

Project Manual for

COOPER ACADEMY- ADDITION AND RENOVATIONS

PROJECT NUMBER: BD #2307

Johnston County Public Schools, NC

Bid Set

February 07, 2024



Owner

Johnston County Public Schools
2320 US 70 Business Highway East
Smithfield, North Carolina 27577
(919) 934-6031

Architect

Boomerang Design
6131 Falls of Neuse Road, Suite 204
Raleigh, North Carolina 27609
919-573-6400

Structural Engineer

Lynch Mykins Structural Engineers
301 North West Street, Suite 105
Raleigh, North Carolina 27603
919-782-1833

**Mechanical, Plumbing
and Electrical Engineers**

Progressive Collaborative Design
3101 Poplarwood Court, Suite 320
Raleigh, North Carolina 28604
919-790-9989

Civil Engineer

CLH Design, PA
400 Regency Forest Drive, Suite 120
Cary, North Carolina 27518
919-319-6716

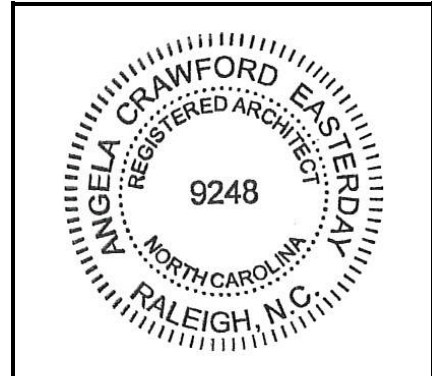


SEALS PAGE

SECTION 00 01 07 – SEALS PAGE

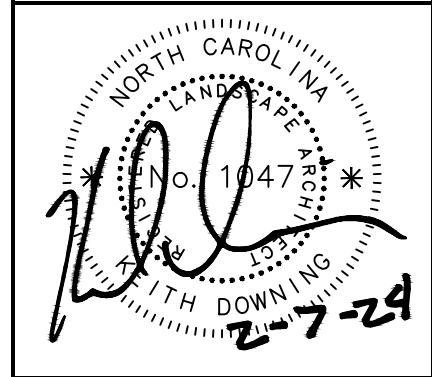
ARCHITECT

Angela Crawford Easterday
Boomerang Design
LIC. # 9248



CIVIL
ENGINEER

Keith Downing, CLH Design PA
LIC. # 1047
Divisions 31, 32 & 33



STRUCTURAL
ENGINEER

Stephen N. Sparks, Lynch Mykins, PC
LIC. #053114
Sections 03 30 00,
05 12 00, 05 21 00,
05 31 00, 04 06 00,
and 04 20 00 only



HVAC
ENGINEER

Steve Campbell, PDC Engineers, PA
LIC. #02502
Division 23



PLUMBING
ENGINEER

Steve Campbell, PDC Engineers, PA
LIC. #02502
Division 21 and 22



ELECTRICAL
ENGINEER

Tom Butkovich, PDC Engineers, PA
LIC. #024651
Divisions 25, 26, 27
and 28

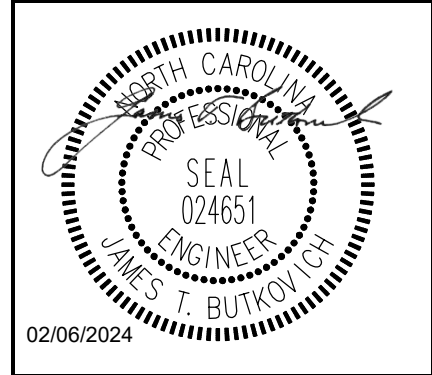


TABLE OF CONTENTS

SECTION 00 01 10 – TABLE OF CONTENTS**DIVISION 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS**

00 00 00	Cover Page
00 01 07	Seals Page
00 01 10	Table of Contents
00 31 00	Information Available to Bidder
00 63 13	Contractor's Request for Interpretation Form
00 65 14	Certification of Non-use of Asbestos
00 65 19.13	Affidavit of Debts and Claims
00 65 19.16	Affidavit of Release of Leins
00 65 36	Contractor's General Warranty Certification

DIVISION 01 - GENERAL REQUIREMENTS

01 10 00	Summary
01 14 00	Work Restrictions (new)
01 14 01	Work Restrictions (Renovation)
01 21 00	Allowances
01 22 00	Unit Prices
01 23 00	Alternates
01 29 00	Payment Procedures
01 31 00	Project Management and Coordination
01 32 00	Construction Progress Documentation
01 33 00	Submittal Procedures
01 40 00	Quality Requirements
01 42 01	References
01 58 00	Jobsite Sign
01 60 00	Product Requirements
01 73 00	Execution Requirements
01 73 29	Cutting and Patching
01 77 00	Closeout Procedures
01 78 23	Operation and Maintenance Data
01 78 39	Project Record Documents
01 79 00	Demonstration and Training

DIVISION 02 - EXISTING CONDITIONS

02 41 19	Selective Demolition
----------	----------------------

DIVISION 03 – CONCRETE

03 10 00	Concrete Forming and Accessories
03 20 00	Concrete Reinforcing
03 30 00	Cast in Place Concrete

DIVISION 04 - MASONRY

04 05 14	Masonry Mortar and Grout
04 20 00	Unit Masonry
04 22 00	Concrete Unit Masonry
04 72 00	Cast Stone

DIVISION 05 – METAL

05 12 00	Structural Steel Framing
----------	--------------------------

05 21 00	Steel Joist Framing
05 31 00	Steel Decking
05 40 00	Cold Formed Metal Framing
05 50 00	Metal Fabrications
05 51 00	Metal Stairs
05 51 33.13	Vertical Metal Ladders
05 52 13	Pipe and Tube Railings

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

06 10 53	Miscellaneous Carpentry
06 64 00	Plastic Paneling

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

07 11 13	Bituminous Dampproofing
07 13 26	Self-Adhering Sheet Waterproofing
07 21 00	Thermal Insulation
07 21 19	Foamed in Place Insulation
07 27 13	Modified Bituminous Sheet Barriers
07 27 26.02	Fluid Applied Membrane (Permeable) Air Barriers
07 41 13	Manufactured Roof Panels
07 42 13	Metal Wall Panels
07 42 43	Composite Panels
07 42 60	Rain Screen Attachment System
07 54 23	TPO Roofing
07 62 00	Sheet Metal Flashing and Trim
07 71 00	Manufactured Roof Specialties
07 71 29	Manufactured Roof Expansion Joints
07 81 00	Applied Fireproofing
07 84 00	Firestopping
07 84 43	Fire-Resistive Joint Sealants
07 90 00	Joint Protection
07 95 00	Expansion Control

DIVISION 08 - OPENINGS

08 11 13	Hollow Metal Doors and Frames
08 14 29	Prefinished Wood Doors
08 41 13	Aluminum Entrances and Storefronts
08 71 00	Door Hardware
08 80 00	Glazing

DIVISION 09 - FINISHES

09 21 16	Gypsum Board Assemblies
09 22 00	Suspended Gypsum Board Ceilings
09 30 00	Tile
09 51 13	Acoustical Panel Ceilings
09 65 13	Resilient Wall Base and Accessories
09 65 20	Resilient Vinyl Plank Flooring
09 72 03	Digitally Printed Wall Coverings
09 75 19.23	Stone Windowsills-Quartz
09 90 00	Painting
09 96 00	High Performance Coatings

DIVISION 10 – SPECIALTIES

- 10 11 00 Visual Display Units
- 10 14 00 Signage
- 10 14 26 Post and Panel Signs
- 10 21 13.17 Solid Phenolic Toilet Compartments
- 10 28 13 Toilet Accessories
- 10 44 00 Fire Protection Specialties

DIVISION 12 - FURNISHINGS

- 12 24 13 Roller Window Shades
- 12 32 16 Manufactured Plastic Laminate Clad Wood Casework

DIVISION 14 – CONVEYING EQUIPMENT

- 14 21 00 Electric Traction Elevators
- 14 42 00 Wheelchair Lifts

DIVISION 21 – FIRE SUPPRESSION

- 21 05 00 Common Work Results for Fire Suppression
- 21 05 23 General Duty Valves for Water Based Fire Suppression Piping
- 21 05 53 Identification for Fire Suppression Piping and Equipment
- 21 05 70 Fire Protection Coordination Drawings
- 21 07 19 Fire Suppression Piping Insulation
- 21 13 00 Fire Suppression Sprinkler Systems

