination grade shall be at adequate depth for future plumbing connection.

5.0 Materials and Requirements for Manholes

a) General

1) Joint surfaces between bases, risers and cones shall be manufactured to the joint surface design and tolerance requirements of ASTM C76.

2) Flexible joint sealants shall be butyl rubber-based conforming to Federal Specification SS-S-210A, AASHTO M-198, Type B - Butyl Rubber and as follows: maximum of 1% volatile matter and suitable for application temperatures between 10 and 100 degrees F.

3) Pipe to manhole connectors shall conform to ASTM C923. The location of the pipe connectors shall vary from the location shown on the project plans by no more than (1/2) inch vertically and five (5) degrees horizontally. Provide for control of the pipe OD to within the tolerances of the connector on flexible pipes larger than twelve (12) inches.

4) Concrete shall conform to ASTM C478 and as follows:

a) Compressive strength: 4000 psi minimum at 28 days.

b) Air Content: 4 percent minimum.

c) Cementitious Materials: Minimum of 564 pounds per c.y.

d) Coarse Aggregates: ASTM C33.

e) Fine Aggregates: ASTM C33. Free from organic impurities.

f) Chemical Admixtures: ASTM C494. Calcium Chloride or admixtures containing calcium shall not be used.

g) Air Entraining Admixtures: ASTM C260.

5) Mortar shall be Type S conforming to ASTM C270.

6) Brick shall be used to bring manhole rings to grade or filler for forming manhole inverts only and shall conform to ASTM C62 Grade SW or ASTM C32 Grade MS.

7) Manholes shall have an eccentric cone. Manholes four (4) feet deep or less may have a flat top.

8) Manholes shall have a minimum six (6) inch extended base.

9) Manholes shall have a minimum inside diameter of four (4) feet for sewer mains eighteen (18) inches diameter and smaller, and shall be five (5) feet

inside diameter for sewer mains larger than eighteen (18) inches. Larger inside diameters may be required for larger pipe sizes, more than two pipes, or when entrance/exit angles require a larger manhole.

10) Drop manholes shall be inside drop, unless otherwise approved by Brunswick County, with a minimum inside diameter of five (5) feet.

11) Manhole steps shall be provided in bases, risers, and cones and aligned vertically on center. Steps shall be cast in place or, if approved by the County, secured to the wall with a compression fit in tapered holes. Steps shall not be vibrated or driven into freshly cast concrete or grouted in place. The steps shall be Copolymer Polypropylene Plastic reinforced with a ½" diameter grade 60 bar and have serrated tread and tall end lugs. Step pullout strength shall be tested per ASTM C497.

12) Each manhole shall be equipped with an insert of high density copolymer meeting the requirements of ASTM 124. Manholes located in traffic areas shall have stainless steel sewer guards.

13) When a watertight manhole is to be used due to flood plain location, a vent pipe shall be installed for proper ventilation of the manhole. Refer to county standard details.

14) Manhole interiors shall be factory coated with a minimum twenty (20) mils coal tar epoxy or other County approved coating.

15) Where sewer force mains connect to a gravity sewer manhole, the interior of the manhole shall be coated with an interior coating to protect against hydrogen sulfide corrosion. Such coating shall be a minimum of twenty (20) mils in thickness and shall be Raven 405 Lining Systems, Zebron 386, or Sewerkote (Duramar 1030).

16) All manhole frames and covers shall conform to ASTM A48.

17) All manhole covers are to be clearly marked “Sanitary Sewer”.

18) Sanitary sewer covers shall utilize lifting bars instead of pick holes.

19) Standard covers shall have up to four (4), one (1) inch diameter vent holes.

20) Acceptable manufacturers of standard manhole frames and covers are US Foundry, Capitol Foundry, East Jordan, General Foundries, or approved equal.

21) Watertight manhole covers are required for all manholes where the rim elevation is less than one (1) foot above the 100-year flood elevation.

22) Acceptable manufacturers of watertight manhole frames and covers are US Foundry, Capitol Foundry, East Jordan, or approved equal.

b) Installation

1) Structure:

a) All damage to pre-cast sections shall be thoroughly repaired. Repair and patching of minor breaks shall be done by chipping and scarifying the defective area before application of grout. Pre-cast sections shall be subject to rejection on account of failure to conform to any of the specification requirements. In addition, individual sections of manhole sections may be rejected because of fractures or cracks passing through the wall, except for a single end crack that does not exceed the depth of the joint; defects that indicate imperfect proportioning, mixing, and molding; surface defects indicating honey-combed or open texture; damaged or cracked end, where such damage would prevent making a satisfactory joint; and/or any continuous crack having a surface which width of 0.01 inches or more and extending for a length of twelve (12) inches or more, regardless of position in the section wall.

2) Setting:

a) The contractor is responsible for getting the manhole tops to proper grade. The top of the pre-cast manhole may be brought to proper grade for receiving manhole frames by using precast riser rings, unless otherwise approved for masonry. Masonry construction shall be performed by experienced and qualified workmen. All work shall be laid plumb, straight, level, square, and true. Extensions may not be made greater than twelve (12) inches. If needed, manhole riser sections with precast steps shall be used.

b) Manholes shall be set on a minimum of eight (8) inches of #57 crushed stone on a level undisturbed or well compacted subgrade.

c) Manhole structures are to be level upon completion.

d) Butyl rubber sealing shall be placed between each manhole riser section. Backing tape shall be removed prior to application and a sufficient amount of sealant shall be used to completely seal the joint.

e) All joints, cracks, lifting nooks inside the manhole are to be grouted to prevent infiltration. All interior grouting shall be covered in a field coat of coal tar epoxy. All exterior joints are to be wrapped with flat butyl rubber tape.

3) Connections:

a) All in place penetrations into manholes must be by core boring methods including main line and service drops. Properly sized elastomeric boots shall be set in penetrations. The boot and the pipe must be fully mortared on the inside and the outside of the manhole.

b) The invert channels shall be (3/4) the depth of the largest pipe and shall be smooth and semicircular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of channels shall be made gradually and evenly. The invert channels shall be formed directly in the concrete of the manhole base or shall be built up with solid brick and Type S mortar.

c) All main or service connections made above the shelf, not exceeding thirty (30) inches, shall have a slide constructed with brick and type S mortar. Slide shall be formed at the connection in a semicircular fashion conforming to the inside of the connected pipe. The slide shall be gradually angled toward the downstream invert of the gravity main for smooth flow. Connections made above thirty (30) inches will require a drop. Refer to county standard details.

d) All drop manholes are to be inside drops unless otherwise approved by county staff. All hardware used to anchor the drop pipe shall be Type 316 stainless steel. Refer to county standard details.

4) Frames and Covers:

a) Standard manhole frames are to be centered over the precast opening of the manhole, sealed with butyl rubber sealant, and mortared into place inside and out. Mortar inside shall be coated with field coat of coal tar epoxy along with all other grouted surfaces.

b) Standard manhole frames and covers shall have high density copolymer inserts in non-traffic areas, and stainless steel inserts in traffic areas.

c) Watertight manhole frames are to be centered over the precast opening of the manhole, sealed with butyl rubber sealant, bolted down, and mortared into place inside and out. Mortar inside shall be coated with field coat of coal tar epoxy along with all other grouted surfaces.

d) Watertight frames and covers do not require an insert.

6.0 Requirements for Connections to Existing Gravity Sewer Systems

a) Connections to Existing Mains

1) Connection of a new gravity sewer collection main to an existing gravity sewer collection main shall be made by installation of a new "doghouse" manhole at the connection point. Refer to county standard details.

2) Connection of a new gravity sewer service to an existing gravity sewer main shall be made by use of a tapping saddle in accordance with county standard details.

3) Where two or more mains of different diameters enter a sanitary sewer manhole, it is required to match the crown elevations of the different size pipes.

7.0 Requirements for Testing and Completion

a) Preparation

1) All personnel and materials needed for satisfactory testing of gravity systems are to be supplied by the contractor. All procedures will be performed by the contractor except where otherwise indicated.

2) Upon completion of construction of the new gravity collection system, all main lines and manholes are to be cleaned of any silt and debris.

3) All newly constructed gravity systems must be allowed a settling period of thirty (30) days from the date of completion of the system prior to any testing. In lieu of a settling period, contractor may opt to backfill trenches in one (1) foot compacted lifts upon approval from Brunswick County. Intention must be made known at the time of the preconstruction meeting.

4) It is the contractor's responsibility to schedule all testing a minimum of (48) hours in advance. The contractor shall have all testing equipment on site and in place prior to the scheduled start time of the respective test. All lines used to pull the mandrel must be in place prior to the start of testing so that personnel are not waiting for set up to take place before testing can commence.

b) Deflection Test

1) Deflection testing shall be performed on all sections of flexible pipe.

2) The maximum allowable deflection at any point shall be five (5) percent.

3) Deflection will be measured by a pin-type mandrel "GO/No GO" gauge outfitted for the proper pipe material and diameter.

4) The mandrel shall be pulled through the pipe by means of a strong cord or cable. Mandrel shall be pulled by hand.

5) Any section not meeting the five (5) percent deflection requirement shall be excavated, backfilled, re-compacted in one (1) foot lifts, and retested.

c) Air Test

1) Each segment of line shall prove airtight.

2) Test pressure shall be five (5) psi. No pressure loss will be allowed.

3) Testing time, in minutes, shall be calculated as [0.625 x Nominal pipe diameter (in inches)]. Minimum air test time is five (5) minutes.

d) Displacement Test

1) Sewer mains will be checked by county personnel to determine whether displacement has occurred.

2) Displacement will be checked by shining light from manhole to manhole by means of flashlight or reflected sunlight. The line shall be visually inspected directly or with the aid of a mirror. A "full moon" shall be visible.

3) If any displacement is visible, the section of pipe displaced shall be excavated, backfilled, re-compacted in one (1) foot lifts, and retested for airtightness and displacement.

e) Other Testing

1) At the discretion of county staff, the following tests may also be required, at the expense of the contractor, prior to acceptance:

a) Manhole Vacuum Test

1) Vacuum testing shall be performed in accordance with the requirements outlined in ASTM C1244.

b) Soil Compaction Test

1) All trenches suspected of not meeting compaction requirements shall be tested for cconformance by an approved facility for the locations and depths specified by county staff. The facility approval shall be by county staff.

Technical Specification 026.01

CONCRETE REINFORCEMENT

1.0 General

a) This specification gives general guidance and requirements for the structural reinforcement of poured in place concrete. Additional requirements may be required by the Engineer for the project and will be shown on the plans approved by the Engineer and Brunswick County.

2.0 Reference Standards and Specifications

a) The latest editions of the reference standards listed below form a part of this specification and are applicable to this project.

b) American Society for Testing and Materials:

1) ASTM A- 615: Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

2) ASTM A -185: Specification for Welded Steel Wire Fabric for Concrete Reinforcement

c) American Concrete Institute:

1) ACI 315: Manual of Standard Practice for Detailing Reinforced Concrete Structures

2) ACI 318: Building Code Requirements for Reinforced Concrete

d) Concrete Reinforcing Steel Institute

1) CRSI 163: Recommended Practice for Placing Reinforcing Bars

2) CRSI 165: Recommended Practice for Placing Bar Supports, Specifications, and Nomenclature

e) Brunswick County technical specification TS 027.01: Cast-in-Place Concrete

3.0 Submittals

a) The general contractor, or utility contractor, shall submit the following items to the Engineer for review and approval prior to beginning work:

1) Manufacturer's certificates giving the properties of steel proposed for use. List the manufacturer's test number and heat number, chemical analysis; yield point, tensile strength and percent elongation. Also identify on the certificates the proposed location of the steel in the work.

2) Submit the bill of materials along with the shop drawings for review.

d) Shop Drawings:

1) Submit shop drawings for proposed reinforcement materials. Show reinforcement fabrication, bar placement location, splices, and spacing and bar designation, bar type, length size, bending number of bars, and other pertinent information, including dimensions. Information must correspond directly to data listed on the bill of material.

2) Provide sufficient detail to permit placement of reinforcement without use of design drawings. Reproduction of design drawings for use as shop drawings will not be allowed. Begin fabrication of reinforcing steel after shop drawings have been reviewed and approved by the Engineer.

3) Refer to ACI reference for detailing, location, placing, splicing, etc. of reinforcing steel to be shown on shop drawings.

4.0 Handling and Storage

a) Store steel reinforcement above the ground on platforms, skids or other supports. Protect reinforcing, as far as practicable, from mechanical injury, surface deterioration and rusting caused by exposure to the weather.

5.0 Materials

a) Deformed Bars: Use deformed bars conforming to ASTM A- 615

b) Marking: Clearly mark all bars with waterproof tags showing the number of bars, size, mark, length, and yield strength. Mark steel with the same designation as the member in which it occurs. Key marks to the concrete placement number as designated in the concrete placement sequence shown on the drawings.

c) Welded Wire Fabric: Use welded wire fabric per ASTM A- 185

d) Tie Wire: Use 18-gage annealed steel for tie wire.

6.0 Accessories

a) Submit all accessory items, such as expansion joint fillers, joint sealing compounds, riser bars, bonding agents, crack fillers, primers, and other accessory items as a shop submittal to the Engineer for review and approval prior to beginning work on the project.

7.0 Notification

a) Notify the Engineer at least twenty – four (24) hours before concrete placement so that reinforcement may be inspected and errors corrected without delaying the work.

b) All reinforcement shall have a minimum two (2) inch clearance from all forms unless designed to protrude into a subsequent, adjacent, concrete pour.

8.0 Payment

a) Include all work for concrete reinforcement in the unit cost for cast-in-place concrete. Separate payment will not be made for this item.

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Clearing and protection of vegetation.

B. Removal of existing debris.

1.2 RELATED SECTIONS

A. Section 011000 - Summary: Limitations on Contractor's use of site and premises.

B. Section 011000 - Summary: Sequencing and staging requirements.

C. Section 017300 - Execution Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products.

D. Section 312200 - Grading: Topsoil removal.

E. Section 312200 - Grading: Fill material for filling holes, pits, and excavations generated as a result of removal operations.

F. Section 312323 - Fill and Backfill: Fill material for filling holes, pits, and excavations generated as a result of removal operations.

G. Section 312323 - Fill and Backfill: Filling holes, pits, and excavations generated as a result of removal operations.

H. Section 312500 - Temporary Erosion and Sedimentation Control.

1.3 SUBMITTALS

A. See Section 013300 - Administrative Requirements, for submittal procedures.

B. Erosion Control Plan: Showing:

1. Vegetation removal limits.
2. Areas for temporary construction and field offices.

1.4 QUALITY ASSURANCE

A. Clearing Firm: Company specializing in the type of work required.

1. Minimum of five years of documented experience.

1.5 PROJECT CONDITIONS

A. Minimize production of dust due to clearing operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

B. Comply with other requirements specified in Section 017300.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fill Material: As specified in Section 312200 - Grading

PART 3 - EXECUTION

3.1 EXISTING UTILITIES AND BUILT ELEMENTS

A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. Protect existing structures and other elements that are not to be removed.

3.2 VEGETATION

A. Scope: Remove trees, shrubs, brush, and stumps in areas to be covered by building structure, paving, playing fields, lawns, and planting beds.

B. Do not begin clearing until vegetation to be relocated has been removed.

C. Do not remove or damage vegetation beyond the following limits:

1. 40 feet outside the building perimeter.
2. 10 feet each side of surface walkways, patios, surface parking, and utility lines less than 12 inches in diameter.
3. 15 feet each side of roadway curbs and main utility trenches.
4. 25 feet outside perimeter of pervious paving areas that must not be compacted by construction traffic.
5. Exception: Specific trees and vegetation indicated on drawings to be removed.
6. Exception: Selective thinning of undergrowth specified elsewhere.

D. Install substantial, highly visible fences at least 3 feet high to prevent inadvertent damage to vegetation to remain:

1. At vegetation removal limits.
2. Around trees to remain within vegetation removal limits; locate no closer to tree than at the drip line.
3. Around other vegetation to remain within vegetation removal limits.
4. See Section 015000 for fence construction requirements.

E. In areas where vegetation must be removed but no construction will occur other than pervious paving, remove vegetation with minimum disturbance of the subsoil.

F. Vegetation Removed: Do not burn, bury, landfill, or leave on site, except as indicated.

1. Chip, grind, crush, or shred vegetation for mulching, composting, or other purposes; preference should be given to on-site uses.
2. Trees: Sell if marketable; if not, treat as specified for other vegetation removed; remove stumps and roots to depth of 18 inches.
3. Existing Stumps: Treat as specified for other vegetation removed; remove stumps and roots to depth of 18 inches.
4. Sod: Re-use on site if possible; otherwise sell if marketable, and if not, treat as specified for other vegetation removed.
5. Fill holes left by removal of stumps and roots, using suitable fill material, with top surface neat in appearance and smooth enough not to constitute a hazard to pedestrians.

G. Dead Wood: Remove all dead trees (standing or down), limbs, and dry brush on entire site; treat as specified for vegetation removed.

H. Restoration: If vegetation outside removal limits or within specified protective fences is damaged or destroyed due to subsequent construction operations, replace at no cost to Owner.

3.3 DEBRIS

A. Remove debris, junk, and trash from site.

B. Leave site in clean condition, ready for subsequent work.

C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION 311000

SECTION 312200 - GRADING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Removal of topsoil.

B. Rough grading and preparation of site for site structures, building pads, and drainage features.

C. Finish grading.

1.2 RELATED SECTIONS

A. Section 311000 - Site Clearing.

B. Section 312300 - Excavation.

C. Section 312323 - Fill and Backfill: Filling and compaction.

D. Section 312333 - Trenching for Site Utilities: Trenching and backfilling for utilities.

E. Section 329219 - Seeding: Finish ground cover.

F. Section 329223 - Sodding: Finish ground cover.

1.3 UNIT PRICES

A. See Section 012200 - Unit Prices, for general requirements relating to unit prices for this work.

1.4 SUBMITTALS

A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with State of North Carolina, Highway Department standards.

1. Maintain one copy on site.

1.6 PROJECT CONDITIONS

A. Protect above- and below-grade utilities that remain.

B. Protect plants, lawns, rock outcroppings, and other features to remain as a portion of final landscaping.

C. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from grading equipment and vehicular traffic.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fill Materials: See Section 312323.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that survey bench mark and intended elevations for the Work are as indicated.

3.2 PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Stake and flag locations of known utilities.

C. Locate, identify, and protect utilities that remain, from damage.

D. Notify utility company to remove and relocate utilities.

3.3 ROUGH GRADING

A. Remove topsoil from areas to be further excavated, re-landscaped, or re-graded, without mixing with foreign materials.

B. Do not remove topsoil when wet.

C. Remove subsoil from areas to be further excavated, re-landscaped, or re-graded.

D. Do not remove wet subsoil, unless it is subsequently processed to obtain optimum moisture content.

E. When excavating through roots, perform work by hand and cut roots with sharp axe.

F. See Section 312323 for filling procedures.

G. Benching Slopes: Horizontally bench existing slopes greater than 1:4 to key fill material to slope for firm bearing.

H. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.

3.4 SOIL REMOVAL

A. Stockpile excavated topsoil on site.

B. Stockpile topsoil to be re-used on site; remove remainder from site.

C. Remove excavated topsoil from site.

D. Stockpile excavated subsoil on site.

E. Stockpile subsoil to be re-used on site; remove remainder from site.

F. Remove excavated subsoil from site.

G. Stockpiles: Use areas designated on site; pile depth not to exceed 8 feet; protect from erosion.

3.5 FINISH GRADING

A. Before Finish Grading:

1. Verify building and trench backfilling have been inspected.
2. Verify subgrade has been contoured and compacted.

B. Remove debris, roots, branches, stones, in excess of 1/2 inch in size. Remove soil contaminated with petroleum products.

C. Where topsoil is to be placed, scarify surface to depth of 3 inches.

D. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 3 inches.

E. Place topsoil in areas where seeding are indicated.

F. Place topsoil where required to level finish grade.

G. Place topsoil to the following compacted thicknesses:

1. Areas to be Seeded with Grass: 6 inches.
2. Areas to be Sodded: 4 inches.
3. Shrub Beds: 18 inches.
4. Flower Beds: 12 inches.
5. Planter Boxes: To within 3 inches of box rim.

H. Place topsoil during dry weather.

I. Remove roots, weeds, rocks, and foreign material while spreading.

J. Near plants spread topsoil manually to prevent damage.

K. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.

L. Lightly compact placed topsoil.

3.6 TOLERANCES

A. Top Surface of Subgrade: Plus or minus 1/10 foot from required elevation.

B. Top Surface of Finish Grade: Plus or minus 1/2 inch.

3.7 FIELD QUALITY CONTROL

A. See Section 312030 for compaction density testing.

3.8 CLEANING AND PROTECTION

A. Remove unused stockpiled topsoil and subsoil. Grade stockpile area to prevent standing water.

B. Leave site clean and raked, ready to receive landscaping.

END OF SECTION 312200

SECTION 312216 - SUBGRADE AND ROADBED

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and provisions of the General Conditions, Supplemental Conditions, and Division 1 are included as part of this Section as though bound herein.

B. Section 500 of the North Carolina Department of Transportation "Standard Specifications for Roads and Structures" dated July 2006.

1.2 WORK INCLUDED

A. The work covered by this section consists of the preparation, shaping, and compaction of that portion of the roadway areas that are to be paved.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 CONSTRUCTION METHODS

A. Preparation of Subgrade:

1. The subgrade shall be shaped to the lines, grades, spot elevations and typical sections shown on the plans. Where the Owner's Representative directs that areas of the subgrade are to be stabilized, the subgrade in such areas may be left uniformly below grade to provide for the addition of the stabilizer material.
2. All unsuitable material, boulders, and all vegetative matter shall be removed and replaced with suitable material. Suitable material, when not available from the subgrade work, shall be taken from pond excavation or borrow sources.
3. Material excavated in preparing the subgrade shall be stored or stockpiled in such a manner as to not interfere with proper drainage or any of the subsequent operations of placing aggregate base course.

B. Compaction of Subgrade:

1. When tested, all material to a depth of 12 inches below the finished surface of the subgrade shall be compacted to a density equal to at least 100% of that obtained by compacting a sample of the material in accordance with ASTM D 698.
2. The subgrade shall be compacted at a moisture content which is approximately that required to produce the maximum density indicated by the above test method. The Contractor shall dry or add moisture to the subgrade when required to provide a uniformly compacted and acceptable subgrade.

3.2 TOLERANCES

A. A tolerance of plus or minus 1/2 inch from the established grade will be permitted after the subgrade has been graded to a uniform surface.

3.3 PROTECTION OF SUBGRADE

A. Ditches and drains shall be provided and maintained when required to satisfactorily drain the subgrade. Where previously approved subgrade is damaged by natural causes, by hauling equipment, or by other traffic, the Contractor shall restore the subgrade to the required lines, grades, and typical sections and to the required density at no cost to the Owner.