DIVISION 22 - PLUMBING

- 22 01 00 Plumbing General Provisions
- 22 05 17 Sleeves and Sleeve Seals for Plumbing Piping
- 22 05 19 Meters and Gauges for Plumbing Piping
- 22 05 23 General-Duty Valves for Plumbing Piping
- 22 05 29 Hangers and Supports for Plumbing Piping and Equipment
- 22 05 53 Identification for Plumbing Piping and Equipment
- 22 07 19 Plumbing Piping Insulation
- 22 07 19.11 Under Lavatory Pipe and Supply Covers-Plumberex
- 22 10 05 Plumbing Piping
- 22 10 06 Plumbing Piping Specialties
- 22 13 29 Sanitary Sewerage Pumps
- 22 30 00 Plumbing Equipment
- 22 40 00 Plumbing Fixtures

DIVISION 23 - HEATING, VENTILATING, and AIR CONDITIONING (HVAC)

- 23 01 00 HVAC General Provisions
- 23 05 12 Electrical Work
- 23 05 13 Common Motor Requirements for HVAC Equipment
- 23 05 16 Expansion Fittings and Loops for HVAC Piping
- 23 05 17 Sleeves and Sleeve Seals for HVAC Piping
- 23 05 19 Meters and Gauges for HVAC Piping
- 23 05 23 General-Duty Valves for HVAC Piping
- 23 05 29 Hangers and Supports for HVAC Piping and Equipment
- 23 05 31 Coil Hookups
- 23 05 33 Heat Tracing for HVAC Piping
- 23 05 48 Vibration and Seismic Controls for HVAC

23 05 53	Identification for HVAC Piping and Equipment
23 05 70	Mechanical Coordination Drawings
23 05 93	Testing, Adjusting, and Balancing for HVAC
23 07 13	Duct Insulation
23 07 16	HVAC Equipment Insulation
23 07 19	HVAC Piping Insulation
23 08 00	Commissioning of HVAC
23 09 13.13	Bas Actuators and Operators
23 09 13.23	Bas Sensors and Transmitters
23 09 13.33	Bas Control Valves
23 09 13.43	Bas Control Dampers
23 09 23	Building Automation System
23 09 23.13	Building Automation Systems-Alternate 4
23 09 23.14	Airflow Instruments
23 09 33	Variable Frequency Drive
23 11 23	Facility Natural Gas Piping
23 21 13	Hydronic Piping
23 21 14	Hydronic Specialties
23 21 23	Hydronic Pumps
23 23 00	Refrigerant Piping
23 25 00	HVAC Water Treatment
23 31 00	HVAC Ducts and Casings
23 33 00	Air Duct Accessories
23 34 23	HVAC Power Ventilators
23 37 00	Air Outlets and Inlets
23 51 00	Breechings, Chimneys, and Stacks
23 52 16	Condensing Boilers
23 64 23	Scroll Water Chillers
23 73 13	Modular Indoor Central-Station Air-Handling Units
23 81 26.13	Small-Capacity Split-System Air Conditioners
23 82 00	Convection Heating and Cooling Units

DIVISION 26 - ELECTRICAL

26 01 00	Electrical General Provisions
26 05 19	Power Conductors and Cables
26 05 26	Grounding and Bonding for Electrical Systems
26 05 29	Hangers and Supports for Electrical Systems
26 05 33.13	Conduit for Electrical Systems
26 05 33.16	Boxes and Cabinets
26 05 36	Cable Trays for Electrical Systems
26 05 48	Vibration and Seismic Controls for Electrical Systems
26 05 53	Identification for Electrical Systems
26 05 73	Power System Studies
26 05 83	Wiring Connections
26 08 00	Commissioning of Electrical Systems
26 09 23	Lighting Control Devices
26 22 00	Dry Type Transformers
26 24 16	Panelboards
26 27 26	Wiring Devices
26 28 13	Fuses
26 28 16.16	Enclosed Switches and Circuit Breakers
26 36 00	Transfer Switches

26 43 00 Surge Protective Devices
26 51 00 Interior and Exterior Lighting

DIVISION 27 - COMMUNICATIONS

27 10 00 Structured Cabling for Voice and Data
27 51 13 Intercom System

DIVISION 28 - ELECTRONIC SAFETY and SECURITY

28 10 01 Access Control
28 16 00 Security Intrusion Detection System
28 46 01 Fire Detection and Alarm

DIVISION 31 - EARTHWORK

31 10 00 Site Clearing
31 20 00 Earth Moving (CIVIL)
31 25 00 Erosion and Sediment Controls
31 31 16 Termite Control

DIVISION 32- EXTERIOR IMPROVEMENTS

32 12 16 Asphalt Paving
32 13 13 Concrete Paving
32 31 13 Chain Link Fences and Gates
32 31 19 Ornamental Fence
32 40 00 Site Furnishings
32 90 00 Planting

DIVISION 33- UTILITIES

33 10 00 Site Water Utilities
33 30 00 Site Sanitary Sewerage Utilities
33 32 00 Sewer Pump Station
33 40 00 Site Storm Drainage Utilities

DIVISION 00
BIDDING AND CONTRACTING REQUIREMENTS

SECTION 00 31 00 – INFORMATION AVAILABLE TO BIDDERS

PART 1 - SUMMARY

1.1 BIDDING REQUIREMENTS

- A. This Document with its referenced attachments is part of the Bidding Requirements for this project and is not part of the Contract Documents. It includes the following:
 - 1. Geotechnical Data.
 - 2. Environmental Determination.
- B. Related Documents and Sections include the following:
 - 1. Document "Instructions to Bidders" for Bidder's responsibilities with respect to examination of the site and existing conditions.
 - 2. Document "Bidder's Checklist".
 - 3. Document "Supplementary Conditions" for Contract Time requirements for this project.

1.2 PROJECT CONDITIONS

- A. Geotechnical Data
 - 1. Subsurface investigation reports have been prepared by an independent agency and are attached to this Document.
 - 2. These reports were obtained by the Owner for reference purposes only and are not a part of the Contract Documents. Test boring records are included for bidders' convenience and information; but are not a warranty of subsurface conditions.
 - 3. Prior to the bid date, bidders may make their own subsurface investigation to satisfy themselves as to the site and subsurface conditions, but such subsurface investigations shall be performed only under time schedules and arrangements approved in advance by the Architect.

1.3 ATTACHMENTS

- A. Document "Geotechnical Data."
- B. Environmental Determination.

END OF DOCUMENT 00 31 00



REPORT OF SUBSURFACE EXPLORATION
AND GEOTECHNICAL EVALUATION
COOPER ACADEMY ADDITION
CLAYTON, NORTH CAROLINA
BUILDING & EARTH PROJECT No.: **RD230492(R01)**

PREPARED FOR:
Johnston County Public Schools

DECEMBER 11, 2023



Geotechnical, Environmental, and Materials Engineers



Geotechnical, Environmental, and Materials Engineers

610 Spring Branch Road
Dunn, North Carolina 28334
Ph: (910) 292-2085
www.BuildingAndEarth.com

December 11, 2023

Johnston County Public Schools
c/o Boomerang Design
6131 Falls of Neuse Road, Suite 204
Raleigh, North Carolina 27609

Attention: Mr. Brooks Moore, PE

Subject: REVISED Report of Subsurface Exploration and Geotechnical Evaluation
Cooper Academy Addition
849 N Mial Street
Clayton, North Carolina 27577
Building & Earth Project No: RD230492R01

Mr. Brooks:

Building & Earth Sciences, LLP (Building & Earth) has completed an authorized subsurface exploration and geotechnical engineering evaluation in support of additions to Cooper Academy located in Clayton, North Carolina.

The purpose of this work has been to assess general subsurface conditions at the site and to provide geotechnical engineering recommendations for use in project design and construction. Geotechnical recommendations in this report are based on a physical reconnaissance of the site and observation and classification of subsurface samples recovered from 20 engineering test borings drilled at the site. Confirmation of subsurface conditions reported herein, during construction, is an essential part of the geotechnical service.

Building & Earth appreciates the opportunity to provide consultation services in support of this project. If there are any questions regarding information in this report, or if additional information is required, please call.

Respectfully submitted,

BUILDING & EARTH SCIENCES, LLP
North Carolina Engineering Firm # 1085


Kurt A. Miller, PE
East Region Vice President





Malcolm D. Barrett, PE (VA)
Chief Engineer

Table of Contents

1.0 PROJECT & SITE DESCRIPTION.....	1
2.0 SCOPE OF SERVICES	5
3.0 GEOTECHNICAL SITE CHARACTERIZATION.....	7
3.1 GEOLOGY	7
3.2 SEISMIC SITE EVALUATION.....	7
3.3 EXISTING SURFACE CONDITIONS	9
3.4 SUBSURFACE CONDITIONS	9
3.4.1 SURFACE COVER: TOPSOIL	9
3.4.2 SURFACE COVER: EXISTING PAVEMENT	10
3.4.3 SILTY TO CLAYEY SAND, FILL.....	10
3.4.4 SANDY LEAN CLAY (CL) OCCASIONALLY SANDY FAT CLAY (CH)	10
3.4.5 SILT (ML), SILT WITH SAND (ML) AND ELASTIC SILT (MH)	10
3.5 AUGER REFUSAL.....	11
3.6 GROUNDWATER	11
3.7 SEASONAL HIGH WATER TABLE & INFILTRATION TESTING.....	11
4.0 SITE DEVELOPMENT CONSIDERATIONS.....	12
4.1 INITIAL SITE PREPARATION	13
4.2 SUBGRADE EVALUATION	14
4.3 MOISTURE SENSITIVE SOILS	15
4.4 UNDERCUTTING OF LOW CONSISTENCY SOILS.....	15
4.5 UNDERCUTTING OF HIGHLY PLASTIC SOILS	16
4.6 STRUCTURAL FILL	16
4.7 EXCAVATION CONSIDERATIONS.....	17
4.8 GROUNDWATER	17
4.9 CUT SLOPES.....	17
4.10 FILL SLOPES	18
4.11 EXISTING SLOPES.....	19
4.12 UTILITY TRENCH BACKFILL.....	19
4.13 LANDSCAPING AND DRAINAGE CONSIDERATIONS	19
4.14 WET WEATHER CONSTRUCTION	20
5.0 FOUNDATION RECOMMENDATIONS.....	20
6.0 SHALLOW FOUNDATIONS.....	20
7.0 BASEMENT RETAINING WALL CONSTRUCTION.....	21
8.0 FLOOR SLABS	22
9.0 PAVEMENT CONSIDERATIONS.....	22

10.0 FLEXIBLE PAVEMENT23
11.0 SUBGRADE REHABILITATION.....24
12.0 CONSTRUCTION MONITORING24
13.0 CLOSING AND LIMITATIONS25

APPENDIX

1.0 PROJECT & SITE DESCRIPTION

Proposed for construction are building additions and civil improvements to the Cooper Academy located at 849 N. Mial St., Clayton, North Carolina. Building additions will extend in a northeasterly direction from an existing one-story school building situated in the rear (southeastern portion) of the Academy Campus. A one-story addition will be constructed adjacent to the existing building, and a two-story building will be constructed beyond the one-story addition. The one-story addition will be separated from the existing one-story school building by a 9'-4" covered walkway, as will the one-story and two-story additions.

The one-story addition will be the same width (80 feet) as the existing building and will have a footprint covering about 117 feet by 80 feet. The finished floor elevation (FFE) of this addition will be the same as the existing structure, 316.64 feet.

Situated northeast of the one-story addition, the two-story addition with overall dimensions of about 80 feet by 202.7 feet will be constructed. This addition will be constructed with the long dimension perpendicular to the one-story addition, with a ground FFE at 301.3-ft. and a first-floor elevation at 316.64-ft. Northeast and southeast building walls will be exposed to about the first floor FFE, and the northwest wall will be partially exposed. The southwest wall, adjacent to the one-story addition, will be completely below grade.

In addition to the buildings, new roadways and parking areas are planned, and a stormwater management structure is planned for an area southeast of the two building additions. Additional project information is tabulated below:

Development Item	Detail	Description
General Site	Size (Ac.)	Approx. 13 acres (site boundaries on Google Earth)
	Existing Development	Cooper Academy (elementary school) with playgrounds and parking lots around perimeter of buildings and trailers
	Vegetation	Low grass around buildings and mature trees to the ESE of property
	Slopes	Yes
	Retaining Walls	Yes, two-story addition basement walls only.
	Drainage	Well drained
	Cuts & Fills	Cuts and fills up to about 10 to 12-ft.
Proposed Buildings	No. of Bldgs	2
	Square Ft.	102,170 S.F.
	Stories	1 and 2
	Construction	Structural Steel & Masonry (assumed)
	Column Loads	60 kips (assumed)
	Wall Loads	6 kips per lineal foot (assumed)
	Preferred Foundation	Conventional shallow spread
Pavements	Preferred Slab	First level: Concrete Slab-on-grade Second level: slab-on-deck
	Traffic	At grade asphalt parking lot with bus drop off loop
	Standard Duty	Yes - Flexible
	Heavy Duty	Yes - Flexible

Table 1: Project and Site Description

- References:
1. Undated untitled drawing showing existing campus with topographic contours.
 2. Undated drawing titled "Grading Plan" Project 09.01.2023 prepared by Boomerang Design.
 3. Undated unlabeled drawing showing civil boring positions.
 4. Undated unlabeled drawing showing structural boring positions.
 5. Drawings A101 and A102 respectively labeled "First Floor Plan" and "Ground Floor Plan / Mech. Yard Plan" both date 06.09.2023.

Notes:

1. ***If actual loading conditions exceed those listed above, Building & Earth should review our geotechnical recommendations to assess any effects on our recommendations for foundation design.***
2. ***As grading plans become finalized, Building & Earth should be allowed to review the plans and assess any effects on our recommendations.***

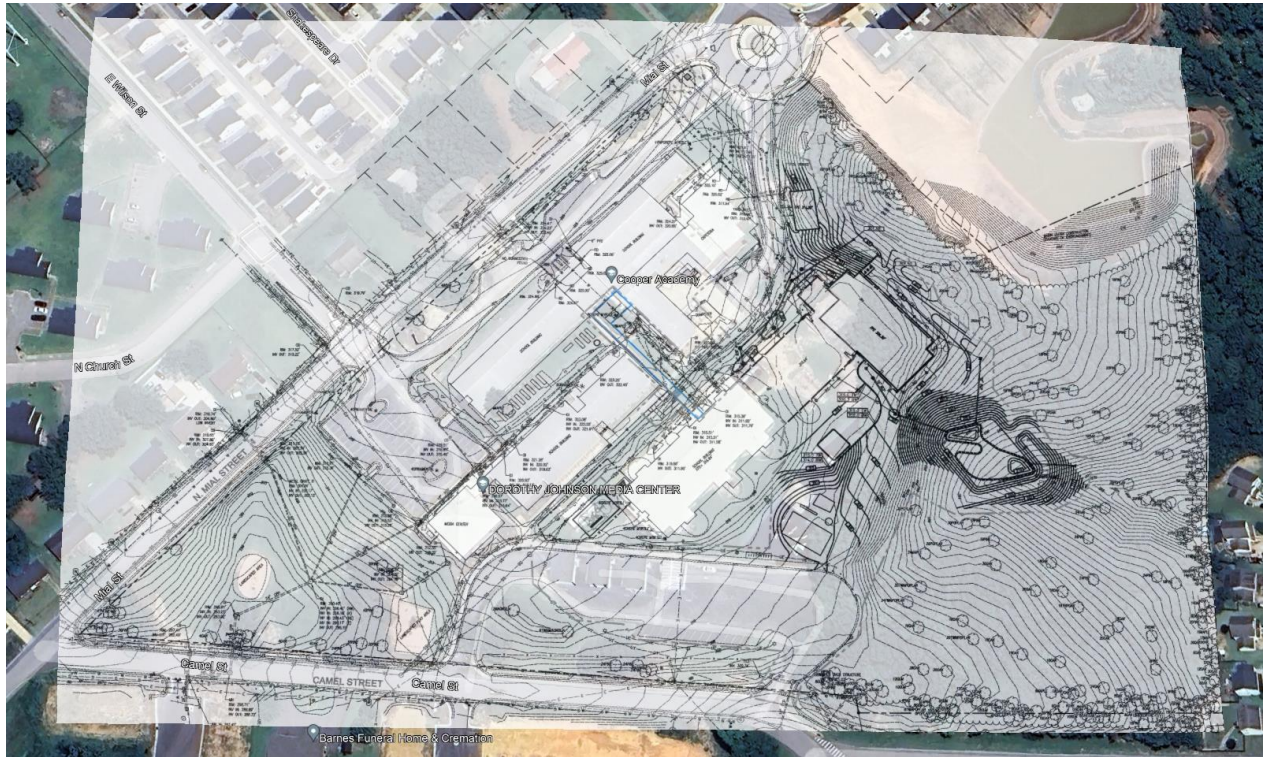


Figure 1: Aerial Imagery with Site Overlay (Google Earth)



Figure 2: View from B-05, Center of proposed building addition



Figure 3: Woods, Infiltration boring location

2.0 SCOPE OF SERVICES

Subsurface exploration was performed during the period October 11-13 and on October 16, 2023 in general conformance with our proposal RD25273, dated July 27, 2023. Notice-to-proceed was provided by Shelly Johnson of Boomerang Design. Occasionally some modification to work scopes appearing in our proposals is required to provide for proper evaluation of encountered subsurface conditions. One boring, B-11, was omitted due to its location inside a playground and one boring, B-20, was hand augured due to the possibility of buried utility lines at the boring site. Only one tri-axial shear test was performed (2 proposed) and one soil unconfined compressive strength test was performed (none proposed). Six classification tests (Atterberg limits and grain size analyses) were performed (4 proposed). Because no new pavement areas are planned, but rather mill and repave, bulk samples were not retrieved from the pavement areas to prevent additional damage to the existing pavement structure. The alternative laboratory testing program reflects actual subsurface conditions.