END OF SECTION 312216

SECTION 312300 - EXCAVATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Excavating for building volume below grade, footings, pile caps, slabs-on-grade, paving, site structures, and utilities within the building.

B. Trenching for utilities outside the building to utility main connections.

1.2 RELATED SECTIONS

A. Section 017800 - Execution Requirements: General requirements for dewatering of excavations and water control.

B. Section 312200 - Grading: Soil removal from surface of site.

C. Section 312200 - Grading: Grading.

D. Section 312323 - Fill and Backfill: Fill materials, filling, and compacting.

E. Section 312333 - Trenching for Site Utilities: Excavating for utility trenches outside the building to utility main connections.

F. Section 313700 - Riprap.

G. Section 334600 - Subdrainage: Filter aggregate and filter fabric for foundation drainage systems.

1.3 UNIT PRICES

A. See Section 012200 - Unit Prices, for general requirements applicable to unit prices for excavation.

B. See Section 312323 - Fill and Backfill, for measurement and payment provisions related to fill.

1.4 PROJECT CONDITIONS

A. Verify that survey bench mark and intended elevations for the Work are as indicated.

B. Protect plants, lawns, rock outcroppings, and other features to remain.

C. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 PREPARATION

A. Identify required lines, levels, contours, and datum locations.

B. See Section 312200 for additional requirements.

3.2 EXCAVATING

A. Underpin adjacent structures which may be damaged by excavating work.

B. Excavate to accommodate new structures and construction operations.

C. Notify Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.

D. Preparation for Piling Work: Excavate to working elevations. Coordinate special requirements for piling.

E. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.

F. Do not interfere with 45 degree bearing splay of foundations.

G. Cut utility trenches wide enough to allow inspection of installed utilities.

H. Hand trim excavations. Remove loose matter.

I. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd measured by volume.

J. Correct areas that are over-excavated and load-bearing surfaces that are disturbed; see Section 312323.

K. Grade top perimeter of excavation to prevent surface water from draining into excavation.

L. Remove excavated material that is unsuitable for re-use from site.

M. Stockpile excavated material to be re-used in area designated on site in accordance with Section 312200.

N. Remove excess excavated material from site.

3.3 FIELD QUALITY CONTROL

A. See Section 014000 – Quality Requirements, for general requirements for field inspection and testing.

B. Provide for visual inspection of load-bearing excavated surfaces before placement of foundations.

3.4 PROTECTION

A. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.

B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

END OF SECTION 312300

SECTION 312323 - FILL AND BACKFILL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Filling, backfilling, and compacting for building volume below grade.

B. Backfilling and compacting for utilities outside the building to utility main connections.

C. Filling holes, pits, and excavations generated as a result of removal (demolition) operations.

1.2 RELATED SECTIONS

A. Section 312200 - Grading: Removal and handling of soil to be re-used.

B. Section 312200 - Grading: Site grading.

C. Section 312300 - Excavation: Removal and handling of soil to be re-used.

D. Section 312333 - Trenching for Site Utilities: Excavating for utility trenches outside the building to utility main connections.

E. Section 313700 - Riprap.

F. Section 334600 - Subdrainage: Filter aggregate and filter fabric for foundation drainage systems.

G. Section 033000 - Cast-in-Place Concrete.

1.3 UNIT PRICES

A. See Section 012200 - Unit Prices, for general requirements applicable to unit prices for earthwork.

1.4 REFERENCES

A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 10-lb Rammer and a 18 in. Drop; American Association of State Highway and Transportation Officials; 2001 (2004).

B. ASTM C 136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2006.

C. ASTM D 698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3); 2000a.

D. ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2000.

E. ASTM D 1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3); 2002.

F. ASTM D 2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 1994(R 2001).

G. ASTM D 2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2000.

H. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth); 2005.

I. ASTM D 3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2005.

J. ASTM D 4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 2005.

1.5 DEFINITIONS

A. Finish Grade Elevations: Indicated on drawings.

B. Subgrade Elevations: 4 inches below finish grade elevations indicated on drawings, unless otherwise indicated.

1.6 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.

C. Compaction Density Test Reports.

1.7 PROJECT CONDITIONS

A. Provide sufficient quantities of fill to meet project schedule and requirements. When necessary, store materials on site in advance of need.

B. When fill materials need to be stored on site, locate stockpiles where indicated.

1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
2. Prevent contamination.
3. Protect stockpiles from erosion and deterioration of materials.

C. Verify that survey bench marks and intended elevations for the Work are as indicated.

PART 2 - PRODUCTS

2.1 FILL MATERIALS

A. Materials shall conform to the respective specifications and other requirements specified below.

1. Granular Material: Shall conform to the gradation requirements of ASTM D 693 size No. 67.
2. Stone Bedding: Shall conform to Class I, 1/4 inch to 1 1/2 inch graded stone bedding, as described in ASTM D 2321.
3. Portland Cement Concrete: Shall conform to ASTM C-94, with a 28-day compressive strength of 3,000 pounds per square inch. Concrete shall be protected from freezing and moisture loss for 7 days.

2.2 SOURCE QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for general requirements for testing and analysis of soil material.

B. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.

C. If tests indicate materials do not meet specified requirements, change material and retest.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Identify required lines, levels, contours, and datum locations.

3.2 PREPARATION

A. Scarify and proof roll subgrade surface to a depth of 6 inches to identify soft spots.

B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.

C. Compact subgrade to density equal to or greater than requirements for subsequent fill material.

D. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.

3.3 BACKFILLING

A. Except for special materials for pavements, the remainder of the trench shall be backfilled with ASTM 2487 Class I, II, III or IV material that is free of stones larger than 6 inches in any dimension or one-half the layered thickness, whichever is smaller. Each layer shall be compacted to not less than the minimum density specified as applicable to the particular area per Section 312010 - Site Grading, of these specifications. Equipment for compacting backfill in trenches and excavation shall be especially selected for the type of material used in the backfill. Generally, vibrating type equipment shall be utilized for non-cohesive soils and impact type equipment shall be used for cohesive soils.

B. Excavated Space: For manholes, wet wells, piers and similar structures shall be free of all debris prior to placing backfill. Remove all concrete forms. Place backfill in 8-inch thick layers and thoroughly compact each layer with mechanical tampers as necessary to prevent subsequent settlement. Extend backfill to indicated finish grade.

C. Equipment shall not be allowed to pass over pipe until 3 feet of compacted cover has been placed over the pipe.

3.4 EXCESS WATER CONTROL

A. General: Grade and maintain all areas of the site to preclude surface runoff into excavations and prevent ponding of water.

B. Dewatering: Excavations should be kept free of surface water and/or groundwater. Provide and maintain at all times the necessary means and devices to prevent water from entering the excavations and for removing all water entering the excavations.

C. Softened Subgrade: Remove all soil softened or eroded by the presence of water and replace with suitable backfill material.

3.5 TOLERANCES

A. Top Surface of General Filling: Plus or minus 1 inch from required elevations.

B. Top Surface of Filling Under Paved Areas: Plus or minus 1 inch from required elevations.

3.6 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for general requirements for field inspection and testing.

B. Perform compaction density testing on compacted fill in accordance with ASTM D1556, ASTM D2167, ASTM D2922, or ASTM D3017.

C. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D 698 ("standard Proctor"), ASTM D 1557 ("modified Proctor"), or AASHTO T 180.

D. If tests indicate work does not meet specified requirements, remove work, replace and retest.

3.7 CLEAN-UP

A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

B. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

END OF SECTION 312323

SECTION 312323.23 - PROOF ROLLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and provisions of the General Conditions, Supplemental Conditions, and Division 1 are included as part of this Section as though bound herein.

B. Section 260 of the North Carolina Department of Transportation "Standard Specification for Roads and Structures" dated July 2006.

1.2 WORK INCLUDED

A. The work covered by this section consists of the Contractor furnishing and operating heavy pneumatic tired compaction equipment for compacting and testing the roadway areas for stability and uniformity of compaction.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. The equipment shall consist of 4 rubber-tired wheels mounted on a rigid steel frame. The wheels shall be evenly spaced in one line across the width of the roller and shall be arranged in such a manner that all wheels will carry approximately equal loads when operated over an uneven surface. The maximum center-to-center spacing between adjacent wheels shall not exceed 32 inches. The compacting equipment shall have a suitable body for ballast loading with such capacity that the gross load shall be from 48 to 50 tons unless otherwise permitted by the Owner's Representative in writing. Other equipment of equal of better effectiveness may be substituted with written permission from the Owner's Representative.

B. The tires shall be operated at inflation pressures between 68 to 72 pounds per square inch unless otherwise permitted by the Owner's Representative in writing. The tires shall be inflated with air only; no liquid shall be used.

C. Ballast to obtain the weight directed by the Owner's Representative shall consist of bulk, sand, bulk stone, bags of sand, stone, or other materials of known unit weight such that the total weight of the ballast used can be readily determined at all times. There shall be a sufficient amount of ballast available to load the equipment to a maximum gross weight of 50 tons. The loaded roller shall be so constructed that it will not trap water that will add weight to the ballast.

D. Rubber tired or other types of tractive equipment may be used for operation of this equipment on the roadbed. The entire assembly including motivating equipment shall be capable of executing a 180-degree turn on a 27-foot wide area.

PART 3 - EXECUTION

3.1 CONSTRUCTION METHODS

A. After the roadway areas have been completed to within 0.50 foot of final grade, these areas shall then be compacted and tested with one coverage, unless otherwise directed by the Owner's Representative, of a heavy pneumatic tired roller meeting the equipment requirements. A coverage is considered that state in

the rolling procedure when the entire width of the area being proof rolled has been in contact with the pneumatic tires of the roller. The roller shall be operated in a systematic manner so that the number of coverages over all areas to be proof rolled can be readily determined and recorded.

B. The equipment shall be operated at a speed between 225 and 300 feet per minute.

C. Proof rolling shall be done only in the presence of the Owner's Representative.

D. If it becomes necessary to take corrective action, such as but not limited to underdrain installation, undercut and backfill of unsuitable material, and aeration of excessively wet material in areas that have been proof rolled, these areas shall be proof rolled again following the completion of the necessary corrections.

END OF SECTION 312323.23

SECTION 312333 - TRENCHING FOR SITE UTILITIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Backfilling and compacting for utilities outside the building to utility main connections.

1.2 RELATED SECTIONS

A. Section 312200 - Grading: Site grading.

B. Section 212300 - Excavation: Building and foundation excavating.

C. Section 312323 - Fill and Backfill: Backfilling at building and foundations.

D. Section 334600 - Subdrainage: Filter aggregate and filter fabric for foundation drainage systems.

1.3 UNIT PRICES

A. See Section 012000 - Unit Prices, for general requirements applicable to unit prices for earthwork.

1.4 REFERENCES

A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 10-lb Rammer and a 18 in. Drop; American Association of State Highway and Transportation Officials; 2001 (2004).

B. ASTM D 698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3); 2000a.

C. ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2000.

D. ASTM D 1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3); 2002.

E. ASTM D 2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 1994(R 2001).

F. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth); 2005.

G. ASTM D 3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2005.

1.5 DEFINITIONS

A. Finish Grade Elevations: Indicated on drawings.

B. Subgrade Elevations: 4 inches below finish grade elevations indicated on drawings, unless otherwise indicated.

1.6 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.

C. Compaction Density Test Reports.

1.7 PROJECT CONDITIONS

A. Provide sufficient quantities of fill to meet project schedule and requirements. When necessary, store materials on site in advance of need.

B. Verify that survey bench marks and intended elevations for the Work are as indicated.

C. Protect plants, lawns, rock outcroppings, and other features to remain.

D. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

PART 2 - PRODUCTS

2.1 FILL MATERIALS

A. Materials shall conform to the respective specifications and other requirements specified below.

1. Granular Material: Shall conform to the gradation requirements of ASTM D 693 size No. 67.
2. Stone Bedding: Shall conform to Class I, 1/4 inch to 1-1/2-inch graded stone bedding, as described in ASTM D 2321.
3. Portland Cement Concrete: Shall conform to ASTM C-94, with a 28-day compressive strength of 3,000 pounds per square inch. Concrete shall be protected from freezing and moisture loss for 7 days.

2.2 SOURCE QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for general requirements for testing and analysis of soil material.

B. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.

C. If tests indicate materials do not meet specified requirements, change material and retest.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Identify required lines, levels, contours, and datum locations.

B. Locate, identify, and protect utilities that remain and protect from damage.

3.2 TRENCHING

A. Notify Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.

B. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.

C. Do not interfere with 45 degree bearing splay of foundations.

D. Cut trenches wide enough to allow inspection of installed utilities.

E. Hand trim excavations. Remove loose matter.

F. Remove large stones and other hard matter which could damage piping or impede consistent backfilling or compaction.

G. Remove excavated material that is unsuitable for re-use from site.

H. Stockpile excavated material to be re-used in area designated on site in accordance with Section 312010.

I. Remove excess excavated material from site.

3.3 PREPARATION FOR UTILITY PLACEMENT

A. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.

B. Compact subgrade to density equal to or greater than requirements for subsequent fill material.

C. Until ready to backfill, maintain excavations and prevent loose soil from falling into excavation.

3.4 BACKFILLING

A. Except for special materials for pavements, the remainder of the trench shall be backfilled with ASTM 2487 Class I, II, III or IV material that is free of stones larger than 6 inches in any dimension or one-half the layered thickness, whichever is smaller. Each layer shall be compacted to not less than the minimum density specified as applicable to the particular area per Section 312200 - Grading, of these specifications. Equipment for compacting backfill in trenches and excavation shall be especially selected for the type of material used in the backfill. Generally, vibrating type equipment shall be utilized for non-cohesive soils and impact type equipment shall be used for cohesive soils.

B. Excavated Space: For manholes, wet wells, piers and similar structures shall be free of all debris prior to placing backfill. Remove all concrete forms. Place backfill in 8-inch thick layers and thoroughly compact each layer with mechanical tampers as necessary to prevent subsequent settlement. Extend backfill to indicated finish grade.

C. Equipment shall not be allowed to pass over pipe until 3 feet of compacted cover has been placed over the pipe.

3.5 BEDDING AND FILL AT SPECIFIC LOCATIONS

A. Bedding material requirements as specified hereinafter are due to the properties of pipe materials and trench depths. Whenever the width of the trench at the top of the pipe cannot be maintained for any reason whatsoever, the Contractor shall immediately stop all work in connection with the preparation of

the pipe bed and shall notify the Owner's Representative. The Owner's Representative will select the proper class of pipe bedding to be provided by the Contractor. Any and all changes to class of pipe bedding made necessary by the Contractor not being able to maintain the conditions specified shall be provided by the Contractor at his expense and without any change in the contract price.

1. Bedding Materials: Shall be classified in accordance with ASTM D 2487, and are described in Table 2221-1. Bedding, haunching, and initial backfill material shall be free of stones larger than 1/2 inch in diameter and shall not be Class V soil.

TABLE 2221-1

DESCRIPTION OF EMBEDMENT MATERIAL CLASSIFICATIONS

SOIL CLASS	SOIL TYPE	DESCRIPTION OF MATERIAL CLASSIFICATION
CLASS I SOILS*	---	Manufactured angular, granular material, 1/4 to 1 1/2 inches (6 to 40 mm) size, including materials having regional significance such as crushed stone or rock, broken coral, crushed slag, cinders, or crushed shells.
	GW	Well-graded gravels and gravel-sand mixtures, little or no fines. 50% or more retained on No. 4 sieve. More than 95% retained on No. 200 sieve. Clean.
	GP	Poorly graded gravels and gravel-sand mixtures, little or no fines. 50% or more retained on No. 4 sieve. More than 95% retained on No. 200 sieve. Clean.
CLASS II SOILS **	SW	Well-graded sands and gravely sands, little or no fines. More than 50% passes No. 4 sieve. More than 95% retained on No. 200 sieve. Clean.
	SP	Poorly graded sands and gravely sands, little or no fines. More than 50% passes No. 4 sieve. More than 95% retained on No. 200 sieve. Clean.
	GM	Silty gravels, gravel-sand-silt mixtures. 50% or more retained on No. 4 sieve. More than 50% retained on No. 200 sieve.
SOIL CLASS	SOIL TYPE	DESCRIPTION OF MATERIAL CLASSIFICATION
CLASS III SOILS***	GC	Clayey gravels, gravel-sand-clay mixtures. 50% or more retained on No. 4 sieve. More than 50% retained on No. 200 sieve.

	SM	Silty sands, sand-silt mixtures. More than 50% passes No. 4 sieve. More than 50% retained on No. 200 sieve.
	SC	Clayey sands, sand-clay mixtures. More than 50% passes No. 4 sieve. More than 50% retained on No. 200 sieve.
	ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands. Liquid limit 50% or less. 50% or more passes No. 200 sieve.
	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. Liquid limit 50% or less. 50% or more passes No. 200 sieve.
CLASS IV SOILS	MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts. Liquid limit Greater than 50%. 50% or more passes No. 200 sieve.
	CH	Inorganic clays of high plasticity, fat clays. Liquid limit greater than 50%. 50% or more passes No. 200 sieve.
	OL	Organic silts and organic silty clays of low plasticity. Liquid limit 50% or less. 50% or more passes No. 200 sieve.
	OH	Organic clays of medium to high plasticity. Liquid limit greater than 50%. 50% or more passes No. 200 sieve.
	PT	Peat, muck and other highly organic soils.

* Soils defined as Class 1 materials are not defined in ASTM D2487.
** In accordance with ASTM D 2487, less than 5% pass No. 200 sieve.
*** In accordance with ASTM D 2487, more than 12% pass No. 200 sieve. Soils with 5% to 12% pass No. 200 sieve fall in borderline classification; e.g., GP-GC.

2. Rigid Pipe (DIP pipe): Bedding, haunching, and initial backfill for rigid pipe shall be placed as specified on the plans. The applicable trench bedding conditions shall be dependent on type of pipe and depth of cut, as specified herein.
3. Flexible Pipe (PVC Pipe): Flexible pipe bedding shall conform to ASTM D2321 and consist of bedding the pipe in compacted granular material placed on a flat trench bottom, as shown in the plans.

3.6 TOLERANCES

A. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

B. Top Surface of Backfilling Under Paved Areas: Plus or minus 1 inch from required elevations.

3.7 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for general requirements for field inspection and testing.

B. Perform compaction density testing on compacted fill in accordance with ASTM D1556, ASTM D2167, ASTM D2922, or ASTM D3017.

C. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D 698 ("standard Proctor"), ASTM D 1557 ("modified Proctor"), or AASHTO T 180.

D. If tests indicate work does not meet specified requirements, remove work, replace and retest.

3.8 CLEAN-UP

A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

END OF SECTION 312333

SECTION 312500 - TEMPORARY EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Prevention of erosion due to construction activities.

B. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.

C. Restoration of areas eroded due to insufficient preventive measures.

D. Performance bond.

E. Compensation of Owner for fines levied by authorities having jurisdiction due to non-compliance by Contractor.

1.2 RELATED SECTIONS

A. Section 311000 - Site Clearing: Limits on clearing; disposition of vegetative clearing debris.

B. Section 312200 - Grading: Temporary and permanent grade changes for erosion control.

C. Section 313700 - Riprap: Temporary and permanent stabilization using riprap.

D. Section 321123 - Aggregate Base Course: Temporary and permanent roadways.

E. Section 329219 - Seeding: Permanent turf for erosion control.

F. Section 329223 - Sodding: Permanent turf for erosion control.

1.3 REFERENCES

A. ASTM D 4355 - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc Type Apparatus; 2005.

B. ASTM D 4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity; 1999a (Reapproved 2004).

C. ASTM D 4533 - Standard Test Method for Trapezoid Tearing Strength of Geotextiles; 2004.

D. ASTM D 4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles; 1991 (Reapproved 2003).

E. ASTM D 4751 - Standard Test Method for Determining Apparent Opening Size of a Geotextile; 2004.

F. ASTM D 4873 - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples; 2002.

G. EPA (NPDES) - National Pollutant Discharge Elimination System (NPDES), Construction General Permit; current edition; http://cfpub.epa.gov/npdes/stormwater/cgp.cfm.

H. FHWA FLP-94-005 - Best Management Practices for Erosion and Sediment Control; Federal Highway Administration; 1995.

I. USDA TR-55 - Urban Hydrology for Small Watersheds; USDA Natural Resources Conservation Service; 1986.

1.4 PERFORMANCE REQUIREMENTS

A. Comply with all requirements of U.S. Environmental Protection Agency for erosion and sedimentation control, as specified for the National Pollutant Discharge Elimination System (NPDES), Phases I and II, under requirements for the 2003 Construction General Permit (CGP), whether the project is required by law to comply or not.

B. Also comply with all more stringent requirements of State of North Carolina Erosion and Sedimentation Control Manual.

C. Comply with all requirements of NCDENR Division of Land Quality for erosion and sedimentation control.

D. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.

1. Owner will obtain permits and pay for securities required by authority having jurisdiction.
2. Owner will withhold payment to Contractor equivalent to all fines resulting from non-compliance with applicable regulations.

E. Provide to Owner a Performance Bond covering erosion and sedimentation preventive measures only, in an amount equal to 100 percent of the cost of erosion and sedimentation control work.

F. Timing: Put preventive measures in place as soon as possible after disturbance of surface cover and before precipitation occurs.

G. Storm Water Runoff: Control increased storm water runoff due to disturbance of surface cover due to construction activities for this project.

1. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less.
2. Anticipate runoff volume due to the most extreme short term and 24-hour rainfall events that might occur in 25 years.

H. Erosion On Site: Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.

1. Control movement of sediment and soil from temporary stockpiles of soil.
2. Prevent development of ruts due to equipment and vehicular traffic.
3. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.

I. Erosion Off Site: Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this project.

1. Prevent windblown soil from leaving the project site.
2. Prevent tracking of mud onto public roads outside site.
3. Prevent mud and sediment from flowing onto sidewalks and pavements.
4. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.

J. Sedimentation of Waterways on Site: Prevent sedimentation of waterways on the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.

1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
2. If sediment basins are used as temporary preventive measures, pump dry and remove deposited sediment after each storm.

K. Sedimentation of Waterways Off Site: Prevent sedimentation of waterways off the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.

1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.

L. Open Water: Prevent standing water that could become stagnant.

M. Maintenance: Maintain temporary preventive measures until permanent measures have been established.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Certificate: Mill certificate for silt fence fabric attesting that fabric and factory seams comply with specified requirements, signed by legally authorized official of manufacturer; indicate actual minimum average roll values; identify fabric by roll identification numbers.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Mulch: Use one of the following:

1. Straw or hay.
2. Wood waste, chips, or bark.
3. Erosion control matting or netting.
4. Cutback asphalt.
5. Polyethylene film, where specifically indicated only.