The purpose of the geotechnical exploration has been to characterize general subsurface conditions at the boring sites and to gather data on which to base a geotechnical evaluation with respect to the project. Subsurface exploration consisted of 20 soil test borings. The site was drilled using a Diedrich D-25 drill rig equipped with an automatic hammer for performing Standard Penetration Tests (SPT's) to evaluate relative soil strength.

Soil boring sites were field located using a layout plan provide by Boomerang Design and measuring from existing site features. Some boring positions were moved to avoid existing site features. As such boring positions appearing on the appended Boring Location Plan should be considered approximate.

Soil samples recovered from the test borings were visually classified and specific samples were selected by the project engineer for laboratory analysis. The laboratory analyses consisted of:

Test	ASTM	No. of Tests
Natural Moisture Content	D2216	22
Atterberg Limits	D4318	6
Material Finer Than No. 200 Sieve by Washing	D1140	6
Unconfined Compression Test on Soil Samples	D2166	1
Triaxial Shear Test (Consolidated-Undrained)	D4767	1
Standard Proctor Compaction Test	D698	1
Particle Size Distribution of Soils (Gradation)	D6913	6

Table 2: Scope of Laboratory Tests

Results of the laboratory analyses are presented on boring logs and in tabular form, both in the report Appendix. Descriptions of laboratory tests that were performed for this work also appear in the Appendix.

Information gathered from the exploration was used to prepare building foundation recommendations, to provide geotechnical recommendations for use in project design and construction, and to aid in identifying geotechnical matters that may be encountered during site earthworks operations. Results of the work presented herein provide or address the following:

- Summary of existing surface conditions.
- A description of the subsurface conditions encountered at boring locations.
- Site preparation considerations including material types to be expected during grading as well as recommendations regarding handling and treatment of unsuitable soils, if encountered.
- Compaction requirements and recommended criteria to establish suitable surfaces for structural backfill.
- Boring logs detailing the materials encountered with soil classifications, penetration values, and groundwater levels (if measured).
- Presentation of laboratory test results.
- Recommendations for foundation and floor slab support of new additions.
- Recommendations for lateral earth pressure
- Presentation of the estimated total and differential settlement.
- Recommendations for medium and light-duty asphalt sections.

- Plans and maps showing the location of the project and our onsite work.

3.0 GEOTECHNICAL SITE CHARACTERIZATION

The following paragraphs are intended to provide a general characterization of the site from a geotechnical engineering perspective. It is not the intention of this report to address every potential geotechnical matter that may arise, nor to provide every possible interpretation of conditions encountered. The following condition descriptions and subsequent geotechnical recommendations are based, in part, on the assumption significant changes in subsurface conditions do not occur between boreholes. However, anomalous conditions can occur due to variations in existing fill that may be present at the site, or due to natural geologic variation. It is therefore necessary to confirm that conditions reported herein during earthworks operations and during foundations installation.

3.1 GEOLOGY

Clayton North Carolina is situated in the eastern Piedmont region. Soils in the piedmont are typically weathered from underlying igneous and metamorphic rock of the Cenozoic (66 million years to present) era. Rock underlying the Cooper Academy is mapped (USGS map titled *Preliminary Bedrock Geologic Map of the Raleigh 30' X 60' Quadrangle, North Carolina* dated 2004) as gneiss and schist, locally influence by a diabase dike. Soils in the area are weathered from this and adjacent bedrock and may have been transported by erosional forces. Conditions encountered in test borings drilled for this study generally correlate to published geologic information. No potentially adverse geologic conditions were noted on maps reviewed for this study.

3.2 SEISMIC SITE EVALUATION

ReMi testing was performed to determine the Seismic Site Classification of the building area. The ReMi array run consisted of 12 geophone receivers and was approximately 289 feet in length. The location of the array run appears on the Boring Location Plan. Results of ReMi testing are presented below.

Basis of Evaluation	Site Classification
2015 International Building Code (IBC) and ASCE 7-16, Chapter 20	D – Stiff Soil
The Geogiga Surface Plus refraction microtremor (ReMi) method was used to determine the Seismic Site Class of the building area. Geogiga Seismic Surface Plus ReMi Vs9.3 software uses data from conventional seismograph and S-wave geophones to estimate average shear wave velocities and one and two-dimensional shear wave profiles to a depth of 100 feet below existing grades. These velocities are used to classify a building site with the Site Class A through E designation. The average shear wave velocity (V_s) in the upper 100 feet was 1,015 feet per second (ft/s). The results of the shear wave velocity analysis are attached.	

Table 3: Seismic Site Classification

The ASCE 7 Hazard Tool (<https://asce7hazardtool.online/>) was used to determine the mapped Risk-targeted Maximum Considered Earthquake (MCE_R) ground motion parameters for 0.2-second (S_S) and 1-second (S_1) spectral response acceleration, 5% damped; the short-period (F_a) and long-period (F_v) site coefficients; the 0.2-second (S_{MS}) and 1-second (S_{M1}) spectral response acceleration, adjusted for site class; the design parameters for 0.2-second (S_{DS}) and 1-second (S_{D1}) spectral response acceleration; and the Seismic Design Category.

Using coordinates from the approximate center of the run: latitude 35°39'17.49"N, longitude 78°27'4.03"W and assuming a Risk Category **III**, the results of the evaluation using the ASCE 7 Hazard Tool are tabulated below. If actual Risk Category is different, Building & Earth Sciences should be notified to review the effects on our evaluation.

Parameter	Value	Parameter	Value
S_S:	0.116	S₁:	0.059
F_a:	1.6	F_v:	2.4
S_{MS}:	0.186	S_{M1}:	0.141
S_{DS}:	0.124	S_{D1}:	0.094
Seismic Design Category:		B	

Table 4: Seismic Parameters

A report provided by the ASCE 7 Hazard Tool is included in the Appendix.

3.3 EXISTING SURFACE CONDITIONS

At the time of our field exploration, the site was developed as an educational campus with several buildings, roadways, and parking areas. Two small buildings, a fenced mechanical equipment area and basketball courts lie within the building additions footprints. Vegetation consisted of low grass and mature trees in a wooded area directly to the east of the building site; it appears a portion of the two-story structure will encroach on the wooded area. Based upon review of historical imagery, site conditions have not been significantly unaltered since at least 1985.

3.4 SUBSURFACE CONDITIONS

A generalized stratification, summarized below, has been prepared using data from the soil test borings. This general stratification depicts general soil conditions and strata types encountered during our field investigation.

Stratum No.	Typical Thickness	Description	Consistency
1	3 inches	Topsoil	N/A
2	1-4 ft.	Silty and Clayey Sand, Various Fill	Loose to Dense
3	3-6 ft.	Sandy Lean to Fat Clay (CL or CH)	Soft to Very Stiff
4	20 ft. +	Silt with Sand and Sandy Silt (ML)	Medium Stiff to Hard

Table 5: Stratification Summary

Subsurface soil profiles, presented in the Appendix, have been prepared using the test boring data. For specific information obtained from the soil borings, please refer to the appended Boring Logs. Ground surface elevations at the boring sites have been estimated using Google Earth imagery and should be considered approximate.

3.4.1 SURFACE COVER: TOPSOIL

Except for test boring locations B-16, B-17, B-19, and B-21, topsoil was encountered at the ground surface. Topsoil depths generally were about 3 inches thick. No testing has been performed to verify this material meets general characteristics (organic material content) of "topsoil". Topsoil depths reported should only be considered an estimate as topsoil thickness may vary in unexplored portions of the site.

3.4.2 [SURFACE COVER: EXISTING PAVEMENT](#)

Test borings B-16, B-17, B-19, and B-21 were performed in existing pavement areas. According to Google Earth the bus parking lot appears in the 1999 aerial photograph but was not present before this date. The remainder of the pavement area appear to be present in all photographs back to 1993. It is not clear if the pavement has been repaired or replaced since the initial construction. The existing pavements consist of 2.25 to 4 inches of asphalt over 3 to 8 inches of aggregate base course stone. Significant areas of the pavement have alligator cracking, and do not appear to be a good candidate for overlay.

3.4.3 [SILTY TO CLAYEY SAND, FILL](#)

Soils and fill materials described variously as light brown, damp, silty and clayey sand (SC and SM) were observed in all test borings but B-9. In addition to the sandy materials, asphalt and gravel road base materials were observed in several of the borings. This material extends to depths up to 4-ft. below the surface and exhibits N-values in the range 4 to 29 bpf. N-values in the range 4 to 14 bpf are considered representative.

Wash 200 grain size and Atterberg limit tests were performed on one (1) sample of the sandy material. The clay fraction exhibits a 37 liquid limit, an 18 plasticity index, and 35 percent of the material passes a standard #200 sieve.

3.4.4 [SANDY LEAN CLAY \(CL\) OCCASIONALLY SANDY FAT CLAY \(CH\)](#)

Soils generally described as brown, damp, Sandy Lean Clay (CL) were encountered in most of the test borings extending below the silty clay sand and fill material to depths approximately 4 to 7 feet below the surface. This material is visually classified Sandy Fat Clay (CH) and Clayey Sand (SC) in some borings. Classification testing was not performed on representative samples collected from this stratum.

3.4.5 [SILT \(ML\), SILT WITH SAND \(ML\) AND ELASTIC SILT \(MH\)](#)

Below the upper strata and extending below the boring termination depths, soils described as Sandy Silt and Silt with Sand (ML), brown, moist and medium stiff were encountered. Standard penetration test values in this material range from 5 to 24 blows per foot, with values in the range 10 to 13 blows per foot considered representative for design.

Wash 200 grain size and Atterberg limit tests were performed on 3 samples recovered from this stratum yielded liquid limit values from 36 to 43 and plasticity indices from 6 to 14. Wash 200 testing yielded a range of 54 to 62 percent passing the #200 sieve. This material is classified as ML in accordance with the USCS classification system. The elastic silt (MH) materials are isolated thin layers in boring B-09, B-12, and B-19.

3.5 AUGER REFUSAL

Auger refusal is the drilling depth at which a borehole can no longer be advanced using soil drilling procedures. Auger refusal can occur on hard soil, boulders, buried debris or bedrock. Coring is required to sample materials below auger refusal. Auger refusal did not occur in test borings drilled for this study. All borings were extended to their planned termination depth.

3.6 GROUNDWATER

Groundwater measurements were made in all of the test borings during drilling, and in borings B-01 and B-15 about 24-hrs. after drilling completion via stand-pipe piezometers. Groundwater observations are tabulated below. Water levels reported are accurate only for the time and date of their measurements. Long term (seasonal) ground-water monitoring was not included as part of the subsurface exploration. With the exception of B-01 and B-15, the test borings were backfilled upon their completion and stand-pipe piezometers were removed following the (approximate) 24-hour readings.

Boring No.	Depth (ft)	Elevation (ft.)	Depth (ft) at 24-hr	Elevation @ 24-hr.
B-01	18.6	288.4	17.4	289.6
B-15	28.6	250.4	19.7	259.3

Table 6: Groundwater Depths and Elevations

3.7 SEASONAL HIGH WATER TABLE & INFILTRATION TESTING

Evidence of seasonal high water table (SHWT) was not encountered within the upper 12 feet of the soil profile at soil boring location B-15. Based on the topographic information provided, the bottom of the basin will be at an elevation of 279 feet which is at or near the existing grade at the bore location. As such, the existing surface soils as well as the newly constructed berms will likely control the infiltration of stormwater.

To determine the parameters that the Civil Designer will need to design the basins, Compact Constant Head Permeability testing was performed at a depth of 24 inches below the ground surface to get below any organic root material that could affect the drainage rate of the near surface soils. The results of our testing are summarized below.

Test Position	Elevation
Ground Surface Elevation (ft)	279
Bottom of Basin Elevation (ft)	279
Depth to Observed SHWT (in)	NE
SHWT Elevation (ft)	NE
Depth to Groundwater (ft)	28.6
Groundwater Elevation (ft)	250.4
CCHP Elevation (ft)	277
Ksat (in/hour)	<0.05

* NE – Not Encountered

Table 7: Seasonal High Water Data (Boring B-15)

The flow of the near surface soils has been approximated using the concepts presented in Bernoulli's Equation for steady state flow and Darcy's Law for fluid flow through a porous media. Additionally, our Ksat values were calculated using the Glover solution which is dependent on soil saturation, the geometry of the bore hole, and the hydraulic head. To develop our recommendations, Building & Earth has measured/calculated the saturated flow rate (Ksat) for the soils at the site using accepted test methods and equipment. Ultimately, the drainage of the basins will be a function of the saturated flow rate of the soils, the surface area of the basin geometry, and the pressure differential (hydraulic head) induced by the storm water levels in the drainage structure. To determine the appropriate Ksat for the soils in each basin, a small diameter bore hole was advanced to a pre-determined depth of interest. At this depth, a constant head (pressure) was established and maintained. Once our measurements approached a stabilized flow rate, our test was terminated.

4.0 SITE DEVELOPMENT CONSIDERATIONS

An undated drawing titled "Grading Plan" Project 09.01.2023 prepared by Boomerang Design was provided for use in this report preparation. The grading plan suggests significant cut and fill depths will be required as part of the work. Estimates of cut and fill depths are tabulated below:

Building Area	Est. Max. Cut (ft.)	Est. Max. Fill (ft.)
One-Story Addition	1	7
Two Story Addition	12	3
General Civil Grading	8 to 10	6 to 8

Table 8: Estimated Maximum Cut and Fill Depths

Subsurface information and estimated foundation loads indicate foundation support using a conventional shallow spread foundation system is appropriate for the project. Site development recommendations have been prepared under the assumption this foundation system type will be employed. ***If a different type of foundation system is preferred, Building & Earth should be requested to review the site development recommendations to verify that they are appropriate for the preferred foundation system.***

Primary geotechnical concerns affecting this this project are:

- The presence of variable fill material, including buried pavement materials.
- Installation of a basement retaining wall beneath the two-story addition approximately adjacent to the one-story addition.
- Primarily silty soils likely to ravel and slough on embankment slopes.
- Primarily silty site soils that may be difficult to place as structural fill. Difficulties may include moisture sensitivity, and difficulty in embankment construction.
- Mass Earthworks likely requiring placement and compaction of relatively silty soil materials.

Recommendations addressing the site conditions are presented in the following report sections.

4.1 INITIAL SITE PREPARATION

Initial site preparation should include removal of all existing structures, playground equipment, trees, roots, topsoil and any otherwise deleterious materials for all areas to receive structural fill or building components. Approximately 3-inches of topsoil is recorded on test boring logs drilled within the building areas with up to 4 feet of fill below; this condition is recorded as prevalent in all test borings. Building & Earth recommends the project geotechnical engineer or a qualified agent of the engineer observe stripping and grubbing operations to confirm all unsuitable materials are removed from proposed development areas.

Due to past use, buried structures such as foundations, utility lines, septic tanks, etc. may be encountered during mass grading and foundation installation operations. If encountered, these should be removed and the resulting excavations should be backfilled in accordance with recommendations appearing in the *Structural Fill* section of this report.

Materials disturbed during clearing operations should be stabilized in place or, if necessary, undercut to undisturbed materials and backfilled with properly compacted, approved structural fill.

During site preparation the contractor should identify borrow source materials that will be used as structural fill and provide samples to the testing laboratory so that conformance to structural fill recommendations (provided below) can be confirmed, and so that laboratory moisture-density (Proctor) testing can be completed prior to earthworks commencement.

4.2 SUBGRADE EVALUATION

We recommend the project geotechnical engineer or a qualified agent of the engineer evaluate subgrades after fill and building areas are stripped as some unsuitable or unstable areas may be present in unexplored areas of the site. All areas that will require fill or that will support structures should be carefully proof-rolled with a heavy (40,000 # minimum), rubber-tired vehicle at the following times.

- After an area has been stripped, and undercut if required, prior to the placement of any fill.
- After grading an area to the finished subgrade elevation in a building or pavement area.
- After areas have been exposed to any precipitation, and/or have been exposed for more than 48 hours.

Some instability may exist during construction, depending on climatic and other factors, immediately preceding and during construction. If any soft or otherwise unsuitable soils are identified during the proof-rolling process, they should be undercut or stabilized prior to fill placement, pavement construction, or floor slab construction. All unsuitable material identified during construction operations should be removed and replaced in accordance with recommendations appearing in the *Structural Fill* section of this report.