B. Grass Seed for Temporary Cover: Select a species appropriate to climate, planting season, and intended purpose. If same area will later be planted with permanent vegetation, do not use species known to be excessively competitive or prone to volunteer in subsequent seasons.

C. Silt Fence Fabric: Polypropylene geotextile resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; fabric including seams with the following minimum average roll lengths:

1. Average Opening Size: 30 U.S. Std. Sieve (0.600 mm), maximum, when tested in accordance with ASTM D 4751.
2. Permittivity: 0.05 sec^-1, minimum, when tested in accordance with ASTM D 4491.
3. Ultraviolet Resistance: Retaining at least 70 percent of tensile strength, when tested in accordance with ASTM D 4355 after 500 hours exposure.
4. Tensile Strength: 100 lb-f (450 N), minimum, in cross-machine direction; 124 lb-f (550 N), minimum, in machine direction; when tested in accordance with ASTM D 4632.
5. Elongation: 15 to 30 percent, when tested in accordance with ASTM D 4632.
6. Tear Strength: 55 lb-f (245 N), minimum, when tested in accordance with ASTM D 4533.

7. Color: Manufacturer's standard, with embedment and fastener lines preprinted.
8. Manufacturers:

    a. BP Amoco, Amoco Fabrics and Fibers: www.geotextile.com.
    b. TC Mirafi: www.tcmirafi.com.
    c. Synthetic Industries: www.fixsoil.com.

D. Silt Fence Posts: One of the following, minimum 5 feet long:

1. Steel U- or T-section, with minimum mass of 1.33 lb per linear foot.

E. Gravel: See Section 321123 for aggregate.

F. Riprap: See Section 313700.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

3.2 PREPARATION

A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

3.3 SCOPE OF PREVENTIVE MEASURES

A. In all cases, if permanent erosion resistant measures have been installed temporary preventive measures are not required.

B. Construction Entrances: Traffic-bearing aggregate surface.

1. Width: As required; 20 feet, minimum.
2. Length: 50 feet, minimum.
3. Provide at each construction entrance from public right-of-way.
4. Where necessary to prevent tracking of mud onto right-of-way, provide wheel washing area out of direct traffic lane, with drain into sediment trap or basin.

C. Linear Sediment Barriers: Made of silt fences.

1. Provide linear sediment barriers:

    a. Along downhill perimeter edge of disturbed areas, including soil stockpiles.
    b. Along the top of the slope or top bank of drainage channels and swales that traverse disturbed areas.
    c. Along the toe of cut slopes and fill slopes.
    d. Perpendicular to flow across the bottom of existing and new drainage channels and swales that traverse disturbed areas or carry runoff from disturbed areas; space at maximum of 200 feet apart.
    e. Across the entrances to culverts that receive runoff from disturbed areas.

2. Space sediment barriers with the following maximum slope length upslope from barrier:

    a. Slope of Less Than 2 Percent: 100 feet.
    b. Slope Between 2 and 5 Percent: 75 feet.

c. Slope Between 5 and 10 Percent: 50 feet.
d. Slope Between 10 and 20 Percent: 25 feet.
e. Slope Over 20 Percent: 15 feet.

D. Storm Drain Curb Inlet Sediment Trap: Protect each curb inlet using the following measures:

1. Filter fabric wrapped around hollow concrete blocks blocking entire inlet face area; use one piece of fabric wrapped at least 1-1/2 times around concrete blocks and secured to prevent dislodging; orient cores of blocks so runoff passes into inlet.

E. Storm Drain Drop Inlet Sediment Traps: As detailed on drawings.

F. Temporary Splash Pads: Stone aggregate over filter fabric; size to suit application; provide at downspout outlets and storm water outlets.

G. Soil Stockpiles: Protect using one of the following measures:

1. Cover with polyethylene film, secured by placing soil on outer edges.
2. Cover with mulch at least 4 inches thickness of pine needles, sawdust, bark, wood chips, or shredded leaves, or 6 inches of straw or hay.

H. Mulching: Use only for areas that may be subjected to erosion for less than 6 months.

1. Wood Waste: Use only on slopes 3:1 or flatter; no anchoring required.
2. Asphalt: Use only where no traffic, either vehicular or pedestrian, is anticipated.

I. Temporary Seeding: Use where temporary vegetated cover is required.

3.4 INSTALLATION

A. The Contractor shall install the erosion control construction measures as shown on the contract drawings, except that should circumstances dictate that extra precaution be taken to prohibit erosion and sedimentation on the project, the Contractor will, at his own expense, take preventative measures as needed.

B. The Contractor is required to maintain all erosion and sediment control facilities to insure proper performance throughout the construction phase and until such time all disturbed areas are permanently stabilized.

C. Upon completion of construction or successful permanent stabilization of all areas which were disturbed before or during construction operations or as indicated on the construction drawings, whichever occurs last, the Contractor shall remove all temporary erosion and sediment control devices and facilities from the project site. The Contractor shall retain these items for future use or properly dispose of these items offsite.

D. The Contractor shall provide temporary or permanent stabilization with ground cover on all perimeter dikes, swales, ditches, perimeter slopes and all slopes steeper than 3:1 (horizontal to vertical) within 7 calendar days from the last land disturbing activity. All other areas shall be stabilized with ground cover within 14 days from the last land disturbing activity.

3.5 MAINTENANCE

A. Inspect preventive measures weekly, within 24 hours after the end of any storm that produces 0.5 inches or more rainfall at the project site, and daily during prolonged rainfall.

B. Repair deficiencies immediately.

C. Silt Fences:

1. Promptly replace fabric that deteriorates unless need for fence has passed.
2. Remove silt deposits that exceed one-third of the height of the fence.
3. Repair fences that are undercut by runoff or otherwise damaged, whether by runoff or other causes.

D. Clean out temporary sediment control structures weekly and relocate soil on site.

E. Place sediment in appropriate locations on site; do not remove from site.

3.6 CLEAN UP

A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Engineer.

B. Clean out temporary sediment control structures that are to remain as permanent measures.

C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

END OF SECTION 312500

SECTION 313116 - TERMITE CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes soil treatment for termite control.

1.2 ACTION SUBMITTALS

A. Product Data: Treatments and application instructions, including EPA-Registered Label.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: Signed by manufacturers of termite control products certifying that treatments furnished comply with requirements of the N.C. Dept. of Agriculture, Structural Pest Control Division.

B. Bill of materials (proof of quantity of material purchased), estimate of square footage of coverage (area of treated ground) and certification that mix and rates of application comply with governing restrictions and manufacturers recommendations. Quantities will be verified.

C. Qualification Data: For qualified Installer of termite control products, including licensing records and application reports as required by local authorities.

1.4 CLOSEOUT SUBMITTALS

A. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's record information, including the following as applicable:

1. Date and time of application.
2. Moisture content of soil before application.
3. Brand name and manufacturer of termiticide.
4. Quantity of undiluted termiticide used.
5. Dilutions, methods, volumes, and rates of application used.
6. Areas of application.
7. Water source for application.

B. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A Pest Control Operator who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment in jurisdiction where Project is located and who is experienced and has completed termite control treatment similar to that indicated for this Project and whose work has a record of successful in-service performance.

1. Installer shall be licensed as a Pest Control Operator (PCO) by NCDOA and as required by state and local authorities.

B. Regulatory Requirements: Formulate and apply termiticides, and label with a Federal registration number, to comply with EPA regulations and authorities having jurisdiction.

C. Standards for Application: Current edition of North Carolina Administrative Code 2:34.0506 and North Carolina Structural Pest Control Committee Rules and Regulations.

D. Source Limitations: Obtain termite control products from single manufacturer for each product.

E. Testing: If required by the Architect's Construction Administrator or Owner, the Contractor shall contact the NC Department of Agriculture to have treated soil tested to verify application compliance. Allow a minimum of 2 days notice to schedule inspection.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with EPA-Registered Label requirements and requirements of authorities having jurisdiction.

1.7 COORDINATION

A. Coordinate soil treatment application with excavating, filling, and grading and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs, before construction.

1.8 WARRANTY

A. Special Warranty: Written warranty, signed by applicator and Contractor certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.

1. Warranty Period: Five years from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

A. Continuing Service: Provide a proposal for continuing service, including monitoring, inspection, and retreatment for occurrences of termite activity, from applicator to Owner, in the form of a standard yearly (or other period) continuing service agreement, starting on the date of Substantial Completion. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Service Life of Soil Treatment: Soil treatment by use of a termiticide that is effective for not less than five years against infestation of subterranean termites.

2.2 SOIL TREATMENT

A. Manufacturers: Subject to compliance with requirements of the N.C. Dept. of Agriculture, Structural Pest Control Division, provide products by one of the following:

1. AgrEvo Environmental Health, Inc.
2. Bayer Corp.
3. Dow AgroSciences.
4. FMC Corp.

5. Zeneca Ag Products.

B. Termiticide: Provide an EPA-registered termiticide, complying with requirements of state and local authorities having jurisdiction, in a soluble or emulsible concentrated formulation that dilutes with water or foaming agent, and formulated to prevent termite infestation. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to the product's EPA-Registered Label.

1. Use only soil treatment solutions that are not harmful to plants.
2. Use compatible dye in termiticide to provide visible evidence of treatment.
3. Service Life of Treatment: Soil treatment termiticide that is effective for not less than five years against infestation of subterranean termites.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of the soil, interfaces with earthwork, slab and foundation work, landscaping, and other conditions affecting performance of termite control.

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

3.2 PREPARATION

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's written instructions for preparing substrate. Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil and around foundations.

B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated, except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended by termiticide manufacturer.

C. Fit filling hose connected to water source at the site with a backflow preventer, complying with requirements of authorities having jurisdiction.

3.3 APPLICATION, GENERAL

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.

3.4 APPLYING SOIL TREATMENT

A. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute the treatment evenly.

1. Slabs-on-Grade: Underground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
2. Foundations: Soil adjacent to and along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing.
3. Masonry: Treat voids.
4. Penetrations: At expansion joints, control joints, and areas where slabs and below-grade walls will be penetrated.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner may engage a qualified independent testing agency to perform field quality-control testing and provide report to Architect.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer receiving termiticide treatment. Proceed with subsequent work only after inspections for previously completed work comply with requirements.

C. When testing agency reports that subgrades, fills, or backfills have not been adequately treated with termiticide, reapply treatment and retest until specified treatment has been achieved.

3.6 PROTECTION

A. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.

B. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

C. Post warning signs in areas of application.

D. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

END OF SECTION 313116

SECTION 313700 - RIPRAP

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Riprap.

1.2 RELATED SECTIONS

A. Section 312323 - Fill and Backfill: Aggregate requirements.

1.3 UNIT PRICES - MEASUREMENT AND PAYMENT

A. See Section 012200 - Unit Prices, for additional unit price requirements.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with State of North Carolina Highways standard.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Riprap: Provide in accordance with State of North Carolina Highways standards.

B. Aggregate: Granular fill as specified in Section 321123.

C. Geotextile Fabric: Non-biodegradable, woven, and Type II.

PART 3 - EXECUTION

3.1 PLACEMENT

A. Place geotextile fabric over substrate, lap edges and ends.

B. Place riprap at culvert pipe ends, embankment slopes, and as indicated on construction documents.

END OF SECTION 313700

SECTION 316329 - EARTHQUAKE DRAINS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Earthquake drains and reservoirs.

1.2 SYSTEM DESCRIPTION

A. Liquefaction Mitigation system consists of vertical liquefaction drains (earthquake drains) of slotted corrugated pipe enclosed by filter sock, providing reservoir for water expelled from the ground during a seismic event.

1.3 DEFINITIONS

A. Obstruction: Man-made or natural object or a stratum that prevents the proper insertion of the mandrel and installation of the earthquake drain.

B. Refusal: The point at which soils resist a reasonable effort at further penetration of the earthquake drains. The refusal criteria shall be established by the geotechnical engineer on the basis of existing soil borings and the initial earthquake drain installations.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to earthquake drains including, but not limited to, the following:

a. Review geotechnical report.
b. Discuss existing utilities and subsurface conditions.
c. Review coordination with temporary controls and protections.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Submit literature documenting the physical and mechanical properties of the earthquake drain components and a list of other, similar projects where the same drain has been successfully installed.

B. Delegated-Design Submittal: For liquefaction mitigation systems indicated to comply with performance requirements and design criteria, including Shop Drawings signed and sealed by the qualified professional engineer responsible for their preparation.

C. Shop Drawings: Include plans, sections and details illustrating the layout and construction of the drains. Drawings and calculations shall be stamped and signed by the registered professional engineer responsible for their preparation. Include the following:

1. Unique identification number for each earthquake drain.
2. Locations and bottom elevations of earthquake drains
3. Installation sequence.

D. Installation Plan: Include the following:

1. Size, type, weight, maximum pushing force, vibratory-hammer rated energy, and configuration of the installation rig.
2. Dimensions and length of the mandrel.
3. Details of earthquake drain anchorage.
4. Detailed description of proposed installation procedures.
5. Proposed methods and equipment for pre-augering.
6. Documentation of the successful application of the proposed earthquake drain installation operations.
7. Method of measuring the installed length of the earthquake drain.

E. Material Certification: Manufacturer's certification that earthquake drain with filter fabric meets or exceeds material requirements specified.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data:

1. For qualified installer, for each referenced project submit the following:

a. Name and address of Project Owner, with contact information for Owner's representative.
b. Name and contact information for Owner's engineering consultant.
c. Detailed description of project, including site and subsurface conditions.
d. The start and completion date
e. Description of earthquake drain material
f. Equipment and method of installation
g. Average and maximum length of drain installed.
h. Total linear feet of earthquake drains installed.

2. For professional engineer.
3. For supervisor, resume documenting experience and qualifications in the installation of earthquake drains.

B. Product Test Reports: Performed by manufacturer and witnessed by a qualified testing agency.

1. Geotextile fabric.

1.7 CLOSEOUT SUBMITTALS

A. Record Drawings: Submit plans of the earthquake drain installation. Include the following:

1. Locations of the earthquake drains.
2. Date each drain was installed.
3. Surface elevation of each drain.
4. Vertical drain tip elevation.
5. Location of rejected or abandoned drains.

1.8 QUALITY ASSURANCE

A. Engineer Qualifications: An experienced professional engineer, licensed in the state where the project is located, with a minimum five years experience in the design of earthquake drains.

B. Installer Qualifications: An experienced installer that has specialized in installation of earthquake drains. Installer shall have successfully installed a minimum of 2,000,000 linear feet of earthquake drains within

the last five year. Installer shall have successfully completed at least five projects of similar size and complexity of that proposed for this project within the last five years.

C. Supervisor Qualifications: Installer shall employ a full-time supervisor to be present at the work site at all times during earthquake drain operations. Supervisor shall be an experienced individual who has been in responsible charge of the installation of earthquake drains on a minimum of five projects in the last five years. The acceptability of the supervisor, as well as any replacement for the supervisor, will be subject to the approval of the Owner.

D. Equipment: Equipment for installation of earthquake drains shall comply with the following:

1. Installation rig shall utilize a vibrator with an eccentric moment sufficient to generate vertical vibration to the mandrel during installation and maintain it in a vertical position during drilling. The equipment shall generate sufficient vertical force (static crowd) to the mandrel necessary to install the earthquake drains through all existing subsurface material to the depths shown on the plans. The equipment shall have the capability of installing the earthquake drains to a depth of not less than 10 feet greater than the maximum earthquake drain depth shown on the plans. Provide a means of checking the plumbness of the mandrel and determining the depth of the earthquake drains.
2. Provide mandrel to protect the earthquake drains during installation. The mandrel shall be fitted with three symmetrically spaces fins for transmitting vibrations to the soil during installation.
3. Augers shall have a minimum outside diameter equal to the largest horizontal dimension of the mandrel, shoe, or anchor, whichever is greatest. The maximum outside diameter of the auger shall be no more than three inches greater than the maximum dimension of the mandrel.

1.9 DELIVERY, STORAGE AND HANDLING

A. Earthquake drain materials shall be labeled or tagged in such a manner that the information for sample identification and other quality control purposes can be read from the label. As a minimum, each roll shall be identified by the manufacturer as to lot or control numbers, individual roll number, date of manufacture, manufacturer and product identification of the filter fabric and core.

B. Wrap the earthquake drains in a burlap or other heavy-duty protective covering during shipment and storage. Protect earthquake drains from sunlight, mud, dirt, dust, debris, and detrimental substances during shipping and on-site storage.

1.10 PROJECT CONDITIONS

A. Existing Utilities: Locate existing underground utilities before excavating earthquake drains. If utilities are to remain in place, provide protection from damage during earthquake-drain operations.

1. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, adapt drilling procedure if necessary to prevent damage to utilities. Cooperate with Owner and utility companies in keeping services and facilities in operation without interruption.

B. Interruption of Existing Utilities: Do not interrupt any utility to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:

1. Notify Owner no fewer than three days in advance of proposed interruption of utility.
2. Do not proceed with interruption of utility without Owner's written permission.

C. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent

interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from this data.

1. Make additional test borings and conduct other exploratory operations necessary for earthquake drains.
2. The geotechnical report is included in the Project Manual.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Design and install earthquake drains to reduce liquefaction induced settlements, which would be expected in the event of earthquake of a magnitude of 7.3 on the Richter scale with a peak ground surface acceleration of 0.321g, to 2 inches or less. Base calculations and design of earthquake drains on geotechnical report of site, a copy of which is included in the Project Manual.

2.2 EARTHQUAKE DRAINS, GENERAL

A. The core shall have an annular-corrugated interior and exterior. The assembled earthquake drain shall be resistant against wet rot, mildew, bacterial action, insects, salts in solution in the ground water, acids, alkalis, solvents, and other ingredients in the site ground water.

B. Earthquake drain materials shall be labeled or tagged in such a manner that the information for sample identification and other quality control purposes can be read from the label. As a minimum, each roll shall be identified by the manufacturer as to lot or control numbers, individual roll number, date of manufacture, manufacturer and product identification of the filter fabric and core.

2.3 DRAINS

A. Vertical drains: Pipes shall comply with SCS 806. Prefabricated geocomposite with perforated corrugated core molded from HDPE complying with ASTM D 3350, cell classification 324420C or ASTM D 1248, Type III, Class C, Category 4, Grade 33.

1. 3 to 8-inch diameter pipes shall comply with ASTM F 405.

B. Anchor Plates: The earthquake drain shall be provided with an anchor plate or similar arrangement to anchor the bottom of the drain at the required depth during mandrel removal and to prevent soil from entering the bottom of the mandrel during drain installation. The anchorage shall be adequate to keep the bottom of the earthquake drain at the required depth. The corresponding dimension of the anchor shall conform as closely as possible to the breadth dimensions of the mandrel to minimize soil disturbance.

C. The prefabricated drain material shall comply with the following:

1. Minimum Pipe Stiffness @ 5 percent deflection: 35 psi.
2. Minimum Drainage Slot Area: 0.013 ft2/ft

2.4 GEOTEXTILE FILTER FABRICS

A. General: The filter fabric shall be synthetic non-woven geotextile capable of resisting bending, punching and tensile forces imposed during installation and during the design life of the earthquake drain. Filter fabric shall meet the following performance requirements:

1. Not be subject to localized damage (e.g., punching through the filter by sand/gravel particles).

2. Be rigid enough to withstand lateral earth pressures due to embedment and surcharge so that the vertical flow capacity through the core will not be adversely affected.
3. Be flexible enough to bend smoothly during installation and induced densification without damage.
4. Not undergo cracking and peeling during installation of the earthquake drain.

B. Description: Fabric of PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft. when tested according to ASTM D 4491.

C. The prefabricated drain material shall comply with the following:

1. Minimum Water Permeability: 0.01 in/sec (K-value) per ASTM D4491.
2. Minimum Water Permittivity: 0.1 sec-1 per ASTM D4491.
3. Minimum Tear Strength: 50 lb per ASTM D4533.
4. Minimum Tensile Strength: 90 lb per ASTM 4632.
5. Minimum Elongation at break: 60 percent per ASTM D4632
6. Minimum Puncture Strength: 35 lb per ASTM 4833.
7. Minimum Mullen Burst: 150 psi per ASTM D3786.

2.5 RESERVOIRS

A. Supplemental water reservoirs shall be one of the following, as noted on the approved Shop Drawings:

1. Naturally occurring permeable soil layer.
2. Layer of open graded stone.
3. Individually constructed reservoirs at each drain.

B. Stone: Crushed granite #57.

1. Limestone is not permitted.

C. Geotextile Fabric: Class 1, Type B.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by earthquake-drain operations.

3.2 LAYOUT

A. Layout, number and stake locations for earthquake drains, based on baseline and benchmark provided by General Contractor, in accordance with approved Shop Drawings. Record actual measurements of each earthquake drain's location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other specified data.

1. Record and maintain information pertinent to each earthquake drain and cooperate with Owner's testing and inspecting agency to provide data for required reports.

3.3 INSTALLATION

A. Install prefabricated vertical earthquake drains using a mandrel to protect the drains during installation. The mandrel will be advanced through the soil to the required depth. Retract the mandrel after the

installation of the drain to the bottom elevation indicated on the approved Shop Drawings or otherwise authorized by the Geotechnical Engineer.

1. Alternate raising and lowering of the mandrel during advancement is not permitted.

B. Install earthquake drains using a continuous push, using static weight and vibration from the working surface (top of fill soil) to the earthquake drain bottom elevations shown on the plans or to refusal.

1. Jetting or the use of an impact hammer to install the earthquake drains will not be permitted.

C. Cut the prefabricated earthquake drains neatly three inches above the working layer. Knot the filter fabric at the top of the drain to prevent soil from entering the drain.

D. Tolerances: Construct earthquake drains to the following tolerances:

1. Location of drain: No more than 6 inches from locations indicated on approved Shop Drawings.
2. Deviation from vertical: No more than one inch per foot or two percent.
3. If location or out-of-plumb tolerances are exceeded, provide corrective construction. Submit design and construction proposals to Architect for review before proceeding.

3.4 OBSTRUCTIONS

A. Where obstructions are encountered, implement the following procedure in the listed sequence:

1. Notify the Geotechnical Engineer immediately.
2. Attempt installation of drains adjacent to obstructed drain location. A maximum of two additional attempts shall be made as directed by the Geotechnical Engineer for each obstructed earthquake drain location.
3. Abandon location and install drain at new location directed by Geotechnical Engineer.
4. Implement obstruction clearance procedures, as noted below and only as approved by Geotechnical Engineer, and install the drain at the design location.