4.3 MOISTURE SENSITIVE SOILS

Moisture sensitive sandy silt and silt with sand (ML), clayey sand (SC) and variously classified fill materials were encountered across the site during the subsurface exploration. These soils will degrade if allowed to become saturated. Therefore, not allowing water to pond by maintaining positive drainage and temporary dewatering methods (if required) will be important to help avoid degradation and softening of the soils.

The contractor should anticipate some difficulty during the project earthworks phase if moisture levels are moderate to high during construction. Increased moisture levels will soften the subgrade and the soils may become unstable under the influence of construction traffic. Accordingly, construction during wet weather conditions should be avoided, as this could result in soft and unstable soil conditions that would require ground modification, such as in place stabilization or undercutting.

4.4 UNDERCUTTING OF LOW CONSISTENCY SOILS

Low consistency soils ($N \leq 8$ as measured using an automatic SPT hammer) were encountered in the upper 1 to 2-ft. in some of the test borings, and may be present in unexplored areas of the site. Where encountered, low consistency soils should be undercut to a stable, suitable subgrade. The undercutting should extend laterally 5 feet outside building footprints.

In areas to receive pavement, low consistency soils removal should extend laterally 3 feet beyond pavement edges. It may be possible to stabilize the soft soils in the pavement areas in place. Typical stabilization methods vary widely and include modification of the soft soils with the addition of shot rock or No. 2 stone, as well as utilization of geogrids and graded aggregates. The design of a specific stabilization method is beyond the scope of this investigation but can be provided by Building & Earth as an additional service if desired. Any undercutting or stabilization performed in pavement areas should be conducted under the observation of the geotechnical engineer or his representative.

Some unsuitable or unstable areas may be present in unexplored areas of the site. Once the known undercut is complete, the areas planned for construction should be proofrolled in order to identify any additional soft soils requiring removal.

Undercut soils should be replaced with structural fill. Clean, non-organic, non-saturated soils taken from the undercut area can be re-used as structural fill. The placement procedure, compaction and composition of the structural fill must meet the requirements of the Structural Fill section of this report.

4.5 UNDERCUTTING OF HIGHLY PLASTIC SOILS

Laboratory testing suggests moderately plastic soils (elastic silt with sand (MH) are present on the site. Where this material occurs beneath building foundation and floor slabs, we recommend it be undercut so that it lies at least 2-ft. below foundations and floor slabs. The undercutting should extend at least 5 feet horizontally beyond building footprints.

In parking and drive areas the highly plastic clays should be undercut to 1-ft. below planned subgrades (bottom of the base layer). The undercut material should be replaced with structural fill meeting the recommendations appearing in the Structural Fill section of this report.

The undercutting should be conducted under the observation of the geotechnical engineer or a qualified representative of the engineer. *Weather conditions at the time of construction will affect the undercutting depths and quantities.* Some instability may exist during construction, depending on climatic and other factors immediately preceding and during construction.

4.6 STRUCTURAL FILL

Structural fill material recommendations follow:

Soil Type	USCS Classification	Property Recommendations	Placement Location
Sand and Gravel	GW, GP, GM, SW, SP, SM or combinations	Maximum 2" particle size	All areas where fill material is confined against raveling. Not recommended in areas subject to foundation or utility trenching.
Clay	CL, SC, GC	LL<50, PI<25, γ_d >100 pcf	All areas.
Clay	CH	LL>55, PI>25, γ_d >100 pcf	Not recommended for use.
Elastic Silt	MH	LL>50, PI>22, γ_d >100 pcf	Not recommended for use.
On-site soils	Silt with Sand (ML) Sandy Silt (ML) Clayey Sand (SC)	As listed above	All areas, Compaction of ML materials will likely be highly moisture sensitive.

Table 9: Structural Fill Recommendations

Notes:

1. LL indicates the soil Liquid Limit; PI indicates the soil Plasticity Index; γ_d indicates the maximum dry density as defined by the density standard outlined in the table below.
2. Laboratory testing of the soils proposed for fill should be performed to verify their conformance with the above recommendations.

3. Any fill to be placed at the site should be reviewed by the geotechnical engineer.
4. Placement of material described as sandy silt or silty sand on embankment slopes may be subject to sloughing until the slopes are stabilized with vegetation. This condition is expected to worsen on slopes steeper than about 3.0 to 1.0V.

Structural fill placement recommendations follow:

Specification	Recommendation
Lift Thickness	8-in. maximum loose, 6-in. maximum compacted
Density	98% as determined by ASTM D698 (standard Proctor)
Moisture	+/- 2% of optimum as determined by ASTM D698 (standard Proctor) ML soils may require a more restrictive compaction moisture tolerance.
Density Testing Frequency	1 test per 10,000 sq. ft. of material placed in each lift, minimum 2 tests per lift.

Table 10: Structural Fill Placement Recommendations

4.7 EXCAVATION CONSIDERATIONS

All excavations performed at the site should follow OSHA guidelines for temporary excavations. Excavated soils should be stockpiled according to OSHA regulations to limit the potential cave-in of soils.

4.8 GROUNDWATER

Groundwater was encountered in borings B-01 and B-15 at the depths tabulated above. Groundwater could be encountered at higher elevations during construction, particularly during undercutting operations. It should be noted that fluctuations in groundwater levels could occur due to seasonal variations in rainfall. The contractor should be prepared to remove groundwater seepage from excavations if encountered during construction. Excavations extending below groundwater levels will likely require dewatering systems (such as well points, sump pumps or trench drains). The contractor should evaluate the most economical and practical dewatering method.

4.9 CUT SLOPES

Provided grading information suggests cut slopes up to about 10 to 15 feet in height are expected. Due to the relatively low strength of the site soils, Building & Earth recommends cut slopes not exceed 3(H):1(V). Due to the types of soils encountered at the site, we recommend that stability analysis be performed for all cut slopes greater than 15 feet. It is noted the stability of cut slopes can be affected by minor discontinuities that may not be detected in the borings. Therefore, careful inspection of the excavation process and the cut slope by Building & Earth engineering personnel during construction is critical.

Proposed cut slopes are expected to expose silt with significant sand content. Therefore, the face of cut slopes will likely be susceptible to erosion. Additionally, the likelihood of surficial slides, sloughing, and shallow failures is greatly increased in excavations where shallow groundwater is present. Water should not be allowed to pond at the toe or crest of the cuts. Nor should water be allowed to flow over the face of the slope. Interceptor ditches should be constructed at proper locations to promote the collection and removal of excess water. Recommended locations for interceptor and collection channels include the crest and the toe of the slopes and at benches within the slope, as applicable.

Permanent drains will be required in areas exhibiting continual seepage such as at the toe of cut slopes. The drain will serve to collect and remove water that continues to seep into the area and reduce the potential of water infiltrating the adjacent subgrade soils.

4.10 FILL SLOPES

Provided grading information suggests fill embankments up to about 15 feet in height are expected to be constructed at the site. Building & Earth recommends a maximum plan inclination of fill embankments at 3(H):1(V). Due to the types of soils available on site for fill construction, we recommend that stability analysis be performed for all fill slopes greater than 15 feet in height. It is important to note that fill embankments are a structural element requiring proper construction techniques and suitable materials to perform as designed.

Even if properly constructed, fill embankments tend to “creep” over time. Creep is the gradual, downward movement of soils near the slope face. The movement can lead to distress in structures supported on the fill. Therefore, pavements and buildings should be set back a minimum distance of 5 and 15 feet from the crest of fill embankments, respectively, or greater if a greater offset distance is required by the International Building Code (IBC).

The long-term stability of fill embankments is dependent on a stable subgrade. Embankments constructed over low-consistency material are susceptible to settlement and slope failure. Therefore, low-strength soils should be removed from beneath the embankment and a minimum of 10 feet beyond the toe of the embankment. Excavations should be backfilled with compacted and tested engineered fill. Building & Earth should verify that the underlying, subgrade soils within the area of influence of the slope exhibit a high consistency prior to embankment construction. All material used to construct the fill embankment should conform to the project requirements for engineered fill. Unsuitable materials (organics, debris, wet or soft soil) should not be placed in embankments. On-site soils must be carefully monitored during construction to ensure only high strength engineered fill is used to construct embankments.

Fill should be placed in thin, horizontal lifts and compacted and tested in accordance with the project requirements. Due to the difficulty in compacting soils on the face of the slope, fill embankments should be overbuilt and cut back to the desired configuration upon completion. In no case should the slope be constructed or reconfigured by pushing soil over the top edge of the slope. Careful control by the contractor during construction is important to ensure that no part of the slope exceeds the design inclination. The fill should be benched into the natural soils to prevent the formation of weak zones.