B. Offset Drains: Install a new drain within an 18-inch radius of the original location of the obstructed drain.

C. Clearance of Obstructions: Subject to approval by the Geotechnical Engineer, augering or other methods may be used to loosen the soil and obstructing material prior to the installation of the drains. Augering or other obstruction removal techniques shall not penetrate more than two feet into the underlying compressible soil.

D. Clearly mark in the field locations where earthquake drains do not meet the depth criteria due to obstructions.

3.5 RESERVOIRS

A. Place a layer of crushed stone layer on top of the drains where indicated on the approved Shop Drawings. Place geotextile fabric over the crushed stone before placing backfill

3.6 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified geotechnical engineering firm to monitor the installation of earthquake drains. The Geotechnical Engineer will have the authority to direct the work when obstructions are encountered and to approve changes in the field.

3.7 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 316329

SECTION 321123 - AGGREGATE BASE COURSE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Aggregate base course.

B. Paving aggregates.

1.2 RELATED SECTIONS

A. Section 312200 - Grading: Preparation of site for base course.

B. Section 312323 - Fill and Backfill: Compacted fill under base course.

C. Section 312333 - Trenching for Site Utilities: Compacted fill over utility trenches under base course.

D. Section 334913 - Manholes and Covers: Manholes including frames.

E. Section 321126 - Bituminous Concrete Paving: Binder and finish asphalt courses.

F. Section 312323 - Fill and Backfill: Topsoil fill at areas adjacent to aggregate base course.

1.3 UNIT PRICES

A. See Section 012000 - Unit Prices, for general requirements applicable to unit prices for earthwork.

1.4 REFERENCES

A. AASHTO M 147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses; American Association of State Highway and Transportation Officials; 1965 (2004).

B. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 10-lb Rammer and a 18 in. Drop; American Association of State Highway and Transportation Officials; 2001 (2004).

C. ASTM C 136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2006.

D. ASTM D 698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3); 2000a.

E. ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2000.

F. ASTM D 1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3); 2002.

G. ASTM D 2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 1994(R 2001).

H. ASTM D 2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2000.

I. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth); 2005.

J. ASTM D 3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2005.

K. ASTM D 4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 2005.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Aggregate Composition Test Reports: Results of laboratory tests on proposed and actual materials used.

C. Compaction Density Test Reports.

1.6 PROJECT CONDITIONS

A. Provide sufficient quantities of aggregate to meet project schedule and requirements. When necessary, store materials on site in advance of need.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General Requirements: Aggregate base course material shall consist of crushed stone, crushed or uncrushed gravel or other similar material having hard, strong, durable, particle free of adherent coatings and comply with the gradation requirements contained in Section 520 of the NCDOT “Standard Specifications for Roads and Structures” referenced above.

2.2 SOURCE QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for general requirements for testing and analysis of aggregate materials.

B. Where aggregate materials are specified using ASTM D 2487 classification, test and analyze samples for compliance before delivery to site.

C. If tests indicate materials do not meet specified requirements, change material and retest.

D. Provide materials of each type from same source throughout the Work.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify substrate has been inspected, gradients and elevations are correct, and is dry.

3.2 PREPARATION

A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.

B. Do not place aggregate on soft, muddy, or frozen surfaces.

3.3 INSTALLATION

A. The subgrade shall be prepared as called for on the plans in accordance with Section 312216 of these specifications prior to placement of the base material.

B. The aggregate material shall be placed on the subgrade with a mechanical spreader capable of placing the material to a uniform loose depth without segregation except that for areas inaccessible to a mechanical spreader, the aggregate material may be placed by other methods approved by the Owner's Representative.

C. Where the required compacted thickness of base is 8 inches or less, the base material may be spread and compacted in one layer. Where the required compacted thickness is more than 8 inches, the base material shall be spread and compacted in 2 or more approximately equal layers. The minimum compacted thickness of any one layer shall be approximately 4 inches.

D. Each layer of material shall have been sampled, tested, compacted and approved prior to placing succeeding layers of base material or pavement.

E. No base material shall be placed on frozen subgrade or base.

F. No traffic shall be allowed on the completed base course other than necessary local traffic and that developing from the operation of essential construction equipment as may be authorized by the Owner's Representative. Any defects that develop in the completed base or any damage caused by local or construction traffic shall be acceptably repaired at no cost to the Owner.

G. The Contractor shall utilize methods of handling, hauling and placing which will minimize segregation and contamination. If segregation occurs, the Owner's Representative may require that changes be made in the Contractor's methods to minimize segregation, and may also require mixing on the roadway areas which may be necessary to correct any segregation. No additional compensation will be allowed for the work of mixing as may be required under this provision. Aggregate that is contaminated with foreign materials to the extent that the base course will not adequately serve its intended use will be removed and replaced by the Contractor at no additional cost to the Owner.

3.4 SHAPING AND COMPACTING

A. Within 48 hours after beginning the placing of a layer of the base, the Contractor shall begin machining and compacting of the layer. Each layer shall be maintained to the required cross section during compaction and each layer be compacted to the required density prior to placing the next layer.

B. Each layer of the base shall be compacted to a density equal to at least 100% of that obtained by compacting a sample of the material in accordance with AASHTO T180.

C. The base material shall be compacted at a moisture content which is approximately that required to produce a maximum density indicated by the above test method. The Contractor shall dry or add moisture to the material when required to provide a uniformly compacted and acceptable base.

D. The final layer of base material shall be shaped to conform to the lines, grades and typical sections shown on the plans or established by the Owner's Representative. When completed, the base course shall be

smooth, hard, dense, unyielding and well bonded. A broom drag may be used in connection with the final finishing and conditioning of the surface of the base course.

E. After final shaping and compacting of the base, the Owner's Representative will check the surface of the base for conformance to the grade and typical section and determine the base thickness.

F. The thickness of the base shall be within a tolerance of plus or minus 0.1 feet of the base thickness required by the plans. The maximum differential between the established grade and the base within any 100-foot section shall be 0.1 feet.

G. Where the base material is placed in a trench section, the Contractor shall provide adequate drainage through the shoulders to protect the subgrade and base until such time as the shoulders are completed.

H. The Contractor shall maintain the surface of the base by watering, machining, and rolling or dragging when necessary to prevent damage to the base by weather or traffic.

I. Where the base or subgrade is damaged, the Contractor shall repair the damaged area; reshape the base to required lines, grades and typical sections; and recompact the base to the required density at no cost to the Owner.

3.5 TOLERANCES

A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.

B. Scheduled Compacted Thickness: Within 1/4 inch.

C. Variation from Design Elevation: Within 1/2 inch.

3.6 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for general requirements for field inspection and testing.

B. Compaction density testing will be performed on compacted aggregate base course in accordance with ASTM D1556.

C. Results will be evaluated in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D 698 ("standard Proctor").

D. If tests indicate work does not meet specified requirements, remove work, replace and retest.

3.7 CLEAN-UP

A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

END OF SECTION 321123

SECTION 321126 - BITUMINOUS CONCRETE PAVING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Aggregate base course.

B. Single course bituminous concrete paving.

C. Double course bituminous concrete paving.

D. Surface sealer.

1.2 RELATED SECTIONS

A. Section 312200 - Grading: Preparation of site for paving and base.

B. Section 312323 - Fill and Backfill: Compacted subgrade for paving.

C. Section 334913 - Manholes and Covers: Manholes, including frames.

D. Section 321723 - Pavement markings.

1.3 UNIT PRICES

A. See Section 012000 - Unit Prices for requirements applicable to this section. Measurement and payment will be as follows:

1.4 REFERENCES

A. AI MS-2 - Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types; The Asphalt Institute; 1994, Sixth Edition.

B. AI MS-19 - A Basic Asphalt Emulsion Manual; The Asphalt Institute; Third Edition.

C. ASTM D 946 - Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction; 1982 (Reapproved 2005).

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with State of North Carolina Highways standard.

B. Mixing Plant: Conform to State of North Carolina Highways standard.

C. Obtain materials from same source throughout.

1.6 REGULATORY REQUIREMENTS

A. Conform to applicable code for paving work on public property.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not place asphalt when ambient air or base surface temperature is less than 40 degrees F, or surface is wet or frozen.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aggregate for Base Course: In accordance with State of North Carolina Highways standards.

B. Aggregate for Binder Course: In accordance with State of North Carolina Highways standards.

C. Aggregate for Wearing Course: In accordance with State of North Carolina Highways standards.

D. Fine Aggregate: In accordance with State of North Carolina Highways standards.

E. Mineral Filler: Finely ground particles of limestone, hydrated lime or other mineral dust, free of foreign matter.

F. Primer: In accordance with State of North Carolina Highways standards.

G. Tack Coat: Homogeneous, medium curing, liquid asphalt.

2.2 BASE COURSE

A. Earth Type Base Course: If allowed in the scope of this project, shall consist of approved selected soil materials. The material shall consist of topsoil, naturally or artificially proportioned sand-clay, or sand-clay gravel obtained from locations designated or approved by the owner's representative. Earth type base course shall comply with requirements of Section 520 for materials and construction procedures. The earth type base course shall be placed on a prepared sub-grade mixed, shaped, brought to proper moisture content and compacted in accordance with these specifications or as directed by the owner's representative.

B. Stabilized Aggregate Base Course: If allowed in the scope of this project, shall consist of properly graded mixture of natural or crushed gravel or stone, crushed slag, natural or processed sand that will readily compact to required density. Base course shall comply with requirements of Section 520 for materials and construction procedures. Stabilized aggregate base course shall be mixed, placed on a prepared sub-grade, brought to proper moisture content, and shaped. Compacted, and primed in accordance with these specifications or as directed by the owner's representative.

C. Hot Laid Asphalt Aggregate Base Course (Black Base): If allowed in the scope of this project, shall consist of a base course of crushed stone, crushed slag, or gravel and asphalt cement mixed in an approved plant and constructed on a prepared sub-grade.Hot laid asphalt aggregate base course shall comply with requirements of Section 610 for materials and construction procedures.

2.3 TACK COAT

A. Asphalt Emulsion Grade SS01: This grade may be diluted with not more than 50% water. Note: ss01 shall meet requirements as specified in section 605 of standard specs manual (latest edition) of the North Carolina Department of Transportation.

B. Apply to contract surfaces of previously constructed bituminous concrete or Portland cement concrete and similar surfaces. Distribute at rate of 0.05 to 0.15 gallons per square yard of surface.

C. Apply tack coat by brush to contact surfaces of curbs, gutters, manholes, and other structures projecting into or abutting asphalt concrete pavement.

D. Allow tack coat to dry to proper conditions of tackiness to receive paving before proceeding with work.

2.4 HOT LAID ASPHALTIC CONCRETE SURFACE COURSE

A. Mineral aggregate and asphalt cement shall conform to Section 610 for materials and construction procedures.

B. Aggregate and asphalt cement shall be mixed in an approved plant in such proportions that compositions by weight of finished mixture shall be within range limits as specified in Section 610.

C. The surface course shall be constructed on a prepared base in accordance with these specifications and to the lines, grades, and typical cross section shown on the plans or as directed by owner's representative.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that compacted subgrade is dry and ready to support paving and imposed loads.

B. Verify gradients and elevations of base are correct.

3.2 BASE COURSE

A. Place and compact base course.

3.3 PREPARATION - TACK COAT

A. Apply tack coat in accordance with manufacturer's instructions.

B. Apply tack coat on asphalt or concrete surfaces over subgrade surface at uniform rate of 1/3 gal/sq yd.

C. Coat surfaces of manhole frames with oil to prevent bond with asphalt pavement. Do not tack coat these surfaces.

3.4 PLACING ASPHALT PAVEMENT - SINGLE COURSE

A. Install Work in accordance with State of North Carolina Highways standards.

B. Place asphalt within 24 hours of applying primer or tack coat.

C. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.

D. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

3.5 PLACING ASPHALT PAVEMENT - DOUBLE COURSE

A. Place asphalt binder course within 24 hours of applying primer or tack coat.

B. Place wearing course within two hours of placing and compacting binder course.

C. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.

D. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

3.6 TOLERANCES

A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.

B. Variation from True Elevation: Within 1/2 inch.

3.7 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for general requirements for quality control.

B. Provide field inspection and testing. Take samples and perform tests in accordance with AI MS-2.

END OF SECTION 321126

SECTION 321313 - CONCRETE PAVING FOR SIDEWALKS Rev. 1.01

1.01 GENERAL

Concrete shall consist of a mixture of Portland cement aggregates and water, proportioned in accordance with the requirements of this specification. Admixtures shall be included with these primary ingredients only when specifically authorized.

SPECIAL PRECAUTIONS IN FREEZING WEATHER

2.01 FROZEN AGGREGATES

Frozen aggregates or aggregates containing lumps of frozen material shall be thawed before using.

2.02 WORK IN FREEZING WEATHER

When the temperature falls below thirty-two (32) degrees Fahrenheit, all the materials which enter into the construction of concrete work of any kind are to be thoroughly heated and used while hot. This shall be accomplished by heating the aggregates and water with which the concrete is mixed. As soon as the concrete is placed, it is to be protected from frost, either by backfilling or covering with hay, straw or some similar substance, to a depth of at least one (1') foot. A covering of canvas or boards will not be sufficient, but where steam is available and it is practical to cover all exposed concrete with canvas and introduce steam under the canvas, it will be deemed a sufficient protection. When the temperature falls to or below thirty-five (35) degrees Fahrenheit, no concrete work of any kind is to be done except by special permission of the Engineer, and then strictly according to his directions. Concrete shall be deposited on frosted or frozen subgrade.

PROPORTIONS AND CONSISTENCY

In proportioning concrete materials one (1) bag (sack) of cement shall be considered as being one (1) cubic foot volume and ninety-four (94) pounds weight.

3.01 AGGREGATES

The weight per unit volume of the aggregates shall be based on dry and rodded weights determined in accordance with ASTM C-29 latest version.

3.02 WATER

Total or maximum water shall be considered as that including added water absorbed (surface) water in the aggregates.

Water shall be measured by volume or weight. The device for the measurement of water shall be readily adjustable under all operating conditions and shall be accurate to one-half (1/2%) percent or less.

3.03 CEMENT

Cement shall be measured by weight when bulk cement is used and where in batching it is necessary to use a portion of a bag. Otherwise for bag cement, the bag weight of ninety-four (94) pounds may be used. Cement shall not be weighed in the same batch box as the aggregates, but a separate scale shall be used.

3.04 ADMIXTURES

Powdered admixtures shall be measured by weight and liquid admixtures by weight or volume.

3.05 WEIGHING HOPPERS & SCALES

Scales utilized in proportioning shall be either springless dial, multiple beam type, or solid-state digital strain gauge transducer type. Scale gradations shall be no greater than:

Aggregate Scales	30 lbs.
Cement Scales	6 lbs.
Water Scales	6 lbs.

All scale indicators shall be enclosed against moisture and dust. Weighing equipment shall be insulated against vibration and movement of other operating equipment in the plant. When the entire plant is running, the scale reading at cut-off shall not vary more than 1% for cement, 1% for water, 1 1/2% for any size of aggregate, nor 1% for the total aggregate in any batch.

3.06 CONSISTENCY

The consistency of the concrete shall be determined by the slump test, hereinafter referred to, and said mixes shall be of the consistency required by the Engineer; but the ratio of fine aggregate to total aggregate shall be maintained as shown in Table 1.

MIXING AND DELIVERY

All concrete under this specification shall be machine mixed, where the volume to be placed is equal to or greater than (1) cubic yard. Hand mixing may be allowed where the volume to be placed is less than (1) cubic yard.

4.01 MIXERS

Mixers shall be stationary or truck mixers and shall conform with ASTM C-94 latest revision. The mixer drum shall be of adequate size to accommodate the maximum batch and shall be rotated at the rate specified by the manufacturer. The mixer shall be equipped with an automatic timing device to prevent discharge of the concrete until the specified mixing time has elapsed. In lieu of an automatic timing device, the Contractor may elect to use a stop watch in the hands of a reliable worker.

4.02 MIXING TIME

The minimum mixing time for batches of one (1) cubic yard capacity or less shall be one (1) minute; for larger capacity of mixes this mixing time shall be increased at the rate of one-half (~) minute for each cubic yard or fraction thereof additional capacity.

The mixing time shall be measured from the time that all of the materials and one-half (1/2) of the water are in the drum. The water shall not be added faster than consuming ten (10) complete drum revolutions.

4.03 CENTRAL PLANT READY MIX CONCRETE DELIVERY

Central Plant Ready Mix Concrete shall be delivered to the work site at the specified consistency in watertight containers in which segregation will not take place and from which the concrete can be discharged freely.

4.03.1 DELIVERY PERIOD

Central Plant Ready Mix Concrete shall be delivered to the work site and pouring begun within a period of one and one half (1 ~) hours after the introduction of mixing the water to the dry materials.

4.03.2 COLD WEATHER DELIVERY

Concrete delivered in out of door temperature lower than forty (40) degrees shall arrive at the work having a temperature of not less than sixty (60) degrees F., nor greater than one hundred (100) degrees F.

4.04 HAND MIXING

Hand mixing shall be permitted when the amount of concrete required for any job is less than one (l) cubic yard. Hand mixed concrete shall be mixed on a watertight platform or in a mortar box in batches not to exceed 1/3 cubic yards each. The aggregate shall first be spread in a uniform layer over which the required quantity of cement shall be evenly distributed. The entire batch shall be turned with shovels until the ingredients are thoroughly blended before adding the water. After adding the proper amount of water, the batch shall again be turned with shovels until a uniform consistency is obtained. Methods of hand mixing which allow the loss of mixing water will not be permitted.

INSPECTION

Proper facilities shall be provided for the inspection and sampling of concrete at the mixing plant, loading plant, and place of delivery.

The manufacturer shall afford the inspector, without charge to the CFPUA, all reasonable facilities for securing samples to determine if the concrete is being furnished in accordance with the requirements of this specification. All inspection and sampling shall be so conducted as not to interfere unnecessarily with the manufacture and delivery of the concrete.

5.01 HANLDING AND PLACING CONCRETE

No concrete shall be used which does not reach its final position in the forms within one (1) hour after water is first added to the mix, except when concrete is continually agitated, when the time may be extended to one and one-half (I Y2) hours. Concrete shall be placed so as to avoid segregation of the materials and the displacement of the reinforcement. The use of long chutes for conveying concrete from the mixer will be permitted only on written authority of the Engineer. In case an inferior quality of concrete is produced by the use of chutes, the Engineer may order discontinuance of their use and the substitution of a satisfactory method of placing. Open troughs and chutes shall be of metal or metal lines; where steep slopes are required, the chutes shall be equipped with baffle boards or be in short lengths that reverse the direction of movement. All chutes, troughs and pipes shall be kept free from coatings of hardened concrete by thoroughly flushing with water after each run; water used for flushing shall be discharged clear of the concrete already in place. Concrete shall not be dropped a distance of more than five (5) feet, and special care shall be taken to fill each part of the form by depositing the concrete as near final position as possible. The coarse aggregate shall be worked back from the face and the concrete forced around the reinforcement without displacing the bars. After initial set of the concrete, the forms shall not be jarred and no strain shall be placed on the ends of the projecting reinforcement. Concrete shall be compacted by continuous working with a suitable tool or by vibrating the forms in a manner acceptable to the Engineer; the mortar shall be flushed to the surface by the use of a suitable spading tool. If puddling cannot be done because of the obstruction of reinforcement or other cause, compacting shall be accomplished by vibrating the form in a manner satisfactory to the Engineer. Concrete shall be placed in horizontal layers not more than twelve (12") thick, except as hereinafter provided. When less than a complete layer is placed in one operation, it shall be terminated in a vertical bulkhead. Each layer shall be placed and compacted before the preceding batch has taken initial set to prevent injury to the green concrete and avoid surfaces of separation between the batches. Each layer shall be compacted so as to void the formation of a construction joint with a preceding layer which has not taken initial set. When placing of concrete is temporarily discontinued, the concrete, after becoming firm enough to sustain its form, shall be cleaned of laitance and other objectionable material to a sufficient depth to expose sound concrete. To avoid visible joints as far as possible upon exposed faces, the top surface of the concrete adjacent to the form shall be smoothed with a trowel. Where a "Feather Edge" might be produced at a construction joint, inset form work shall be used to form the preceding layer so that the thickness of the edge shall be not less than six (6") inches. Work shall

not be discontinued within eighteen (18") inches thick, in which case, if permitted by the Engineer, the construction joint may be made at the underside of the coping. Construction joints shall be placed across regions of low shearing stress, in locations which will be hidden from view to the greatest possible extent, and at only the locations shown on the plans or as directed by the Engineer. All concrete shall be placed so as to be properly finished and curing begun during the daylight hours. At no time shall concrete be placed which will require the finishing, etc., to be performed by artificial light. Paving operations shall be scheduled by the Engineer.

FINISHED AND CURING OF CONCRETE

6.01 FINISHING

Concrete for curb, curb and gutter, sidewalk and driveways shall have a broomed finish. This finish shall be accomplished as follows: The surface shall be screened and tamped with a special tool to force the coarse aggregate away from the surface, floated to bring the surface to the required finish level, steel-troweling to an even smooth surface and brooming with a fibre-bristle brush. The surface shall be of uniform texture.

6.02 CURING

Curing shall be accomplished by preventing loss of moisture, rapid temperature change, and mechanical injury or injury from rain or flowing water for a period of 7 days when normal Portland cement has been used or 3 days when high-early-strength Portland cement has been used. Curing shall be started as soon after placing and finishing as free water has disappeared from the surface of the concrete. Curing may be accomplished by any of the following methods or combination thereof, as approved.

6.02.1 MOIST CURING

Uniformed surfaces shall be covered with burlap, cotton, or other approved fabric mats, or with sand and shall be kept continually wet. Forms shall be kept continually wet and if removed before the end of the curing period, curing shall be continued as on uniformed surfaces, using suitable materials. Burlap shall be used only on surfaces which will be unexposed in the finished work and shall be in two layers.

6.02.2 WATERPROOF-PAPER CURING

Surfaces shall be covered with waterproof paper lapped 4 inches at edges and ends and sealed with masting or pressure-sensitive tape not less than I Y2 inches wide. Paper shall be weighted to prevent displacement, and tears and holes appearing during the curing period shall be immediately repaired by patching.

6.02.3 MEMBRANE CURING METHOD

The entire exposed surfaces shall be covered with a pigmented membrane-forming curing compound approved by the Engineer. The curing compound shall be applied in two coats by hand operated pressure sprayers at a coverage of approximately 200 square feet per gallon for both coats. The second coat shall be applied in a direction approximately at right angles to the direction of application of the first coat. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel and shall be free from pinholes or other imperfections. Concrete surfaces to which membrane-curing compounds have been applied shall be adequately protected for 7 days from pedestrian and vehicular traffic and from any other action which might disrupt the continuity of the membrane. Any area covered with curing compound and damaged by subsequent construction operations within the 7-day curing period shall be resprayed at no additional expense to the CFPUA.