4.11 EXISTING SLOPES

Existing slopes are present within the development area. Minimum slope setback requirements are identified in the International Building Code (IBC) Section 1808.7.1. The setbacks should be followed to assure building foundations have adequate vertical and lateral support, and that foundations are installed a minimum safe distance from the top of the slopes.

4.12 UTILITY TRENCH BACKFILL

All utility trenches should be backfilled and compacted in the manner specified above for structural fill. It may be necessary to reduce the lift thickness to 4 to 6 inches to achieve compaction using hand-operated equipment.

4.13 LANDSCAPING AND DRAINAGE CONSIDERATIONS

The potential for soil moisture fluctuations within building areas and pavement subgrades should be reduced to lessen the potential of subgrade movement. Site grading should include positive drainage away from buildings and pavements. Excessive irrigation of landscaping poses a risk of saturating and softening soils below shallow footings and pavements, which could result in settlement of footings and premature failure of pavements.

4.14 WET WEATHER CONSTRUCTION

Excessive movement of construction equipment across the site during wet weather may result in ruts, which will collect rainwater, prolonging the time required to dry the subgrade soils.

During rainy periods, additional effort will be required to properly prepare the site and establish/maintain an acceptable subgrade. The difficulty will increase in areas where clay or silty soils are exposed at the subgrade elevation. Grading contractors typically postpone grading operations during wet weather to wait for conditions that are more favorable. Contractors can typically disk or aerate the upper soils to promote drying during intermittent periods of favorable weather. When deadlines restrict postponement of grading operations, additional measures such as undercutting and replacing saturated soils or stabilization can be utilized to facilitate placement of additional fill material.

5.0 FOUNDATION RECOMMENDATIONS

Actual foundation loading has not been provided for this work. Our experience with similar projects suggests individual column loads will be less than about 60 kips and wall loads will be less than about 6 kips per linear foot. ***If these assumptions concerning foundation loading are incorrect, our office should be contacted, such that our recommendations can be reviewed and revised accordingly.***

6.0 SHALLOW FOUNDATIONS

Provided field conditions reported herein are confirmed and after our site preparation and grading recommendations are implemented, Building & Earth recommends the proposed structure be supported on conventional shallow spread foundations designed using a 3,000 psf allowable soil bearing capacity.

Even though computed footing dimensions may be less, column footings should be at least 24 inches wide and strip footings should be at least 18 inches wide. These dimensions facilitate hand cleaning of foundation bearing surfaces that may have been disturbed during excavation and reinforcing steel placement. They also reduce the potential for localized punching shear failure. ***All exterior footings should bear at least 24 inches below the adjacent exterior grades for frost protection and to enhance bearing capacity.*** Total settlement of footings designed and constructed as recommended above should be 1 inch or less, with differential settlement up to about 1/2-inch or less.

7.0 BASEMENT RETAINING WALL CONSTRUCTION

Where basements are constructed, Building & Earth recommends basement retaining walls be designed as braced against lateral deflection, with earth pressures against the walls computed for the “at rest” (K_0) condition. It is recommended the walls be braced at the top prior to backfilling the space between the wall exteriors and the adjacent, retained earth. We further recommend a minimum 12-inch thick layer of freely draining stone be placed as a drainage blanket between retaining walls and retained earth, and that a “socked” perforated pipe be placed at the base of this drainage blanket to provide a removal pathway for any water that may build up in the retained materials. A non-woven filter fabric should separate the stone blanket from the retained soils and a water barrier should be applied to the retaining walls prior to backfilling. Drainage piping should be run either to daylight or to a sump that will preclude standing water from building up behind the walls.

Lateral loading against basement retaining walls should be computed as an equivalent fluid pressure based upon the material retained. Where backfill is installed following wall bracing, the “at rest” soil condition is recommended. Where backfill is placed prior to bracing or where unbraced cantilever walls are used, the walls should be expected to move laterally and the active case condition should be used to compute loading.

Two backfill material conditions should be considered in design. These are: 1) Use of soil materials native to the site; and 2) Use of well graded clean gravel or gravel sand mixes. If soil is used, a freely draining stone material (described above) should be placed against the walls. If stone is used as a backfill material, it is recommended the stone be installed in a trench sloped at a minimum 1H:1V extending away from the wall foundations to the surface. A non-woven filter fabric should be placed between the stone and the native soils. The ground surface above and surrounding the retaining walls should be graded to promote rapid and efficient drainage away from the walls. If stone is used as the backfill material, it should be covered with a non-woven filter fabric and, where exposed to precipitation, at least 18-inches of low permeability soil should be placed over the stone. Recommended equivalent fluid pressure values for the four loading conditions are tabulated below:

Backfill Material	Active Case (pcf)	At Rest Case (pcf)
Native, Local Soil	85	100
Clean Gravel or Gravel-Sand Mixture	35	60

Table 11: Equivalent Fluid Pressures for Retaining Wall Design

Fill material placed behind retaining walls should be placed in lifts as described above and compacted using hand operated compaction equipment. Heavy equipment should not be used to place and compact the retained materials as the vehicle loads may damage the retaining walls.

8.0 FLOOR SLABS

We recommend floor slabs for the proposed additions be supported on a minimum four-inch layer of ½-inch up to 1½-inch, free-draining, gap-graded gravel, such as AASHTO No. 57 stone, with no more than 5 percent passing the ASTM No. 200 sieve. The purpose of this layer is to help distribute concentrated loads and to act as a capillary break for moisture migration through the subgrade soil. This gravel material should be consolidated in-place with vibratory equipment. The surface of the base material should be choked with finer material. A clean fine-graded material with at least 10 to 30 % of particles passing a No. 100 sieve but not contaminated with clay, silt or organic material is recommended. With the gravel material, such as AASHTO No. 57 stone, a modulus of subgrade reaction of 150 pci can be used in the design of a grade-supported building floor slab.

We recommend a minimum 10-mil thick vapor retarder meeting ASTM E 1745, Class C requirements be placed directly below slab-on-grade floors. A higher quality vapor retarder (Class A or B) may be used if desired to further inhibit the migration of moisture through the slab-on-grade and should be evaluated based on the floor covering and use. The vapor retarder should extend to the edge of the slab-on-grade floors and should be sealed at all seams and penetrations. The slab should be appropriately reinforced (if required) to support the proposed loads.

9.0 PAVEMENT CONSIDERATIONS

Provided site preparation recommendations are followed, soil conditions encountered at the boring sites support pavement design using a California Bearing Ratio (CBR) of five (5). Note that no CBR or plate load testing was completed to develop these recommendations.

For pavement design purposes, we have assumed two levels of traffic shown on the table below. Specific traffic information was not provided. If the pavement were a typical roadway, according to the "AASHTO Guide for Design of Pavement Structures, 1993", these pavement sections would be adequate for the following daily traffic volume:

Type	Automobiles (per day)	Delivery Trucks (2-Axle/4-Tire) (per day)	Delivery Trucks / Busses (2-Axle/6-Tire) (per day)	Trash Trucks (per week)	ESAL
Standard Duty	200	10	5	0	1.4 X E+4
Heavy Duty	200	6	55	2	2.7 X E+5

Table 12: Assumed Traffic Volume

The volumes shown above are just one example of possible vehicle types and daily traffic that would result in the total equivalent 18-kip single-axle load (ESAL) shown.

It has been our experience that parking lots experience a certain level of wear and stress greater than roadways designed for similar traffic volumes. Therefore, parking lots are typically designed using the AASHTO method and adjusted based on experience. Alternative traffic volume estimates may result in alternate section recommendations. In addition to the estimated CBR value, we have assumed the following design parameters:

Design Criteria	Value
Design life (Years)	20
Terminal Serviceability	2.0
Reliability	85%
Initial Serviceability	4.2
Standard Deviation	0.45(Flexible)
Standard Deviation	0.35(Rigid)

Table 13: Assumed Design Parameters

Note: All subgrade, base and pavement construction operations should meet minimum requirements appearing in the North Carolina Standard Specification for Road and Bridge Construction.