7.01 TABLE I – RECOMMENDED PROPORTIONS OF AGGREGATES

Maximum Size of Coarse Aggregate – Inches	Ratio of Fine (*) to Total Aggregate on Basis of Dry, Compacted Columns, Measured Separately	
	Minimum	Maximum
3/8”	0.55	0.70
3/4”	0.40	0.60
1” and over	0.30	0.50

(*) Note: The finer the sand, the lower will be the percentage required.

8.00 TABLE II – CONCRETE PROPORTIONS AND STRENGTH REQUIREMENTS

Type of Construction	Max. Water Gals. Per Bag Cement	Min Cement Bags per 1 Lb. Cubic Yard	Min. Compo Strength Per Concrete Sq. In. at 28 Classification Days
AA. Reinforced Piles, Thin Walls Light Structural Members	5 ½	6 ¾	4000
A. Reinforced Retaining Walls Sewers, except Cradles, Side-Walks, Driveways and Curbs	6 ¾	5 ¾	3000
B. Retaining Walls non Rein-Forced, Cradles for Sewers	7 ½	5 ¼	2500
C. Additional Foundation, Mass Work Not Exposed to the Weather, Trench Paving	8 ¼	4 ¼	2000

9.00 SAMPLING AND TESTING

All sampling, curing and testing of Portland Cement concrete shall be in accordance with the current ASTM designation applicable to each case as listed in the subsections. Not less than three cylinders shall be taken for testing at anyone time. Unless otherwise directed by the Engineer, three cylinders shall be taken for breaking at seven days and three cylinders taken for breaking at twenty-eight (28) days from each batch to be tested. The cost of concrete for samples is to be considered incidental testing company. The Owner will pay the costs of the initial tests. Any retests will be paid by the Contractor.

9.01 SAMPLING FRESH CONCRETE: CI72 - Latest Revision

9.02 OBTAINING DRILLED CORES: C42 - Latest Revision

9.03 MOLDING AND CURING SPECIMENS: C31 - Latest Revision

9.04 COMPRESSING STRENGTH: C39 - Latest Revision

9.05 FLEXURAL STRENGTH: C78 - Latest Revision

9.06 SLUMP: Cl43 - Latest Revision

9.07 AIR CONTENT: Cl73 or C231 - Latest Revision

9.08 UNIT WEIGHT YIELD: Cl38 - Latest Revision

9.09 SETTING OF MORTAR: C191 or C266 - Latest Revision

10.00 PAYMENT

No separate payment for concrete will be made.

END OF SECTION 321313

SECTION 321613 - CONCRETE CURBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of Division 1 shall govern this section.

1.2 DESCRIPTION OF WORK

A. Extent of concrete curbing is shown on the drawings.

B. Concrete curbing shall be constructed as detailed on the drawing. All curbing shall be "formed" in the road curvature and radii. Extruded curbing is permitted on tangents.

1.3 QUALITY ASSURANCE

A. All work and materials shall comply with North Carolina Department of Transportation standard specifications, latest edition.

1.4 JOB CONDITIONS

A. Concrete curb shall be applied only when ambient temperature is above 50 degrees F and when temperature has not been below 35 degrees F for 12 hours immediately prior to application.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Concrete shall be 3000 psi mix from an approved batch plant using Portland cement ASTM C150-67, Type 1, sand ASTM C33-67 and coarse aggregate ASTM C33-67.

B. Expansion joint material for joints shall conform to the requirements of AASHTO M-173. All preformed point fillers shall have a thickness equal to the width of the joint required (1/2-inch minimum) and shall be furnished in lengths equal to the widths of the slab in which they are to be installed. The upper surface shall be 1/2-inch below the surface of the slab.

C. Curing materials shall be burlap cloth conforming To AASHTO B-182; waterproof, polyethylene film; or liquid curing compounds conforming to AASHTO M-148 for Type 2 (white pigmented).

PART 3 - EXECUTION

3.1 CONCRETE CURBS

A. The curbs shall be installed as detailed on the Drawings.

B. The subgrade shall be thoroughly compacted and finished to a smooth, firm surface, and shall be moist at the time the concrete is placed. Any concrete that settles after placement shall be removed and replaced without additional compensation as directed by the owner's representative.

C. Forms shall be of wood or metal and of a depth equal to the thickness of the concrete course. They shall be free from warp, and of sufficient strength, when staked, to hold the alignment during the concrete placing and finishing operations. All forms shall be cleaned and oiled each time they are used, before concrete is placed against them. Flexible or curved form shall be used on curves as necessary in order to prevent a chord effect in the alignment of the finished work.

D. The concrete shall be batched and mixed in an approved batch plant and transported to the job site in a truck mixer. Unless otherwise indicated on the plan, concrete curbs, gutters, and curb and gutters shall be constructed uniform section ten feet in length, except where shorter sections are necessary for closures; but no section shall be less than 4 feet in length. The sections shall be separated by sheet steel templates or dividing plates set normal to the face and top of the curb. The plates shall be carefully set during the placing of the concrete and allowed to remain in place until the concrete has set sufficiently to hold its shape, but shall be removed while the forms are still in place.

E. Concrete shall be deposited in the forms in such manner that the forms will not be displaced out of grade or alignment. During the placing operations, the concrete shall be spaded or vibrated through out the entire mass and especially against the forms and points. The surface of the concrete shall be tamped, floated, troweled, roomed, corners edged, and finished to the typical section, lines, and grades as soon as practical after the placing of the concrete. The forms shall be left in place until the concrete has set sufficiently that their removal will not injure the concrete.

F. The curb shall be rubbed with a brush and water to leave a smooth finish free of voids and honeycomb.

G. The contractor shall pay particular attention to the alignment of curbs on tangents and maintain a smooth radius on curves.

H. The contractor shall remove any curb that is cracked, settled, honeycombed, or in poor alignment or elevation as determined by the owner's representative.

I. The contractor shall backfill all curbs with clean topsoil, smooth, free of clogs or debris. The contractor shall fine-grade the backfill to top of curb elevation, ready for plating. The contractor shall replace all curb that is damaged or mud stained beyond cleaning. All curbs shall be left clean and shall present a neat appearance after the back-filling operation.

J. Preformed expansion joints 3/4 inch thick, extending the full depth of the concrete slab, shall be constructed at the locations indicated on the plans and at other locations as follows:

1. Transverse expansion joints shall be placed at intervals of not more than 100 feet in all new concrete pavement, sidewalk and curb and gutter.

K. Contraction joints for concrete curbing shall be placed not the exceed 10 feet o/c, by scoring after loading operations are completed. Contraction joints shall be 1 inch deep by 1/2 inch wide and shall be edged and finished smooth and true to line.

L. As soon as the concrete curb has hardened sufficiently, the forms for the exposed surfaces shall be removed and the concrete for the curb face and top shall be floated and troweled as necessary to provide a smooth uniform finish. Templates shall be left in place a sufficient length of time to prevent bonding at the joint.

M. After the surface of the gutter has been properly shaped and prepared and the water sheen has disappeared, the final finish shall be by brooming. Brooming shall be transverse to the line of traffic. All joints shall be in a vertical plane perpendicular to the curb face. Joints shall be clean with corners well rounded. All corners shall be edged to conform to the typical cross section. Tool marks shall be eliminated.

N. Concrete curb shall be backfilled within 48 hours after pouring.

END OF SECTION 321613

SECTION 321723 - PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and provisions of the General Conditions, Supplemental Conditions, and Division 1 are included as part of this Section as though bound here.

1.2 RELATED REQUIREMENTS

A. The General Provisions of Division 1 shall govern this section.

B. Construction drawings.

C. Section 321126 - Bituminous Concrete Paving.

1.3 DESCRIPTION OF WORK

A. Extent of traffic stripe painting is shown on the drawings.

B. All parking stalls, centerline of entrance drives and other markings as shown on the drawings.

C. All handicap symbols, directional arrows, turn symbols, stop and yield symbols, no parking stripping, as required for traffic control, are a part of this specification.

D. All work and materials shall comply with appropriate department of transportation standard specifications, latest edition.

1.4 JOB CONDITIONS

A. Traffic painting shall be applied only when ambient temperature is above 50 degrees F. and when temperature has not been below 35 degrees F. for 12 hours immediately prior to application. Do not apply when pavement is wet, unclean, or damaged.

PART 2 - PRODUCTS

2.1 PAINT

A. Paint shall be "white" traffic stripe suitable for traffic line marking on highways with composition conforming to appropriate department of transportation standard specifications; however, all sections related to pavement shall be excluded.

B. Paint color for fire lanes and for handicap symbols shall be as per local codes. All paint used shall be suitable for traffic line marking and shall conform to appropriate department of transportation standard specifications.

PART 3 - EXECUTION

3.1 PARKING LOT STRIPE PAINTING

A. All parking stalls and centerline striping shall be 4" wide with a wet film thickness of 0.015 inches.

B. The paint shall dry to touch within 15 minutes, shall dry to no pick-up within 30 minutes when tested in accordance with ASTM C-711. The color after drying shall be pure flat white, free from tint, furnishing the maximum amount capacity for both daylight and artificial light.

C. The contractor shall certify via letter to the engineer that the paint and execution of work complies with the appropriate North Carolina Department of Transportation standard specifications.

END OF SECTION 321723

SECTION 323113 - CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Chain-link fences.
2. Swing gates.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for cast-in-place concrete equipment bases/pads for gate operators and controls and post footings.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review coordination of interlocked equipment specified in this Section and elsewhere.
2. Review required testing, inspecting, and certifying procedures.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:

a. Fence and gate posts, rails, and fittings.
b. Chain-link fabric, reinforcements, and attachments.
c. Accessories:
d. Gates and hardware.

B. Shop Drawings: For each type of fence and gate assembly.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include accessories, hardware, gate operation, and operational clearances.

C. Samples: For each type of component with factory-applied finish, prepared on Samples of size indicated below:

1. Polymer-Coated Components: In 6-inch lengths for components and on full-sized units for accessories.

D. Delegated-Design Submittal: For structural performance of chain-link fence and gate frameworks, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer

B. Product Certificates: For each type of chain-link fence and gate.

C. Product Test Reports: For framework strength according to ASTM F 1043, for tests performed by manufacturer and witnessed by a qualified testing agency.

D. Sample Warranty: For special warranty.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing fence grounding; member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.8 WARRANTY

A. Special Warranty: Installer agrees to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure to comply with performance requirements.
b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: Two (2) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design chain-link fence and gate frameworks.

B. Structural Performance: Chain-link fence and gate frameworks shall withstand the design wind loads and stresses for fence height(s) and under exposure conditions indicated according to ASCE/SEI 7.

1. Design Wind Load: 120 mph.

a. Minimum Post Size: Determine according to ASTM F 1043 for post spacing not to exceed 10 feet for Material Group IA, ASTM F 1043, Schedule 40 steel pipe
b. Minimum Post Size and Maximum Spacing: Determine according to CLFMI WLG 2445, based on mesh size and pattern specified.

2.2 CHAIN-LINK FENCE FABRIC

A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist according to "CLFMI Product Manual" and requirements indicated below:

1. Fabric Height: As indicated on Drawings.
2. Steel Wire for Fabric: Wire diameter of 0.192 inch.
    a. Mesh Size: 2 inches.
    b. Polymer-Coated Fabric: ASTM F 668, Class 2a over aluminum-coated steel wire.
        1) Color: Black, according to ASTM F 934.
    c. Coat selvage ends of metallic-coated fabric before the weaving process with manufacturer's standard clear protective coating.
3. Selvage: Knuckled at both selvages.

2.3 FENCE FRAMEWORK

A. Posts and Rails: ASTM F 1043 for framework, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F 1043 based on the following:

1. Fence Height: As indicated on Drawings.
2. Light-Industrial-Strength Material: Group IC-L, round steel pipe, electric-resistance-welded pipe.
    a. Line Post: 1.9 inches in diameter.
    b. End, Corner, and Pull Posts: 2.375 inches.
3. Horizontal Framework Members: top and bottom rails according to ASTM F 1043.
    a. Top Rail: 1.66 inches in diameter.
4. Brace Rails: ASTM F 1043.
5. Metallic Coating for Steel Framework:
    a. Type A: Not less than minimum 2.0-oz./sq. ft. average zinc coating according to ASTM A 123/A 123M or 4.0-oz./sq. ft. zinc coating according to ASTM A 653/A 653M.
6. Polymer coating over metallic coating.
    a. Color: Black, according to ASTM F 934.

2.4 TENSION WIRE

A. Metallic-Coated Steel Wire: 0.177-inch-diameter, marcelled tension wire according to ASTM A 817 or ASTM A 824, with the following metallic coating:

1. Type II: Zinc coated (galvanized) by electrolytic process, with the following minimum coating weight:
    a. Matching chain-link fabric coating weight.

B. Polymer-Coated Steel Wire: 0.148-inch-diameter, tension wire according to ASTM F 1664, Class 2b over aluminum-coated steel wire.

1. Color: Black, according to ASTM F 934.

2.5 SWING GATES

A. General: ASTM F 900 for gate posts and single and double swing gate types.

1. Gate Leaf Width: As indicated.
2. Framework Member Sizes and Strength: Based on gate fabric height as indicated.

B. Pipe and Tubing:

1. Zinc-Coated Steel: ASTM F 1043 and ASTM F 1083; manufacturer's standard protective coating and finish.
2. Gate Posts: Round tubular steel.
3. Gate Frames and Bracing: Round tubular steel.

C. Frame Corner Construction: Welded.

D. Hardware:

1. Hinges: 360-degree inward and outward swing.
2. Latch: Permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.
3. Lock: Manufacturer's standard internal device.
4. Padlock and Chain: Provided by Owner, however; Contractor shall coordinate lock type with Owner to be certain gate can accept the lock.
5. Closer: Manufacturer's standard.

2.6 FITTINGS

A. Provide fittings according to ASTM F 626.

B. Post Caps: Provide for each post.

1. Provide line post caps with loop to receive tension wire or top rail.

C. Rail and Brace Ends: For each gate, corner, pull, and end post.

D. Rail Fittings: Provide the following:

1. Top Rail Sleeves: Pressed-steel or round-steel tubing not less than 6 inches long.
2. Rail Clamps: Line and corner boulevard clamps for connecting bottom rails to posts.

E. Tension and Brace Bands: Pressed steel.

F. Tension Bars: Steel, length not less than 2 inches shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.

G. Truss Rod Assemblies: Steel, hot-dip galvanized after threading rod and turnbuckle or other means of adjustment.

H. Tie Wires, Clips, and Fasteners: According to ASTM F 626.

1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, according to the following:

a. Hot-Dip Galvanized Steel: 0.106-inch-diameter wire; galvanized coating thickness matching coating thickness of chain-link fence fabric.

I. Finish:

1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz./sq. ft. of zinc.

a. Polymer coating over metallic coating.

2.7 GROUT AND ANCHORING CEMENT

A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout, recommended in writing by manufacturer, for exterior applications.

B. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating, and that is recommended in writing by manufacturer for exterior applications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for a certified survey of property lines and legal boundaries, site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.

1. Do not begin installation before final grading is completed unless otherwise permitted by Architect.

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

3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 CHAIN-LINK FENCE INSTALLATION

A. Install chain-link fencing according to ASTM F 567 and more stringent requirements specified.

1. Install fencing on established boundary lines inside property line.

B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.

C. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.

1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.

a. Exposed Concrete: Extend 2 inches above grade; shape and smooth to shed water.

b. Concealed Concrete: Place top of concrete as indicated on Drawings to allow covering with surface material.
c. Posts Set into Sleeves in Concrete: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed according to anchoring material manufacturer's written instructions. Finish anchorage joint to slope away from post to drain water.
d. Posts Set into Holes in Concrete: Form or core drill holes not less than 5 inches deep and 3/4 inch larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout mixed and placed according to anchoring material manufacturer's written instructions. Finish anchorage joint to slope away from post to drain water.

D. Terminal Posts: Install terminal end, corner, and gate posts according to ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more. For runs exceeding 500 feet, space pull posts an equal distance between corner or end posts.

E. Line Posts: Space line posts uniformly at 96 inches o.c.

F. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fence posts. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.

1. Locate horizontal braces at midheight of fabric 72 inches or higher, on fences with top rail, and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.

G. Tension Wire: Install according to ASTM F 567, maintaining plumb position and alignment of fence posts. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch-diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches o.c. Install tension wire in locations indicated before stretching fabric. Provide horizontal tension wire at the following locations:

1. Extended along top and bottom of fence fabric. Install top tension wire through post cap loops. Install bottom tension wire within 6 inches of bottom of fabric and tie to each post with not less than same diameter and type of wire.

H. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fence posts. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.

I. Intermediate and Bottom Rails: Secure to posts with fittings.

J. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 1-inch bottom clearance between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.

K. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts, with tension bands spaced not more than 15 inches o.c.

L. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric according to ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.

1. Maximum Spacing: Tie fabric to line posts at 12 inches o.c. and to braces at 24 inches o.c.

M. Fasteners: Install nuts for tension bands and carriage bolts on the side of fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

3.4 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation.

3.5 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Lubricate hardware and other moving parts.

END OF SECTION 323113

SECTION 329113 - SOIL PREPARATION

PART 1 - GENERAL

SCOPE

The work under this section shall consist of providing all work, materials, labor, equipment and supervision necessary to provide and prepare soil for seeding, sodding, and landscape planting. Included are the following topics:

1.1 SECTION INCLUDES

A. PART 1 - GENERAL

Scope
Related Sections
Unit Prices
Definitions
Regulatory Requirements
Reference Standards
Submittals
Quality Assurance

B. PART 2 - MATERIALS

Topsoil
Soil Amendments
Fertilizer

C. PART 3 - EXECUTION

Subgrade Soil Preparation
Placing Topsoil
Organic Soil Amendments and pH Adjustment
Fertilizer

1.2 RELATED SECTIONS

A. Section 312200 – Grading: Topsoil material.

B. Section 312200 – Grading: Preparation of subsoil and placement of topsoil in preparation for the work of this section.

C. Section 312323 – Fill and Backfill: Topsoil material.

1.3 UNIT PRICES - MEASUREMENT AND PAYMENT

A. See Section 012000 - Unit Prices, for additional unit price requirements.

1.4 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Balled and Burlapped stock: Exterior plants dug with firm, natural balls of earth in which they are grown, with ball size not less than sizes indicated diameter and depth recommended by ANSI Z60.1 for type and

size of tree or shrub required; wrapped, tied, rigidly supported, and drum-laced as recommended by ANSI Z60.1.

C. Container-Grown Stock: Healthy, vigorous, well-rooted exterior plants grown in a container with well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for kind, type, and size of exterior plant required.

D. Finish Grade: Elevation of finished surface of planting soil.

E. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

F. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant or desiccant.

G. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals or people. These include insects, mites, grubs, mollusks (snails or slugs), rodents, unwanted plants (weeds), fungi, bacteria and viruses.

H. Planting Soil: The following types of standardized topsoil: existing in-place surface topsoil, surface soil modified to become topsoil imported topsoil, or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

I. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill immediately beneath planting soil.

J. Weeds but are not limited to: Include Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.5 REGULATORY REQUIREMENTS

A. Comply with regulatory agencies for fertilizer and herbicide composition.

1.6 REFERENCE STANDARDS

A. ASTM D5268-07 Standard Specification for Topsoil Used for Landscaping

B. USDA Agricultural Handbook No. 60 Diagnosis and Improvement of Saline and Alkali Soils

C. American Nursery and Landscape Association

1.7 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened, labeled, and undamaged containers showing weight, name of manufacturer and indication of conformance with state and federal laws (as applicable). Store and handle materials according to manufacturer's and supplier's recommendations.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements or on existing turf areas or plants.
2. Provide erosion control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems or walkways.
3. Accompany each delivery of bulk fertilizers, lime and/or soil amendments with appropriate certificates. Provide copies of these to the Owner/Architect upon request.

C. Pesticides:

1. Handle all pesticides in accordance with federal, state and local rules and regulations.
2. Do not store these products near structures, utilities, walkways and pavements or on existing turf areas or plants.

1.8 SUBMITTALS

A. Soil Testing: For existing soil in landscape areas, provide testing results and analysis or recommendations from an independent third party testing laboratory to correct deficiencies or problematic soil conditions.

B. Material Test Reports: Provide copies of all quality assurance testing reports for all soils intended for use in planting or turf areas on the site. Reports required for at least: existing surface soil, manufactured soil, imported soil in planting areas and soil intended for use as planting soil (if different than existing surface soil).

C. Provide product data, including applicable analytical data, for soil amendments including but not limited to:

- Peat products
- Lime
- Fertilizer

1.9 QUALITY ASSURANCE

The Contractor shall retain the services of an independent soil testing laboratory to process soil sampling, testing and analysis of salvaged and imported soil and amendments as required by this section and elsewhere in the Contract Documents. The materials testing consulting Architect/Engineer shall be subject to approval by the Owner.

Soil-Testing Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

Soil Analysis: A soil test and analysis of a wide representation of soils through out the intended planting and turf areas. For each unamended soil type and each selected location, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of the soil. The test results should also include the soil-testing laboratory's recommendations for any corrective measures needed to grow healthy, thriving specified plant material or turf on the site.

Testing methods and written recommendations shall comply with USDA's Handbook No. 60.

The soil-testing laboratory shall be given samples with information including depth and location, and number of samples taken over the entire site. If the Owner or Architect chose, the contractor may be

required to have the soil-testing laboratory oversee the soil sampling. A minimum of three representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.

Report suitability of and recommended alterations of tested soil for healthy, thriving plant and turf growth.

Based upon the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. or volume per cu. yd. for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.

Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.

Fertilizer shall be delivered to the site in original, sealed containers, and stored in a waterproof space. Containers shall bear the manufacturer's name, analysis, trademark and guarantee unless otherwise approved by Owner or Architect.

Collection of soil specimens shall be complete in accordance with accepted practices, and shall be subject to approval by the Owner.

PART 2 - PRODUCTS

2.1 TOPSOIL

Clean salvaged or imported material capable of passing the 1" sieve and meeting the requirements of Section 625.2(1) of the Standard Specifications for Highway Construction. The material shall be free of rocks, gravel, wood, debris, and of noxious weeds and their seeds.

2.2 SOIL AMENDMENTS

Soil amendments acceptable as part of a backfill mix (if appropriate according to soils testing report) include but not limited to:

- Peat Moss - Type 1 sphagnum, weed and seed free, 3.1-5.0 pH
- Sedge Peat - decomposed peat with no identifiable fibers
- Leaf Compost - screened and free of trash and other debris
- Compost - standard commercial grade compost of sheep or cow manure
- Pine Bark - potting grade pine bark with no particles larger than 1/2", less than 10% wood fiber
- Lime: ASTM C 602, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent and as follows:
- Class: Class T, with a minimum 99 percent passing through No. 8 sieve and a minimum 75 percent passing through No. 60 sieve.
- Class: Class O, with a minimum 95 percent passing through No. 8 sieve and a minimum 55 percent passing through No. 60 sieve.
- Provide lime in form of ground dolomitic limestone.
- Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, with a minimum 99 percent passing through no. 6 sieve and a maximum 10 percent passing through No. 40 sieve.
- Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- Aluminum Sulfate: Commercial grade, unadulterated.
- Perlite: Horticultural perlite, soil amendment grade.

- Agricultural Gypsum: Finely ground, containing a minimum of 90 percent calcium sulfate with 90 percent passing through No. 50 sieve.
- Sand: Clean, washed, natural or manufactured, free of toxic materials.
- Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.
- Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

Soil amendments shall be capable of passing the 1" sieve. The material shall be free of rocks, gravel, wood, debris, and of noxious weeds and their seeds. Any soil amendments other than those listed above should be approved by Owner and/or Architect prior to use on site.

2.3 FERTILIZER

Use commercially available fertilizer meeting the following requirements: 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 composition as recommended by the findings and recommendations in the soils report.

All fertilizers shall be delivered fully labeled according to applicable regulations, bearing name, trade name or trademark of producer, along with producer's warranty. Application amounts of fertilizer and lime will be governed by the recommendations of the soil test.

PART 3 - EXECUTION

3.1 SUBGRADE SOIL PREPARATION

Remove or mow all vegetation to a height 3". Remove all rocks, debris, and litter that will prevent compliance with topsoil and seeding specifications. Final grade area to within 2" of subgrade elevations. Rake, till or disc the subsoil to a depth of 2"-4" to allow aeration.

3.2 PLACING TOPSOIL

Place topsoil to achieve final grades indicated on the Drawings, allowing for settlement. Place topsoil to the depth shown on the Drawings. If no depth is shown provide a minimum of 4" of topsoil.

Do not apply topsoil to saturated or frozen subgrades.

3.3 ORGANIC SOIL AMENDMENTS AND pH ADJUSTMENT

Provide organic soil amendments and lime as recommended soil analysis. If topsoil has been determined acceptable by a soil test, no amendments are needed.

Uniformly apply organic soil amendments and lime, and incorporate into the top 4"-6" of soil by tilling or discing.

3.4 PRE-EMERGENT HERBICIDE

Pre-emergent herbicides shall be applied in accordance with any local, state, or federal guidelines to control weeds in planting and turf areas.

3.5 FERTILIZER

Fertilizer shall be applied in accordance with the recommendations of the soils test.

END OF SECTION 329113

SECTION 329200 - PLANTS

PART 1 - GENERAL

SCOPE

These specifications, along with contract drawings and lists of plant materials, apply to those items necessary for and incidental to the preparation, execution, completion and maintenance of the landscape planting activities (excluding lawn areas) specified in the contract. The scope includes the planting of trees, shrubs, ground covers, perennials, annuals, and bulbs, and the maintenance activities of fertilizing, pruning and watering.

PART 1 - GENERAL

Scope
Related Work
References
Quality Assurance
Measurement
Inspection
Substitutions
Delivery, Storage and Handling
Planting Schedule
Job Conditions
Guarantee

PART 2 - PRODUCTS

Materials

PART 3 - EXECUTION

Preparation
Planting of Trees and Shrubs
Finishing
Staking
Planting of Ground Covers, Perennials, Annuals and Bulbs
Inspection and Acceptance
Cleaning
Pruning
Maintenance

1.1 RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Section 329700 – Landscape Maintenance and Extended Warranty
Section 329113 – Soil Preparation

1.2 REFERENCES

ANSI Z60.1 American Standards for Nursery Stock
ANSI A300 American National Standard for Tree Care Operations - Tree, Shrub and Other Woody Plant Maintenance-Standard Practices

1.3 QUALITY ASSURANCE

All plant material shall conform to the *American Standards for Nursery Stock*, unless noted otherwise herein.

All plant material shall be true to the species and variety/hybrid/cultivar specified, and nursery-grown in accordance with good horticultural practices, and under climatic conditions similar to those of the site location. Nursery dug specimens to be replanted shall have been freshly dug and properly prepared for planting.

Trees and shrubs shall be trained in development and appearance as to be superior in form, compactness and symmetry. Trees with multiple leaders, unless specified otherwise, and shrubs with damaged or cut main stem(s), will be rejected.

Trees and shrubs with a damaged, cut or crooked leader, abrasion of bark, sunscald, frost crack, disfiguring knots, insects (including eggs and larvae) or insect damage, cankers/cankerous lesions or fungal mats, mold, prematurely-opened buds, or cuts of limbs over 3/4" diameter that are not completely callused will be rejected.

Trees and shrubs shall have healthy, well-developed root systems, and be free from physical damage or other hindrances to healthy growth.

Balled and burlapped plants shall be dug with solid balls of a diameter not less than that recommended by the *American Standards for Nursery Stock*, and of sufficient depth to include both fibrous and feeding roots. Balls shall be securely wrapped with burlap, and tightly bound with rope or twine. No plant shall be bound with rope or wire in such manner as to damage bark or break branches. The root flare should be within the top 2" of the soil ball.

Balled and burlapped plants will not be accepted if the ball is dry, cracked, or broken before or during planting.

Containerized plants are to be well-established within the container, with a root system sufficiently developed to retain its shape and hold together when removed from the container. Soil within the container should be held together by the roots, in form and whole. Plants shall not be pot-bound, nor have kinked, circling, or bent roots.

Bare root plants are to have a healthy, well-branched, and adequately spreading root system characteristic of the species.

Herbaceous perennials, annuals and bulbs shall only be supplied from nurseries certified by state plant inspectors. Substitutes or collected material may be used if approved by Owner or Architect/Engineer.

Soil-Testing Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed

For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and

Clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of the soil.

Testing methods and written recommendations shall comply with USDA's Handbook No. 60.

The soil-testing laboratory shall oversee soil sampling; with depth, location, and number of samples to be taken per instructions from Architect. A minimum of three representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.

Report suitability of tested soil for plant growth.

Based upon the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft.or volume per cu. yd. for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.

Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.

Installer Qualifications:

1. A qualified, State of North Carolina licensed landscape contractor whose work has resulted in successful establishment of exterior plants. Licensed Landscape Contractor must be in compliance with all applicable local, state, and federal regulations and requirements.
2. Installer's Field Supervision: Require landscape installer to maintain an experienced full-time supervisor on project site when planting is in progress.
3. Irrigation Installer: State of North Carolina licensed irrigation contractor.
4. Pesticide Applicator: State of North Carolina licensed applicator of commercial pesticide.

1.4 MEASUREMENT

Plants shall conform to the measurements specified within the contract documents. Specified height and spread dimensions will refer to the main body of the plant, and not from branch tip to branch tip. Plants meeting a specified measurement, but judged to lack the balance between height and spread characteristic of the species will be rejected.

Plants shall be measured when branches are in their normal position.

No plant shall be less than the minimum size specified, and no less than fifty (50) percent of the plants shall be as large as the maximum size specified.

Measure trees and shrubs with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inchcaliper size, and 12 inches above the root flare for larger sizes.

Containerized shrubs shall be measured by height and width for conformity with the plant list.

Herbaceous perennials shall be measured by pot size, not by top growth.

All other measurements, such as number of canes, ball sizes, and quality designations, shall conform to *American Standards for Nursery Stock*.

1.5 INSPECTIONS

Plant materials shall be subject to pre-delivery inspection and approval by the Owner or Architect/Engineer at a nursery or some other site where they are growing, this to judge conformity with specified requirements. Upon securing all plant materials, the Contractor shall submit to Owner a written request for inspection at

least five (5) working days prior to the proposed date. After approval by the Owner or Architect/Engineer, the plant is to be tagged for delivery.

Tagged plants are to be inspected on delivery to the project site, and the Owner or Architect/Engineer may reject any specimens no longer meeting the specified standards or that have been damaged in transit.

A representative of the Contractor shall be present at all inspections by the Owner or Architect/Engineer.

1.6 SUBSTITUTIONS

The substitution of plant materials is not permitted unless authorized in writing by Owner. If written proof is submitted by the Contractor that a plant of specified species, variety or size is unavailable, consideration will be given towards the nearest available size or variety, or towards an alternate species selection, with a corresponding adjustment of the contract price.

Larger plants than those specified can be used upon approval of the Owner or Architect/Engineer. The use of larger plants shall not increase the contract price. The root ball, root spread and container size of the larger specimen shall be proportionally increased, relative to the specified size.

1.7 DELIVERY, STORAGE AND HANDLING

The Contractor is to arrange for the acceptance and unloading of plants at the project site.

All plants are to be labeled by plant name and size. Labels shall be attached securely to all plants, bundles, and containers of plant materials when delivered. Labels shall be durable and legible, with information given in weather-resistant ink or embossed process lettering.

All plant materials, shipments and deliveries shall comply with current state and federal laws and regulations governing the inspection, shipping, selling and handling of plant stock. If required by law or regulation, a certificate of inspection, or a copy thereof, for injurious insects, plant diseases, and other plant pests shall accompany each shipment or delivery of plant material. The certificate shall bear the name(s) and address(es) of the source of the plant stock.

During transport, no plant shall be bound with rope or wire in a manner that damages trunks or breaks branches. Plants shall also not be dragged, lifted or pulled by the trunk, branches or foliage in a damaging way. No plant shall be thrown off of a truck or loader to the ground.

Prior to installation, all plants must be protected from sun and drying winds.

Containerized or balled and burlapped plants not being installed immediately must be kept in a shaded area, well-covered with wood chips, soil, or other approved material, and kept well-watered. Install all plants within three (3) days of delivery.

Cover roots of bare root plants with a moist tarp, burlap, sphagnum moss, or mulch while being transported to, or while being held at the project site. Soak the bare roots overnight in water before planting. Just before planting, extend the roots carefully into a natural position, free of bunching, kinking or circling. Cut back all broken or damaged roots to a point clean and free of rot. No additional root pruning is allowed. Carefully work backfill mix among the roots while simultaneously watering.

Fertilizer shall be delivered to the site in original, sealed containers, and stored in a waterproof space. Containers shall bear the manufacturer's name, analysis, trademark and guarantee as per standards of the North Carolina Department of Agriculture.

1.8 PLANTING SCHEDULE

Planting of deciduous, conifers and broadleaf evergreen tree and shrub species shall be completed before winter before first freeze and may resume planting again in spring after last frost.

Tender perennials planting shall be coordinated with and approved by the Owner/Architect prior to installation.

1.9 JOB CONDITIONS

A. Protect all plants, lawns, and grass areas from damage at all times. Damaged plants, lawns or grass areas shall be replaced or treated as required to conform with specifications herein for fresh stock.

B. Work areas shall be kept clean and orderly during the installation period. Under no condition shall debris from planting activities result in a safety hazard on-site or to adjacent off-site property.

C. Damage to lawns or grass areas incurred as a result of replacement operations shall be repaired by Contractor at no cost to Owner.

D. Warranty: All plants shall be warranted to be in healthy and flourishing condition by after the end of one full growing season.

1. At any time during the warranty period, the Contractor shall remove or replace, without cost to the Owner, and within a specified planting period, all plants not in a healthy and flourishing condition as determined by the Owner or Architect/Engineer.
2. Replacement plants shall be subject to the same specified requirements of the contract. The warranty of replacement plants shall extend for one year. If one year warranty ends during a dormant season, the warranty shall extend at least one month into the following growing season (or as otherwise specified by the Owner/Architect). In the event that a replacement plant is not acceptable during, or at the end, of the said warranty extension period, Owner may choose between subsequent replacement or credit for that item.
3. Include the following remedial actions as a minimum:
    a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
    b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
    c. A limit of one replacement of each plant will be required except for losses or replacements due to failure to comply with requirements.
    d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

PART 2 - PRODUCTS

2.1 MATERIALS

Plant Materials: A complete list of plant materials, including a schedule of quantities, sizes, quality and source location, shall be included in the contract documents. If discrepancies occur between the printed plant list, and the drawings, notify the Owner/Architect for clarification prior to purchase or installation of these materials.

Owner may request a written list of the proposed sources of nursery stock at the preconstruction meeting. This list may not be added to or otherwise altered without the consent of Owner.

Topsoil: Naturally fertile, agricultural soil, capable of sustaining vigorous growth, of uniform composition throughout, without admixtures of subsoil, free of clay, stones larger than 1" inch diameter, roots, trash and debris of any kind, supplied by Contractor at his/her expense, and subject to approval by the Owner or Architect/Engineer.

Organic 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 sieve; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings. Organic Matter Content: 50 percent of dry weight.

Planting Mixture: Material used in tamping around balls and roots during the planting operation shall be prepared on site.

Ratio of Loose Compost to Topsoil by Volume: 1:4 parts native topsoil from project site to organic compost unless otherwise directed by soil test recommendations. Conform to alternate mixes as specified for beds of certain ornamental plants. All mixing shall be done by mechanical means subject to the approval of the Project Representative or Landscape Architect.

Fertilizer: Granular, non-burning product composed of not less than fifty (50) percent organic slow-acting, guaranteed analysis professional fertilizer. Commercial fertilizer shall conform to North Carolina State Statutes and meet the standards of the North Carolina Department of Agriculture as to registration and labeling. Fertilizer shall be specified in the contract documents as to composition, but is subject to revision to suit project site conditions.

Organic Mulch: Mulch including: Shredded Bark, Wood Chips, Pine Needles, Cocoa Bean Hulls, or other Owner approved organic mulches, shall be free of material detrimental to healthy plant growth. Organic Mulch shall be 1/8" nominal thickness, with at least fifty (50) percent having an area of not less than 1 sq. inch, and no piece having an area of more than 6 sq. inches.

Weed Control Fabric: Spun-bonded, rot-resistant polypropylene fabric, water and air permeable, and unaffected by freezing and thawing, or by deterioration from fertilizers or pesticides.

Stakes: 6-8 foot (1.8 - 2.4 m) long sections of unflanged metal, or 2" x 2" (5.1 cm x 5.1 cm) hardwood.

Flexible Support Ties: 2" (5.1 cm) or wider bands of polypropylene, or elasticized or webbed strapping.

Wrapping Material: Biodegradable geotextile (fabric) trunk wrap, or waterproofed crepe wrapping paper, secured with 1" wide masking tape.

Anti-desiccant: If required as protection for leaf surfaces, anti-desiccant shall be permeable to permit transpiration, and mixed and applied in accordance with manufacturer's specifications.

Pre-emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

Mycorrhizal Fungi: Dry, granular inoculant containing at least 5300 spores per lb of vesicular-arbuscular mycorrhizal fungi and 95 million spores per lb of ectomycorrhizal fungi, with a maximum of 5.5 percent inert material

Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the composition compatible with the soil test recommendations but not to exceed the following unless otherwise approved by owner or owner's representative:

Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.

Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

PART 3 - EXECUTION

3.1 PREPARATION

Receive Owner or Architect/Engineer approval of staking layout prior to excavation. Schedule site review with Owner/Architect at least three (3) days prior to the site review.

Excavate planting areas as shown in the contract drawings.

Adequately barricade with proper warning devices any planting pit left open when planting work is not in progress, and that poses a hazard to vehicles and/or pedestrians.

Notify the Owner in writing of any soil conditions, obstructions, or concerns about water drainage deemed detrimental to healthy plant growth. These conditions or obstructions shall be detailed, along with any suggestions for correction, removal or relocation. Where soil conditions, poor drainage or other obstructions are encountered that cannot be easily remedied, the Owner will designate alternate locations, and will bear the additional costs of such relocation.

The planting pit for containerized and balled and burlapped plants shall be at least 2.5 to 3 times the diameter of the soil ball, or to a dimension otherwise specified.

The planting pit for a single shrub shall be 12" wider than the root ball.

Loosen the soil beyond the edge of the planting pit. The soil at the base of the planting pit is to remain undisturbed, the depth of which shall correspond to the distance from the bottom of the soil ball to the root flare, or slightly less.

Planting pits for bare root plants shall be only broad enough to receive the full extension of the roots when the plant is set, and only deep enough to set the uppermost roots just below existing grade.

For a shrub mass planting, the entire bed area is to be tilled to a depth of 4-6". Excavate individual shrub pits to the proper depth.

Application of Mycorrhizal Fungi: At time directed by Architect/Engineer, broadcast dry product uniformly over prepared soil at application rate recommended by manufacturer.

3.2 PLANTING OF TREES AND SHRUBS

Remove plant containers by cutting or carefully inverting the container. For plants grown in plastic containers slash the edges of the root ball from top to bottom with vertical 1" cuts using a sharp blade.

Root balled plants shall have rope, string, wire baskets, burlap and other wrapping material removed from the top half of the ball after the plant has been set in the hole.

Remaining wrappings, other than those made from plastic or synthetic material, may be left around the bottom half of the ball.

If deciduous species are planted in leaf, they may be sprayed with an approved anti-desiccant prior to planting when so directed by the Owner.

Trees and shrubs grown using root containment material shall have the containment bag removed prior to setting.

Set trees and shrubs straight and upright, and in the center of the planting hole and on the unexcavated base of the planting pit, with the most desirable face towards the most prominent view.

Root-balled shrubs are to be carried and set in the hole by the root ball.

Backfill pits with excavated soil. No soil in frozen or muddy condition shall be used for backfilling.

When pit is approximately two-thirds backfilled, tamp down and water to eliminate air pockets. After initial watering, add remainder of the soil to the top of pit, water without puddling, and firmly tamp without overcompacting. Form a 2-3" high saucer around the outer rim of the pit prior to mulching.

3.3 FINISHING

Finish-grade planting areas to required elevations after plants have fully settled.

No soil is to cover the top of the root ball. All plants shall be completely mulched over the root system with a 3" layer of specified mulching material immediately after planting. Pull back mulch no less than 3" and no more than 6" from the trunk.

If used, lay weed control fabric over grade prior to mulching as per manufacturer's recommendations. Secure to slopes with "T"-shaped pin anchors.

Thoroughly water plants immediately after planting and before mulching, primarily within and filling the saucer.

Only trees so designated shall be protected with tree wrap. Secure wrapping at a minimum of 5 locations, including the top, middle and bottom of the trunk. Cover the trunk's entire surface in a spiral manner, starting at the tree's base and extending to just below the height of the lowest main branches. Overlap material at 1/2-1". Owner will be responsible for removing the tree wrap after a recommended period.

Prune any dead or broken branches. Prune newly-planted hedges as directed by the Landscape Architect or Project Representative.

Remove all twine and rope after planting, along with any labels attached around trunks or branches.

3.4 STAKING

Stake only those individual plants designated on-site by Owner.

Space stakes evenly outside of, and driven clear of, the root ball. Stakes are to be driven at an angle then drawn to vertical.

Ties made of approved material shall be directly attached to the stakes. Attach ties so as to allow for 1-3" of sway in the trunk. For drooping stems, ties shall be placed at the point on the stem at which the top can then stand on its own.

Staking shall conform to any additional directions found in the drawings.

3.5 PLANTING OF GROUND COVERS, PERENNIALS, ANNUALS AND BULBS

Loosen soil of the planting bed to a depth of 6" by mechanical or hand tilling while soil is dry. For bulbs, the depth of loosened soil will be determined by the type of bulb planted, and specified in the contract or landscape plan

After soil is loosened, till organic compost into the soil across the planting bed to a uniform depth of 2" for compost.

Fertilizer, at amounts determined by the soil test, shall be topdressed to the soil. Liquid fertilizer may be applied to annuals if directed by Owner or Architect/Engineer.

Space as described in the landscape plan.

Unless otherwise specified, install plants no closer than 12" to the trunks of trees or shrubs within planting bed, and to within 6" of the edge of the bed.

Prior to planting, biodegradable plant containers shall be split and non-biodegradable containers removed. The root systems of all such plants shall be split or crumbled by hand.

For small quantities of bulbs, or in sections where bulbs are set within other plants, drive bulb planting holes through mulch using a bulb planter, hand trowel, or power auger. Plant bulb such that its basal plate faces downward, then cover with soil and mulch.

For larger quantities of bulbs, excavate designated areas to specified planting depth, place bulbs such that their basal plates face downward, then cover with soil and mulch.

When applying mineral mulch lay weed control fabric over grade prior to mulching as per manufacturer's recommendations. Secure to slopes with "T"-shaped pin anchors.

When applying organic mulch apply pre-emergent herbicide per manufacturer's recommendations before applying mulch.

Apply approved mulch uniformly across the entire planting bed to a depth of 3" minimum, 4" maximum.

Separate mulched areas from turf areas with a 45-degree, 4- to 6-inch- deep, shovel-cut edge.

3.6 INSPECTION AND ACCEPTANCE

Owner and the Agency Contact responsible for maintenance following acceptance shall perform inspections with the Contractor of all plant material at one (1) week and three (3) week intervals (or other specified interval) after the original planting to note and correct any discrepancies from the contract. Plants that are alive and healthy following the three (3) week (or other time frame specified) inspection shall be accepted.

Acceptance of plant material by Owner shall reflect general conformity with the *American Standards for Nursery* Stock as to specified size, character and quality. Acceptance shall not relieve the Contractor of responsibility for full conformity to the contract documents and the guarantee period. Any defects or imperfections appearing in whole or any part of the work caused by or due to any fault or negligence on the part of the Contractor shall be corrected before the work is accepted.

Planting work may be accepted in stages when the Contractor and Owner deem that practice to be in their mutual interest. Approval must be given in writing by Owner to the Contractor verifying that work may be completed in stages. Acceptance of planting work in stages shall not waive any other provisions of the contract.

3.7 CLEANING

Soil, branches, binding and wrapping material, rejected plants, or other debris resulting from plant installation shall be promptly cleaned up and removed. New landscape construction in and around the planting areas are to be especially well-cleaned.

3.8 PRUNING

Prune in accordance with current *American National Standards (ANSI) for Tree Care Operations*. Perform all pruning work in a manner consistent with the landscape design intent. Plants overhanging and blocking pedestrian and/or vehicular paths shall be pruned as needed to allow the desired clearance.

Except in the cases of hedges, or to conform to some design intent, all pruning of ornamental trees, shrubs and ground covers should aim to retain their natural shapes. With multiple leader plants, preserve the leader that best promote the plant's symmetry. Prune branches of deciduous stock to improve the branch structure of the plant.

Plants that flower before late spring should be pruned immediately after flowering unless otherwise directed by Owner/Architect or best practices of the industry.

Prune evergreens only to remove dead, broken or damaged branches in accordance with best practices for the plant material.

Where necessary, repairs to damaged wood shall be performed under the direction of Owner, or a certified arborist.

Prune using scissors-style cutting devices, and not anvil-style hand pruners, pole pruners or loppers.

The Contractor shall remove all trimmed branches and other debris from the site at the end of each work day.

3.9 MAINTENANCE

Any and all chemical applications of fertilizer are to be performed in accordance with current federal, state and local laws, through EPA-registered materials and application techniques, and performed under the supervision of a licensed certified applicator. Apply fertilizer to planted areas at the specified rate, and as per manufacturer's recommendations.

All plant materials installed under the contract shall be watered within the first 24 hours of initial planting and not less than twice weekly until final acceptance by Owner.

Water used shall be of sufficient quality for irrigation and free of materials harmful to plant growth.

Any use of pesticides during the contracted maintenance period, as determined by the Owner, shall utilize the minimum amount of approved pesticide needed to control pests on plant materials installed under the contract. Pesticide applications are to be performed in accordance with current federal, state and local laws, through EPA-registered materials and application techniques, and performed under the supervision of a licensed certified applicator. Apply at the specified rate, and as per manufacturer's recommendations.

END OF SECTION 329200

SECTION 329219 - SEEDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Preparation of subsoil.

B. Placing topsoil.

C. Seeding, mulching and fertilizer.

D. Maintenance.

1.2 RELATED SECTIONS

A. Section 312200 - Grading: Topsoil material.

B. Section 312200 - Grading: Preparation of subsoil and placement of topsoil in preparation for the work of this section.

C. Section 312323 - Fill and Backfill: Topsoil material.

1.3 UNIT PRICES - MEASUREMENT AND PAYMENT

A. See Section 012000 - Unit Prices, for additional unit price requirements.

1.4 DEFINITIONS

A. Weeds: Include Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.5 REGULATORY REQUIREMENTS

A. Comply with regulatory agencies for fertilizer and herbicide composition.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable. Deliver seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.

1.7 MAINTENANCE SERVICE

A. Furnish maintenance of seeded areas for three months from Date of Substantial Completion.

B. Maintain seeded areas immediately after placement until grass is well established and exhibits a vigorous growing condition.

PART 2 - PRODUCTS

2.1 SEED MIXTURE

A. Seed Mixture: Refer to seeding schedule located on construction documents Sheet C-1.0, General Notes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that prepared soil base is ready to receive the work of this Section.

3.2 PREPARATION

A. Prepare subgrade in accordance with Section 312200.

B. Place topsoil in accordance with Section 312200.

3.3 FERTILIZING

A. Apply fertilizer in accordance with manufacturer's instructions.

B. Apply after smooth raking of topsoil and prior to roller compaction.

C. Do not apply fertilizer at same time or with same machine as will be used to apply seed.

D. Mix thoroughly into upper 2 inches of topsoil.

E. Lightly water to aid the dissipation of fertilizer.

3.4 SEEDING

A. Apply seed in accordance with NCDOT Standard Specifications for Roads and Structures, July 2006.

B. Do not seed areas in excess of that which can be mulched on same day.

C. Do not sow immediately following rain, when ground is too dry, or during windy periods.

D. Immediately following seeding and compacting, apply mulch to a thickness of 1/8 inches. Maintain clear of shrubs and trees.

E. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

F. Following germination, immediately re-seed areas without germinated seeds that are larger than 4 by 4 inches.

G. Finished surface of seeded area and underlying grade to be smooth without dips, trenches, or depressions. Any irregularities should be repaired immediately and the site should be monitored regularly to address problems as they occur.

3.5 MAINTENANCE

A. Mow grass at regular intervals to maintain at a maximum height of 2-1/2 inches. Do not cut more than 1/3 of grass blade at any one mowing.

B. Water to prevent grass and soil from drying out and to maintain healthy, viable turf grass.

C. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.

D. Immediately reseed areas which show bare spots.

END OF SECTION 329219

SECTION 329223 - SODDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Preparation of subsoil.

B. Placing topsoil.

C. Fertilizing.

D. Sod installation.

E. Maintenance.

1.2 RELATED SECTIONS

A. Section 312200 - Grading: Topsoil material.

B. Section 312200 - Grading: Preparation of subsoil and placement of topsoil in preparation for the work of this section.

C. Section 312323 - Fill and Backfill: Topsoil material.

1.3 UNIT PRICES - MEASUREMENT AND PAYMENT

A. See Section 012000 - Unit Prices, for additional unit price requirements.

1.4 REFERENCES

A. TPI (SPEC) - Guideline Specifications to Turfgrass Sodding; Turfgrass Producers International; 1995.

1.5 DEFINITIONS

A. Weeds: Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.6 REGULATORY REQUIREMENTS

A. Comply with regulatory agencies for fertilizer and herbicide composition.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver sod on pallets. Protect exposed roots from dehydration.

B. Do not deliver more sod than can be laid within 24 hours.

1.8 MAINTENANCE SERVICE

A. Furnish service and maintenance of sodded areas for three months from Date of Substantial Completion.

B. Maintain sodded areas immediately after placement until grass is well established and exhibits a vigorous growing condition.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Sod: TPI, Certified Turfgrass Sod quality; cultivated grass sod; type indicated in plant schedule on Drawings; with strong fibrous root system, free of stones, burned or bare spots; containing no more than 5 weeds per 1000 sq ft. Minimum age of 18 months, with root development that will support its own weight without tearing, when suspended vertically by holding the upper two corners.

B. Topsoil: As specified in Section 312030.

C. Fertilizer: Recommended for grass, with fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil, as indicated by analysis.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that prepared soil base is ready to receive the work of this section.

3.2 PREPARATION

A. Prepare subgrade in accordance with Section 312200.

B. Place topsoil in accordance with Section 312200.

3.3 FERTILIZING

A. Apply fertilizer in accordance with manufacturer's instructions.

B. Apply after smooth raking of topsoil and prior to installation of sod.

C. Apply fertilizer no more than 48 hours before laying sod.

D. Mix thoroughly into upper 2 inches of topsoil.

E. Lightly water to aid the dissipation of fertilizer.

3.4 LAYING SOD

A. Moisten prepared surface immediately prior to laying sod.

B. Lay sod immediately after delivery to site to prevent deterioration.

C. Lay sod tight with no open joints visible, and no overlapping; stagger end joints 12 inches minimum. Do not stretch or overlap sod pieces.

D. Lay smooth. Align with adjoining grass areas.

E. On slopes 6 inches per foot and steeper, lay sod perpendicular to slope and secure every row with wooden pegs at maximum 2 feet on center. Drive pegs flush with soil portion of sod.

F. Water sodded areas immediately after installation. Saturate sod to 4 inches of soil.

G. After sod and soil have dried, roll sodded areas to ensure good bond between sod and soil and to remove minor depressions and irregularities. Roll sodded areas with roller not exceeding 150#/ft of roller width.

H. Finished surface of sod and underlying grade to be smooth without dips, trenches, or depressions. Any irregularities should be repaired immediately and the site should be monitored regularly to address problems as they occur.

3.5 MAINTENANCE

A. Mow grass at regular intervals to maintain at a maximum height of 2-1/2 inches. Do not cut more than 1/3 of grass blade at any one mowing.

B. Water to prevent grass and soil from drying out or as otherwise required to maintain healthy, viable turf grass.

C. Roll surface to remove irregularities.

D. Level out any irregularities in soil/turf grade.

E. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.

F. Immediately replace sod to areas which show deterioration or bare spots.

END OF SECTION 329223

SECTION 329700 - LANDSCAPE MAINTENANCE AND EXTENDED WARRANTY

PART 1 - GENERAL

SCOPE

These specifications, along with contract drawings apply to those items necessary for and incidental to the maintenance of the landscape planting, seeding, or sodding activities specified in the contract. The scope includes the maintenance activities of mowing, pruning, fertilizing, pest and weed management (pre and post emergents), and watering.

1.1 SECTION INCLUDES

A. PART 1 - GENERAL

Scope
Related Work
Definitions
References
Quality Assurance
Job Conditions

B. PART 2 - PRODUCTS

Materials

C. PART 3 - MAINTENANCE

General Requirements
Plant Maintenance
Turf Maintenance
Integrated Pest Management, Herbicide, and Pesticide Applications

1.2 RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Section 329200 Plants
Section 329219 Seeding
Section 329223 Sodding

1.3 DEFINITIONS

Landscape Maintenance Provider – Insured and bonded contractor, with a minimum of 5 years of experience in landscaping including grading, seeding, sodding, planting and hardscapes. The Landscape Contractor shall be the Landscape Maintenance Provider.

REFERENCES
ANSI Z60.1 American Standards for Nursery Stock
ANSI A300 American National Standard for Tree Care Operations - Tree, Shrub and Other Woody Plant Maintenance-Standard Practices

1.4 QUALITY ASSURANCE

Soil Analysis: A soil test and analysis of a wide representation of soils through out the intended planting and turf areas. For each unamended soil type and each selected location, furnish soil

Analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ration; deleterious material; pH; and mineral and plant-nutrient content of the soil. The test results should also include the soil-testing laboratory's recommendations for any corrective measures needed to grow healthy, thriving specified plant material or turf on the site.

Testing methods and written recommendations shall comply with USDA's Handbook No. 60.

The soil-testing laboratory shall be given samples with information including depth and location, and number of samples taken over the entire site. If the Owner or Architect chose, the contractor may be required to have the soil-testing laboratory oversee the soil sampling. A minimum of three representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.

Report suitability of and recommended alterations of tested soil for healthy, thriving plant and turf growth.

Based upon the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. or volume per cu. yd. for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.

Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.

Fertilizer shall be delivered to the site in original, sealed containers, and stored in a waterproof space. Containers shall bear the manufacturer's name, analysis, trademark and guarantee unless otherwise approved by Owner or Architect.

Collection of soil specimens shall be complete in accordance with accepted practices, and shall be subject to approval by the Owner.

1.5 JOB CONDITIONS

Protect all plants, lawns, and grass areas from damage at all times. Damaged plants, lawns or grass areas shall be replaced or treated as required to conform to specifications herein for fresh stock.

Work areas shall be kept clean and orderly during the installation period. Under no condition shall debris from planting activities result in a safety hazard on-site or to adjacent off-site property.

Damage to any portion of the site, including, but not limited to, lawns or grass areas incurred as a result of replacement or installation operations shall be repaired by Maintenance Provider at no cost to Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

Topsoil: Naturally fertile, agricultural soil, capable of sustaining vigorous growth, of uniform composition throughout, without admixtures of subsoil, free of clay, stones larger than 1" inch diameter, roots, trash and debris of any kind, supplied by Maintenance Provider at his/her expense, and subject to approval by the Owner or Architect/Engineer.

Organic 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 sieve; soluble salt content of 5 to

10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings. Organic Matter Content: 50 to 60 percent of dry weight.

Fertilizer: Granular, non-burning product composed of not less than fifty (50) percent organic slow-acting, guaranteed analysis professional fertilizer. Commercial fertilizer shall conform to Wisconsin State Statutes, Section 94.64, and meet the standards of the Wisconsin Department of Agriculture as to registration and labeling. Fertilizer shall be specified in the contract documents as to composition, but is subject to revision to suit project site conditions.

Organic Mulch: Shredded Bark, free of material detrimental to healthy plant growth. Organic Mulch shall be 1/8" nominal thickness, with at least fifty (50) percent having an area of not less than 1 sq. inch, and no piece having an area of more than 6 sq. inches.

Stakes: 6-8 foot long sections of unflanged metal, or 2" x 2" hardwood or other staking system as approved by Owner or Architect.

Flexible Support ties: 2" or wider bands of polypropylene, or elasticized or webbed strapping.

Wrapping Material: Biodegradable geotextile (fabric) trunk wrap, or waterproofed crepe wrapping paper, secured with 1" wide masking tape.

Nonselective Herbicides: EPA registered and approved glyphosate based herbicide for *upland* use (broad spectrum, non-persistent) intended for vegetation removal while preparing seed beds and for maintenance during establishment period and recommended surfactants and adjuvants.

EPA registered and approved glyphosate based herbicide for *wetland* use (broad spectrum, non-persistent) intended for vegetation removal while preparing seed beds and for maintenance during establishment period and recommended surfactants and adjuvants.

Pre-emergent Herbicide effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

Post-Emergent Herbicide effective for controlling weed growth that has already germinated.

Mycorrhizal Fungi: Dry, granular inoculant containing at least 5300 spores per lb of vesicular-arbuscular mycorrhizal fungi and 95 million spores per lb of ectomycorrhizal fungi, with a maximum of 5.5 percent inert material

Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.

Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

PART 3 - MAINTENANCE

3.1 GENERAL REQUIREMENTS

Introduction: This section establishes minimum standards and procedures for grounds maintenance services. Resource-efficient and sustainable landscape management practices have been incorporated throughout the specifications

Part of Contract: This maintenance specification is part of the contract. Compliance with the requirements herein is mandatory. In the event of question or dispute over applicability of any requirement, the requirement shall be assumed to apply, unless the Owner/Architect provides written clarification stating that it does not.

Maintenance and Guarantee Period: The start date for the maintenance period and warranty period for all areas is the date (month, day, and year) that the seeding/planting is considered substantially complete by the Owner. The maintenance period will continue for exactly one (1) year from the start date unless otherwise stated by the Owner/Architect.

Laws, Codes, and Ordinances: The Landscape Maintenance Provider shall comply with all rules, ordinances, and regulations set forth by the State, or other entity having jurisdiction, which apply to the work site, the Landscape Maintenance Provider, or Landscape Maintenance Provider's personnel.

Safety: The Landscape Maintenance Provider shall comply at all times with all local, state, or other legal requirements for safety, including operating all equipment in conformance with the manufacturer's operating instructions for each, and in compliance with Federal Occupational and Health Safety Administration (OSHA) standards and requirements. The safety provisions of applicable building and construction codes shall be observed. No work shall be performed in any manner or location that may endanger the health, safety, or welfare of all persons, including employees, from foreseeable injury, or damage to property.

Protection of Existing Surfaces and Property: The Landscape Maintenance Provider shall take proper precautions to protect existing vegetation, structures, infrastructure and utilities. Injuries to any person or damage to State property, the property of employees, customers or any property not belonging to the Landscape Maintenance Provider shall be reported immediately to the Owner. Damage or destruction as a result of the Landscape Maintenance Provider's operations shall be repaired or replaced at the Landscape Maintenance Provider's expense and to the satisfaction of the Owner.

Damage to items covered by this provision include, but are not limited to, curbs, sidewalks, lawns (including scalped areas), plantings, trees, signs, down spouts, and refuse containers. Damages may be the result of, but not limited to power equipment damage to plantings or structures, improper pruning, over or under watering of plant materials, or chemical overspray.

Replacement of damaged or destroyed plant material shall be of the same size and species or cultivar. Replacement shall occur within two (2) weeks of identification of damage. Substitute or alternative replacement, and scheduling of replacement shall be allowed only by the Owner's written permission.

The Landscape Maintenance Provider is not responsible for losses, repair or replacement of damaged property due to extreme weather, vandalism, theft, or the acts of others over whom they have no reasonable control.

The Landscape Maintenance Provider shall inform the Owner of such losses and provide the Owner with the cause and extent of the loss and recommendations for repair or replacement.

Interference with Intended Use: The Landscape Maintenance Provider shall not interfere with the use of this facility and shall conduct its operations so that there is the least possible obstruction and inconvenience to the public and owner.

The Landscape Maintenance Provider shall provide forty-eight (48) hour advance notice to the Owner whenever maintenance activities prevent normal access to a site or building for a time exceeding two (2) hours. It is the Owner's responsibility to provide notice to building occupants. The Owner will inform the Landscape Maintenance Provider of any special events or circumstances that will limit the Landscape Maintenance Provider's ability to perform maintenance activities.

Owner/Landscape Maintenance Provider Communication: The Landscape Maintenance Provider shall provide the Owner with a phone number where a message can be left for the Landscape Maintenance Provider twenty-four (24) hours a day. The Landscape Maintenance Provider shall respond to messages at this number within twenty-four (24) hours. The Landscape Maintenance Provider shall also provide a number where immediate contact can be made in the event of emergencies.

In the event of imminent danger of injury to the public or damage to property, the Owner will attempt to contact the Landscape Maintenance Provider using the emergency number provided. If the Landscape Maintenance Provider does not respond within four (4) hours, the Owner reserves the right to effect such repairs itself or with another Maintenance Provider.

The Landscape Maintenance Provider shall provide the Owner with names and phone numbers of maintenance supervisors and other key personnel and further advise the Owner of personnel substitutes or replacements.

The Landscape Maintenance Provider, or other key personnel, shall attend meetings and site inspections as requested by the Owner.

Maintenance Record Keeping: The Landscape Maintenance Provider shall maintain an itemized log of schedule and tasks performed. The log is to be submitted monthly to the Owner and complete set of records submitted with the maintenance plan.

Extra Work: The Landscape Maintenance Provider shall submit requests for work that requires additional payment in writing. The Landscape Maintenance Provider shall not start work until the request has been approved in writing. Failure to obtain advance approval may result in non-payment or delays in processing payment.

The Landscape Maintenance Provider may not change the regular maintenance schedule due to unscheduled or extra work unless authorized by the Owner.

Complaint Response: All complaints shall be abated as soon as possible after notification; but in all cases within forty-eight (48) hours or as required by the Owner.

Contract Renegotiation: The Owner reserves the right to renegotiate the maintenance contract due to a change in ownership of the site, concurrent construction at the site that affects maintenance tasks, or due to other changes at the site that eliminate the need for certain tasks.

Failure to Perform: The Owner may terminate the contract at any time at its sole discretion by delivering written notice to the Landscape Maintenance Provider. In the event the Landscape Maintenance Provider terminates the contract, such termination will require written notice to that effect to be delivered by the Landscape Maintenance Provider to the Owner not less than ninety (90) days prior to said termination.

General Practice Guidelines: This document is a benchmark of minimum standards for grounds maintenance. All sites governed by these specifications shall be maintained with good horticultural practices to ensure normal and healthy growth of landscape plantings, and in a resource-efficient, sustainable, and cost-effective manner.

The Landscape Maintenance Provider shall furnish all labor, equipment, materials, and transportation necessary to complete the maintenance of landscape improvements as specified herein. The Landscape Maintenance Provider shall provide services at whatever frequency is necessary to meet the specified standards.

The Landscape Maintenance Provider shall acquaint himself with the location of utilities, which may be encountered or be affected by the work, and shall be responsible for damage caused by failure to provide

proper precautions or protection. Consult with the Owner and contact Digger's Hotline (North Carolina 811) to locate existing underground utilities prior to performing any work requiring subsurface excavation.

All turf shall be mowed with professional quality mulch-mowing equipment. Prior to award of contract, the Landscape Maintenance Provider Maintenance Provider shall provide the Owner with the manufacturer and model of equipment to be used.

Mowers, trimmers and other equipment shall be properly maintained to operate at "normal" operating sound levels. Equipment that is generating excessive noise or is otherwise objectionable to the Owner or building tenants shall be discontinued from use, at the Owner's request, until repairs can be affected.

The Landscape Maintenance Provider is encouraged to use non-polluting devices like rakes and brooms when feasible. The Owner prefers low-decibel, low-fossil fuel consumption, and low-emissions models of blowers, trimmers, and other power equipment. Do not use

Blowers around parked cars to avoid scratching vehicle paint with blowing sand and debris. Do not blow trash or debris onto the property of others.

3.2 PLANT MAINTENANCE (TREES, SHRUBS AND PERNNIAL PLANTS)

Inspection and Acceptance: Owner and the Agency Contact responsible for maintenance following acceptance shall perform inspections with the Maintenance Provider of all plant material at one (1) week and three (3) week intervals (or other specified interval) after the original planting to note and correct any discrepancies from the contract. Plants that are alive and healthy following the three (3) week (or other time frame specified) inspection shall be accepted.

Acceptance of plant material by Owner shall reflect general conformity with the *American Standards for Nursery Stock* as to specified size, character and quality. Acceptance shall not relieve the Maintenance Provider of responsibility for full conformity to the contract documents and the guarantee period. Any defects or imperfections appearing in whole or any part of the work caused by or due to any fault or negligence on the part of the Maintenance Provider shall be corrected before the work is accepted.

Planting work may be accepted in stages when the Maintenance Provider and Owner deem that practice to be in their mutual interest. Approval must be given in writing by Owner to the Maintenance Provider verifying that work may be completed in stages. Acceptance of planting work in stages shall not waive any other provisions of the contract.

Warranty: At the end of the first full growing season (on, or around November 1st) Maintenance Provider shall arrange to meet with the Owner or Owner's representative to coordinate initial acceptance. Owner or Owner's representative will provide the Maintenance Provider with a list of any final punch list items that need to be performed. Upon confirmation that the punchlist items were completed, a letter of acceptance will be issued.

All plants shall be warranted to be in healthy and flourishing condition after the end of one full growing season.

Maintenance Provider shall warranty all planting for an additional one full growing season after Initial Acceptance for a total warranty/maintenance period of two full growing seasons.

At any time during the warranty period, the Maintenance Provider shall remove or replace, without cost to the Owner, and within a specified planting period, all plants not in a healthy and flourishing condition as determined by the Owner or Architect/Engineer.

Replacement plants shall be subject to the same specified requirements of the contract. The warranty of replacement plants shall extend for one year. If one year warranty ends during a dormant season, the

warranty shall extend at least one month into the following growing season (or as otherwise specified by the Owner/Architect). In the event that a replacement plant is not acceptable during, or at the end, of the said warranty extension period, Owner may choose between subsequent replacement or credit for that item.

Include the following remedial actions as a minimum:

a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
c. A limit of one replacement of each plant will be required except for losses or replacements due to failure to comply with requirements.

Warranty /Performance Standards: at the end of the Warranty Maintenance Period and at the time of final acceptance of the following performance standards shall be met:

100% of the woody material shall be alive and growing in a healthy condition.
97% of the planted plugs and container-grown plants (other than woody material) shall be alive and in a healthy condition.

Cleaning: Soil, branches, binding and wrapping material, rejected plants, or other debris resulting from plant installation shall be promptly cleaned up and removed. New landscape construction in and around the planting areas are to be especially well-cleaned.

Pruning: Prune in accordance with current *American National Standards (ANSI) for Tree Care Operations*. Perform all pruning work in a manner consistent with the landscape design intent. Plants overhanging and blocking pedestrian and/or vehicular paths shall be pruned as needed to allow the desired clearance.

Except in the cases of hedges, or to conform to some design intent, all pruning of ornamental trees, shrubs and ground covers should aim to retain their natural shapes. With multiple leader plants, preserve the leader that best promote the plant's symmetry. Prune branches of deciduous stock to improve the branch structure of the plant.

Plants that flower before late spring should be pruned immediately after flowering unless otherwise directed by Owner/Architect or best practices of the industry.

Prune evergreens only to remove dead, broken or damaged branches in accordance with best practices for the plant material.

Where necessary, repairs to damaged wood shall be performed under the direction of Owner, or a certified arborist.

Prune using scissors-style cutting devices, and not anvil-style hand pruners, pole pruners or loppers.

The Maintenance Provider shall remove all trimmed branches and other debris from the site at the end of each workday.

Fertilizing: Any and all chemical applications are to be performed in accordance with current federal, state and local laws, through EPA-registered materials and application techniques, and performed under the supervision of a licensed certified applicator. Apply fertilizer to planted areas at the specified rate, and as per manufacturer's recommendations.

Excessive nutrients can be a hindrance in establishing native perennials and plugs. Do not apply fertilizer in these planting areas unless approved by the Owner/Architect.

Watering: All plant materials installed under contract shall be watered within the first 24 hours of initial planting and not less than twice weekly until final acceptance by the Owner. Additional watering may be required during the warranty period. Water used shall be of sufficient quality for irrigation and free of materials harmful to plant growth.

Pesticide: Any use of pesticides during the contracted maintenance period, as determined by the Owner, shall utilize the minimum amount of approved pesticide needed to control pests on plant materials installed under the contract. Pesticide applications are to be performed in accordance with current federal, state and local laws, through EPA-registered materials and application techniques, and performed under the supervision of a licensed certified applicator. Apply at the specified rate, and as per manufacturer's recommendations.

Native perennials and plugs: Maintain for the warranty period by watering, weeding and other operations as required to establish healthy, viable plantings. Do not let weedy volunteer species exceed 10% of the ground cover. Hand weed and/or use appropriate herbicide (by licensed applicator) at a minimum of twelve times each growing season during the maintenance period. Submit dated time sheets of required maintenance operations to Owner. Hand pulling should include removal of all above ground and below ground stems, roots and flower masses prior to development of seeds. Care should be taken to disturb as little soil as possible during the hand pulling to avoid exposure of additional weed seed in the soil layer and protect adjacent plantings.

Wildlife Control Measures: Maintenance Provider shall monitor the plantings during the warranty period to identify predation by wildlife and take all reasonable measure to protect the plant material from predation. These measures may include fencing, barriers, repellents, and frightening devices.

At the conclusion of the warranty/maintenance period, the maintenance provider shall conduct a training/review session with the Owner's maintenance staff to review existing conditions and discuss required maintenance activities for each distinct type of plant community. The following issues shall be reviewed: monitoring plant health and spread of weed species; yearly mowing and/or prescribed burning operations/ control methods for removing weed species; herbivore protection; and enhancement /repair operations. Long-term stewardship recommendations will be provided to the Owner's staff in writing.

3.3 TURF MAINTENANCE

Maintenance shall consist of all facets of care for seeded or sodded turf grass areas.

Fertilization: The Maintenance Provider shall provide soil tests performed by an approved laboratory during the first year of the contract to determine turf fertility and pH requirements. Collect samples from at least three (3) locations in the turf area and combine into one (1) composite sample. Collect additional composite samples where turf is visibly non-uniform. Use a soil probe or auger to collect soil (4) inches deep. Submit the test results and recommendations to the Owner.

Fertilize turf areas with slow-release synthetic (supplies at least twenty-five to fifty percent (25-50%) slow-release nitrogen), organic, or a combination fertilizer as required to provide deep rooting and a healthy, green appearance. Determine application rates from soil test results. The Landscape Maintenance Provider shall submit a fertilizer schedule, listing proposed materials, application rates and timing prior to performing any turf fertilization.

Apply no more than one (1) pound of nitrogen per one thousand (1000) square feet of turf area at one time.

Average quality turf shall receive at least two (2) applications of fertilizer each year, one early in growing season and one no later than one month before the end of the growing season.

The use of lawn fertilizers with phosphorus is prohibited.

Weed Control: The Landscape Maintenance Provider shall apply the concepts of Integrated Pest Management to turf weed control. Pre and post emergent to be applied as needed or as approved by Owner and/or Architect. Good cultural management practices (mowing, fertilizing, and irrigation) will minimize weed problems.

Average quality turf: post-emergent herbicides may be applied during the active growing season to control broadleaf weeds when weed cover exceeds ten percent (10%) of turf or as otherwise determined necessary by Owner or Architect.

Material and method to be used shall be discussed with the Owner prior to any herbicide applications. Spot applications of low-hazard herbicides targeted to the specific weed problem shall be selected whenever possible.

Applications of all weed control products shall conform to Department of Agriculture, Trade and Consumer Protection posting requirements. Applications shall be at the minimum rate allowed on the product label and shall be applied by State certified applicators.

Pre-emergent herbicide crabgrass control may be applied to turf areas by May 1 to prevent crabgrass seed germination. Spot treat only in areas of previous year's infestation. The Landscape Maintenance Provider shall consult with the Owner to determine treatment areas, material and method of application.

Insect and Disease Control: The Landscape Maintenance Provider shall apply the concepts of Integrated Pest Management to turf insect and disease control. The Landscape Maintenance Provider shall monitor all turf areas for insects and diseases and use cultural and mechanical methods of control when possible. Chemical controls shall be used only to specific areas that have been identified by the Landscape Maintenance Provider, in consultation with the Owner, to pose significant risks to the health and appearance of the turf. In such cases, the most effective and least hazardous product shall be used.

Aeration and Thatch Removal: Maintenance tasks under this section shall be performed annually and coordinated with Owner to verify necessity and timing. Aerate with a vertically operating core aerator with hollow tines; cores shall be four (4) inches on center to a three (3) inch depth. Aerate in fall from September to October while turf is actively growing. Aeration may also occur in spring if needed. The Landscape Maintenance Provider shall consult with the Owner to determine whether or not cores can be left on lawn surfaces.

Over-seed after aeration if turf is thin or weed infested, or area is subject to heavy use. Overseeding shall be accomplished with a slice-seeding machine. Seed mix shall be approved by the Owner.

Top-dress turf with one-quarter to one-half (1/4 to 1/2) inch of mature, weed-free compost after aeration and overseeding, as needed and approved by the Owner. Drag or rake after application to get compost into aeration holes and break up clumps of compost and aeration cores.

Remove thatch when its depth reaches one-half (1/2) inch on average. Thatch may be naturally decomposed by topdressing with one-quarter (1/4) inch of topsoil. Remove thatch mechanically with a vertical mower or de-thatcher. De-thatch in September or October. Landscape Maintenance Provider shall remove and dispose of debris.

Seeding: Reseed or slit-seed bare spots or other areas of turf in need of renovation due to drought or winter kill in early spring or fall. The Landscape Maintenance Provider shall consult with the Owner to determine areas to be reseeded.

Watering: All turf installed under the contract shall be watered within the first 24 hours of initial planting and not less than twice weekly until final acceptance by Owner. However, watering must be closely monitored by contractor to insure healthy, viable growth of turf. Water used shall be of sufficient quality for irrigation and free of materials harmful to plant growth.

Water Source: If this facility is not irrigated it is the responsibility of the Landscape Maintenance Provider to provide a water source if not available or limited from the Owner.

3.4 INTEGRATED PEST MANAGEMENT, HERBICIDE, AND PESTICIDE APPLICATIONS

The Landscape Maintenance Provider shall adhere to the principals of Integrated Pest Management (IPM) during landscape maintenance.

General Concepts: Integrated Pest Management is an approach to weed, insect, and disease control that uses regular monitoring to determine if and when treatments are needed, and employs physical, mechanical, cultural, biological, and educational tactics to keep pest numbers low enough to prevent unacceptable damage or annoyance. Chemical treatments are made only when and where monitoring has indicated that the pest will cause unacceptable economic, medical, or aesthetic damage. Treatments are chosen and timed to be most effective and least hazardous to non-target organisms and the general environment.

Pest and Weed Monitoring: The Landscape Maintenance Provider shall visually inspect all landscape areas once weekly throughout the contract period to identify potential pest and weed problems. Pest problems include insect, disease, and weed infestations. The presence of a pest does not necessarily mean there is a problem. The Landscape Maintenance Provider shall keep written records of pests identified, areas where problems may be developing, and controls implemented. The Landscape Maintenance Provider shall educate himself regarding pest identification, pest life cycle, and best control methods including cultural, physical, and biological means.

The Landscape Maintenance Provider shall notify the Owner if a pest problem appears to be developing. The Landscape Maintenance Provider shall make recommendation of necessary corrective measures and either photo document or inspect the problem site jointly with the Owner and/or Architect. The provider shall keep monitoring records for review by the Owner and/or Architect and identify and execute approved control methods.

Pesticide Applications: Pesticides include all herbicides (both pre and post emergent), insecticides, fungicides, and various other substances used to control pests.

All pesticide applications shall be preceded by monitoring and positive pest identification. Combination products (for example, "weed and feed" or insect control plus fertilizer) shall not be used. Regular calendar-based or preventative applications of pesticides are not allowed unless approved by the Owner.

All pesticides used shall be used in strict accordance with federal, state, county, and local regulations, and applied by a State of North Carolina certified Commercial Pesticide Applicator per the label directions. All applications must be posted for twenty-four (24) hours after application. All chemicals must have a MSDS filed with the owner. Pesticide application records shall be kept by the Landscape Maintenance Provider and copies provided to the Owner.

The Landscape Maintenance Provider is responsible for verifying that the pesticide used is appropriate for use with the respective plant material. Landscape Maintenance Provider is responsible for any damages incurred as a result of pesticide application and shall repair or replace any such damage at no cost to the Owner

END OF SECTION 329200

SECTION 334000 - STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Storm drainage piping, fittings, and accessories.

B. Catch basins, paved area drainage, site surface drainage, and detention basin.

1.2 RELATED SECTIONS

A. Section 312300 - Excavation: Excavating of trenches.

B. Section 312323 - Fill and Backfill: Bedding and backfilling.

C. Section 312333 - Trenching for Site Utilities: Excavating, bedding, and backfilling.

D. Section 334913 - Manholes and Covers.

E. Section 033000 - Cast-in-Place Concrete: Concrete for cleanout base pad construction.

1.3 UNIT PRICES

A. See Section 012200 - Unit Prices, for additional unit price requirements.

1.4 REFERENCES

A. AASHTO M 36 - Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains; American Association of State Highway and Transportation Officials; 2003.

B. ASTM A 74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2005.

C. ASTM C 12 - Standard Practice for Installing Vitrified Clay Pipe Lines; 2006.

D. ASTM C 14 - Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe; 2005a.

E. ASTM C 14M - Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe; 2005a.

F. ASTM C 76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe; 2005b.

G. ASTM C 76M - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe; 2005b.

H. ASTM C 425 - Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings; 2004.

I. ASTM C 443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets; 2005a.

J. ASTM C 443M - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets; 2005a.

K. ASTM C 564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2003a.

L. ASTM C 700 - Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated; 2005.

M. ASTM D 1785 - Standard Specification for Poly Vinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2005.

N. ASTM D 2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; 2005.

O. ASTM D 2729 - Standard Specification for Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings; 2003.

P. ASTM D 2751 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings; 2005.

Q. ASTM D 3034 - Standard Specification for Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings; 2004a.

1.5 DEFINITIONS

A. Bedding: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.

1.6 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.7 REGULATORY REQUIREMENTS

A. Conform to applicable code for materials and installation of the Work of this section.

PART 2 - PRODUCTS

2.1 SEWER PIPE MATERIALS

A. Concrete Pipe: Reinforced, AASHTO M170, Class III with Wall type A; mesh reinforcement; bell and spigot end joints.

B. Reinforced Concrete Pipe Joint Device: ASTM C 443 (ASTM C 443M) rubber compression gasket joint.

C. High Density Polyethylene Pipe: N-12 WT (Watertight) by Advanced Drainage Systems, Inc. All installation shall conform to the plans and the manufacturer’s recommendations.

2.2 CATCH BASIN, CLEANOUT, AND AREA DRAIN COMPONENTS

A. Concrete: Unless otherwise specified, concrete and reinforced concrete shall conform to ASTM C-94 and have a minimum 28-day compressive strength of 3,000 psi. The concrete mixture shall have air content by volume of concrete, based on measurements made immediately after discharge from the mixer, of 3 to 6 percent when maximum size of coarse aggregates exceeds 1-1/2 inches. Air content shall be

determined in accordance with ASTM C 231. The concrete covering over steel reinforcing shall be not less than 1 inch thick for covers and not less than 1-1/2 inches thick for walls and flooring. Concrete covering deposited directly against the ground shall have a thickness of at least 3 inches between steel and ground. Expansion-joint filler material shall conform to ASTM D 1725, D 1752, or AASHTO M 33 or shall be resin impregnated fiberboard conforming to the physical requirements of ASTM D 1752.

B. Mortar: Mortar for drainage structures, and brick or block construction shall conform to ASTM C 270, Type S. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar but in no case shall exceed 7 gallons of water per sack of cement. Water shall be clean and free of harmful acids, alkalies, and organic impurities. The mortar shall be used within 30 minutes after the ingredients are mixed with water.

C. Precast Concrete Segmental Blocks: Shall conform to ASTM C 139, not more than 8 inches thick, not less than 8 inches long and of such shape that joints can be sealed effectively and bonded with cement mortar.

D. Brick: Shall conform to ASTM C 62, Grade SW; ASTM C 55, Grade S-I or S-II; or ASTM C 32, Grade MS. Mortar for jointing and plastering shall consist of one part Portland cement and two parts fine sand. Lime may be added to the mortar in a quantity not more than 25 percent of the volume of cement. The joints shall be filled completely and shall be smooth and free from surplus mortar on the inside of the structure. Brick structures shall be plastered with 3/4 inch of mortar over the entire outside surface of the walls. For square or rectangular structures, brick shall be laid in stretcher courses with a header course every sixth course. For round structures, brick shall be laid radially with every sixth course a stretcher course.

E. Reinforcing Steel: Steel reinforcement shall be protected at all times from damage and when placed in the work shall be free from dirt, dust, loose mill scale, loose rust, paint, oil, or other foreign materials. Deformed steel bar reinforcement shall conform to the requirements of ASTM A 615 for Grade 60. Tolerances for bending and cutting during fabrication shall be in accordance with the "Manual of Standard Practice" published by the Concrete Reinforcing Steel Institute. Bars shall be bent cold to the details shown on the plans. Cold drawn steel wire to be used as spirals or in fabricated form for the reinforcement of concrete shall meet the requirements of ASTM A 82. Welded wire fabric shall conform to ASTM A185.

F. Iron Casting: Castings shall be boldly filleted at angles, and the rises shall be sharp and perfect. No sharp, unfileted angles or corners will be permitted. They shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes, and other defects affecting their strength and value for the service intended. All castings shall be sand blasted or otherwise effectively cleaned of scale and sand so as to present a smooth, clean, and uniform surface.

G. Steps: Steps for minor drainage structures shall be polypropylene encapsulated steel meeting requirement of ASTM C-478.

1. Steps differing dimension, configuration, or materials from those shown on the plans may also be used provided the Contractor has furnished the Owner’s Representative with details of the proposed steps and has received written approval from the Owner’s Representative for the use of such steps.

H. Stone Bedding for Drainage Structures: Stone bedding for drainage structures shall be NCDOT standard size No. 57.

2.3 BEDDING AND COVER MATERIALS

A. Bedding: As specified in Section 312333.

B. Cover: As specified in Section 312333.

PART 3 - EXECUTION

3.1 TRENCHING

A. See Section 322333 for additional requirements.

B. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

3.2 INSTALLATION – PIPE

A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.

B. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal watertight.

C. Lay pipe to slope gradients noted on layout drawings; with maximum variation from true slope of 10% from structure to structure.

3.3 INSTALLATION - CATCH BASINS AND CLEANOUTS

A. Form bottom of excavation clean and smooth to correct elevation.

B. Form and place cast-in-place concrete base pad, with provision for sanitary sewer pipe end sections.

C. Establish elevations and pipe inverts for inlets and outlets as indicated.

D. Mount lid and frame level in grout, secured to top cone section to elevation indicated.

3.4 FIELD QUALITY CONTROL

A. Perform field inspection and testing in accordance with Section 014000.

3.5 PROTECTION

A. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress.

END OF SECTION 334000

SECTION 334600 - SUBDRAINAGE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Building perimeter, retaining wall, and under-slab drainage systems.

B. Filter aggregate and fabric and bedding.

1.2 RELATED SECTIONS

A. Section 312300 - Excavation: Excavating for subdrainage system piping and surrounding filter aggregate.

B. Section 3102323 - Fill and Backfill: Backfilling over filter aggregate, up to subgrade elevation.

C. Section 312333 - Trenching for Site Utilities: Excavating and backfilling for site subdrainage systems.

1.3 UNIT PRICES

A. See Section 012200 - Unit Prices, for additional unit price requirements.

1.4 REFERENCES

A. ASTM C 4 - Standard Specification for Clay Drain Tile and Perforated Clay Drain Tile; 2004.

B. ASTM C 412 - Standard Specification for Concrete Drain Tile; 2005a.

C. ASTM C 412M - Standard Specification for Concrete Drain Tile; 2005a.

D. ASTM D 2729 - Standard Specification for Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings; 2003.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

1.6 REGULATORY REQUIREMENTS

A. Conform to applicable code for materials and installation of the work of this section.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS

A. Polyvinyl Chloride Pipe: ASTM D 2729; plain end, 4 inch inside diameter; with required fittings.

B. Use perforated pipe at subdrainage system; unperforated through sleeved walls.

2.2 AGGREGATE AND BEDDING

A. Filter Aggregate and Bedding Material: Granular fill as specified in Section 312030.

B. Filter Sand and Bedding Material: Sand as specified in Section 312030.

2.3 ACCESSORIES

A. Pipe Couplings: Solid plastic.

B. Filter Fabric: Water pervious type, black polyolefin. Provide a type I engineering fabric in accordance with NCDOT standard specifications for roads and structures, Section 1056, and dated July 2006.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout Drawings.

3.2 PREPARATION

A. Hand trim excavations to required elevations.

B. Remove large stones or other hard matter which could damage drainage piping or impede consistent backfilling or compaction.

3.3 INSTALLATION

A. Install and join pipe and pipe fittings in accordance with pipe manufacturer's instructions.

B. Place drainage pipe on clean cut subsoil.

C. Lay pipe to slope gradients noted on Drawings; with maximum variation from true slope of 1/8 inch in 10 feet.

D. Loosely butt pipe ends. Place joint cover strip 12 inches wide, around pipe diameter centered over joint.

E. Place pipe with perforations facing down. Mechanically join pipe ends.

F. Install pipe couplings.

G. Install filter aggregate at sides, over joint covers and top of pipe. Provide top cover compacted thickness of 12 inches.

H. Place filter fabric over levelled top surface of aggregate cover prior to subsequent backfilling operations.

I. Place aggregate in maximum 4 inch lifts, consolidating each lift.

J. Refer to Section 312030 for compaction requirements. Do not displace or damage pipe when compacting.

K. Connect to storm sewer system with unperforated pipe, through installed sleeves.

3.4 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Field inspection and testing.

B. Request inspection prior to and immediately after placing aggregate cover over pipe.

3.5 PROTECTION

A. Protect pipe and aggregate cover from damage or displacement until backfilling operation begins.

END OF SECTION 334600

SECTION 334913 - MANHOLES AND COVERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Modular precast concrete manhole sections with tongue-and-groove joints with masonry transition to lid frame, covers, anchorage, and accessories.

B. Masonry manhole sections with masonry transition to lid frame, covers, anchorage, and accessories.

1.2 RELATED SECTIONS

A. Section 033000 - Cast-in-Place Concrete.

B. Section 042613 - Masonry Veneer: Masonry units and mortar and grout.

1.3 UNIT PRICES - MEASUREMENT AND PAYMENT

A. See Section 012200 - Unit Prices, for additional unit price requirements.

1.4 REFERENCES

A. ACI 530.1/ASCE 6/TMS 602 - Specification For Masonry Structures; American Concrete Institute International; 2005.

B. ASTM A 48/A 48M - Standard Specification for Gray Iron Castings; 2003.

C. ASTM A 123/A 123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2002.

D. ASTM C 55 - Standard Specification for Concrete Brick; 2003.

E. ASTM C 62 - Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale); 2005.

F. ASTM C 478 - Standard Specification for Precast Reinforced Concrete Manhole Sections; 2006a.

G. ASTM C 478M - Standard Specification for Precast Reinforced Concrete Manhole Sections; 2006a.

H. ASTM C 923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals; 2002.

I. ASTM C 923M - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals; 2002.

J. ASTM D 3753 - Standard Specification for Glass-Fiber-Reinforced Polyester Manholes and Wetwells; 2005.

K. IMIAWC (CW) - Recommended Practices & Guide Specifications for Cold Weather Masonry Construction; International Masonry Industry All-Weather Council; 1993.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate manhole locations, elevations, piping sizes and elevations of penetrations.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Cold and Hot Weather Requirements: Comply with requirements of ACI 530.1/ASCE 6/TMS 602 or applicable building code, whichever is more stringent.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Manhole Sections: Reinforced precast concrete in accordance with ASTM C 478 (ASTM C 478M), with resilient connectors complying with ASTM C 923 (ASTM C 923M).

B. Concrete: As specified in Section 033000.

C. Concrete Brick Units: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2,000 psi.
2. Density Classification: Lightweight.

D. Mortar and Grout: As specified in Section 042613, Type S.

E. Reinforcement: Formed steel wire, galvanized finish, wire diameter as indicated on drawings.

2.2 CONFIGURATION

A. Shaft Construction: Concentric with concentric cone top section; lipped male/female dry joints; sleeved to receive pipe sections.

B. Shape: Cylindrical.

C. Clear Inside Dimensions: As indicated.

D. Design Depth: As indicated.

E. Clear Lid Opening: As indicated.

F. Pipe Entry: Provide openings as indicated.

G. Steps: As indicated.

H. Steps: As required by code.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify items provided by other sections of Work are properly sized and located.

B. Verify that built-in items are in proper location, and ready for roughing into Work.

C. Verify excavation for manholes is correct.

3.2 MANHOLES

A. Place concrete base pad, trowel top surface level.

B. Place manhole sections plumb and level, trim to correct elevations, anchor to base pad.

C. Form and place manhole cylinder plumb and level, to correct dimensions and elevations. As work progresses, build in fabricated metal items.

D. Cut and fit for pipe.

E. Grout base of shaft sections to achieve slope to exit piping. Trowel smooth. Contour as required.

F. Coordinate with other sections of work to provide correct size, shape, and location.

3.3 MASONRY WORK

A. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

B. Lay masonry units in running bond. Course one unit and one mortar joint to equal 8 inches.

C. Form concave mortar joints.

D. Lay masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.

E. Install joint reinforcement 16 inches on center.

F. Place joint reinforcement in first and second horizontal joints above base pad and below lid frame opening.

END OF SECTION 334913