10.0 FLEXIBLE PAVEMENT

Asphalt pavement sections described herein were designed using the "AASHTO Guide for Design of Pavement Structures, 1993". Alternative pavement sections were designed by establishing the structural numbers used for the AASHTO design system and substituting materials based upon structural equivalency as follows:

Material	Structural No.
Asphalt Concrete	0.44
Crushed Stone Base	0.14

Table 14: Structural Equivalent Coefficient

The following flexible pavement sections are based on the design parameters presented above:

Minimum Recommended Thickness (in)		Material
Standard Duty	Heavy Duty	
1.5	1.5	Surface Course
2.0	6	Binder Course
8.0	12	Base

Table 15: Asphalt Pavement Recommendations

11.0 SUBGRADE REHABILITATION

Subgrade soils often become disturbed during the period between initial site grading and construction of surface improvements. The amount and depth of disturbance will vary with soil type, weather conditions, construction traffic, and drainage.

The engineer should evaluate subgrade soils during final grading to verify the subgrade is suitable to receive pavement and/or concrete slab base materials. The final evaluation may include proofrolling or density tests.

Subgrade rehabilitation can become a point of controversy when different contractors are responsible for site grading and building construction. The construction documents should specifically state which contractor will be responsible for maintaining and rehabilitating the subgrade. Rehabilitation may include moisture conditioning and re-compacting soils. When deadlines or weather restrict grading operations, additional measures such as undercutting and replacing saturated soils or chemical stabilization can often be utilized.

12.0 CONSTRUCTION MONITORING

Field verification of site conditions is an essential part of the services provided by the geotechnical consultant. To confirm our recommendations, it will be necessary for Building & Earth personnel to make periodic visits to the site during site grading. Typical construction monitoring services are listed below.

- During stripping and clearing to confirm subgrade conditions adequate for fill placement.
- During mass excavation to confirm soil types in-situ and soil types selected for embankment construction.
- Earthworks embankment construction.
- During retaining wall construction and backfill operations.
- During foundation installation.
- To address all special inspection requirements appearing in applicable building codes.

13.0 CLOSING AND LIMITATIONS

This report was prepared for Johnson County Public Schools, for specific application to the additions planned for Cooper Academy located in Clayton, North Carolina. The information in this report is not transferable. This report should not be used for a different development on the same property without first being evaluated by the engineer.

The recommendations in this report were based on the information obtained from our field exploration and laboratory analysis. The data collected is representative of the locations tested. Variations are likely to occur at other locations throughout the site. Engineering judgment was applied in regards to conditions between borings. It will be necessary to confirm the anticipated subsurface conditions during construction.

This report has been prepared in accordance with generally accepted standards of geotechnical engineering practice. No other warranty is expressed or implied. In the event that changes are made, or anticipated to be made, to the nature, design, or location of the project as outlined in this report, Building & Earth must be informed of the changes and given the opportunity to either verify or modify the conclusions of this report in writing, or the recommendations of this report will no longer be valid.

The scope of services for this project did not include any environmental assessment of the site or identification of pollutants or hazardous materials or conditions. If the owner is concerned about environmental issues Building & Earth would be happy to provide an additional scope of services to address those concerns.

This report is intended for use during design and preparation of specifications and may not address all conditions at the site during construction. Contractors reviewing this information should acknowledge that this document is for design information only.

An article published by the Geoprofessional Business Association (GBA), titled *Important Information About Your Geotechnical Report*, has been included in the Appendix. We encourage all individuals to become familiar with the article to help manage risk.

Appendix Table of Contents

- GEOTECHNICAL INVESTIGATION METHODOLOGIES 1
 - DRILLING PROCEDURES – STANDARD PENETRATION TEST (ASTM D1586) 1
 - HAND AUGER BORINGS AND DYNAMIC CONE PENETRATION TESTING..... 1
 - BULK SAMPLING2
 - UNDISTURBED SAMPLING2
- BORING LOG DESCRIPTION 2
 - DEPTH AND ELEVATION2
 - SAMPLE TYPE.....2
 - SAMPLE NUMBER.....2
 - BLOWS PER INCREMENT, REC%, RQD%2
 - SOIL DATA3
 - SOIL DESCRIPTION3
 - GRAPHIC3
 - REMARKS3
- SOIL CLASSIFICATION METHODOLOGY..... 4
- KEY TO LOGS..... 6
- KEY TO HATCHES 8
- BORING LOCATION PLAN 9
- SUBSURFACE SOIL PROFILES..... 10
- BORING LOGS..... 11
- SEISMIC SITE CLASS 12
- LABORATORY TEST PROCEDURES..... 13
 - DESCRIPTION OF SOILS (VISUAL-MANUAL PROCEDURE) (ASTM D2488) 13
 - POCKET PENETROMETER..... 13
 - NATURAL MOISTURE CONTENT (ASTM D2216) 13
 - ATTERBERG LIMITS (ASTM D4318)..... 13
 - GRAIN-SIZE DISTRIBUTION (ASTM D6913)..... 13
 - STANDARD PROCTOR COMPACTION TEST (ASTM D698)..... 13
 - LABORATORY CALIFORNIA BEARING RATIO (ASTM D1883) 14
 - TRIAXIAL SHEAR TEST (CONSOLIATED-UNDRAINED) (ASTM D4767) 14

LABORATORY TEST RESULTS.....	15
Table A-1: General Soil Classification Test Results.....	15
IMPORTANT INFORMATION ABOUT THIS GEOTECHNICAL-ENGINEERING REPORT	16

GEOTECHNICAL INVESTIGATION METHODOLOGIES

The subsurface exploration, which is the basis of the recommendations of this report, has been performed in accordance with industry standards. Detailed methodologies employed in the investigation are presented in the following sections.

DRILLING PROCEDURES – STANDARD PENETRATION TEST (ASTM D1586)

At each boring location, soil samples were obtained at standard sampling intervals with a split-spoon sampler. The borehole was first advanced to the sample depth by augering and the sampling tools were placed in the open hole. The sampler was then driven 18 inches into the ground with a 140-pound manual hammer free-falling 30 inches. The number of blows required to drive the sampler each 6-inch increment was recorded. The initial increment is considered the “seating” blows, where the sampler penetrates loose or disturbed soil in the bottom of the borehole.

The blows required to penetrate the final two (2) increments are added together and are referred to as the Standard Penetration Test (SPT) N-value. The N-value, when properly evaluated, gives an indication of the soil’s strength and ability to support structural loads. Many factors can affect the SPT N-value, so this result cannot be used exclusively to evaluate soil conditions.

The SPT testing was performed using a drill rig equipped with a manual hammer. Manual hammers are dropped using a manually operated rope and cathead system. The N-values discussed or mentioned in this report and shown on the boring logs are recorded field values.

Samples retrieved from the boring locations were labeled and stored in plastic bags at the jobsite before being transported to our laboratory for analysis. The project engineer prepared Boring Logs summarizing the subsurface conditions at the boring locations.

HAND AUGER BORINGS AND DYNAMIC CONE PENETRATION TESTING

Hand auger borings were drilled with a 3-inch diameter auger to advance the hole below the existing grade. A Building & Earth representative collected samples of the subsurface soils at regular depth intervals and at depths where a change in lithology occurred.

Dynamic Cone Penetration (DCP) testing was performed in the hand auger borings to evaluate the consistency of the subgrade soils. The DCP apparatus consists of a steel, cylindrical shaft with a conical tip at the end. The conical tip measures 1.5-inches in diameter, with a 45° tip angle. A 15-pound sliding ring weight is mounted to the shaft. When dropped from a height of 20 inches, the ring weight strikes a steel anvil, driving the point into the soil. After seating the point into the soil 2 inches, the weight is dropped until the shaft travels an interval of 1.75 inches. The number of blows necessary to drive the tip each 1.75-inch increment is recorded. Given the material type and certain soil properties, this number can then be correlated to the Standard Penetration Test (ASTM D1586) N-

values. The DCP test results are shown under the "Remarks" column on the boring logs.

BULK SAMPLING

Bulk sample are obtained for the evaluation of the compaction characteristics of the site soils and for determination of the California Bearing Ratio (CBR). The bulk samples are obtained from manual excavations, backhoe test pits, or from auger cutting. Similar soils are normally combined to provide samples of adequate size for compaction or CBR testing.

UNDISTURBED SAMPLING

Soil samples are obtained using Shelby tube samplers. The Shelby tube is a three (3) inch diameter, thin walled sampling tube that allows for relatively undisturbed sampling of soil. The undisturbed or thin-walled tube sampling is conducted in general accordance with ASTM D1587.

The sampling procedure consists of augering to the sample depth, then cleaning out the open borehole and continuously pushing the thin-walled, metal Shelby tube into the soil. The Shelby tubes are carefully withdrawn from the borehole to reduce the possibility of disturbing the sample. The ends of the Shelby tube are sealed in the field and the tubes are transported to the laboratory for testing.

BORING LOG DESCRIPTION

Building & Earth Sciences, Inc. used the gINT software program to prepare the attached boring logs. The gINT program provides the flexibility to custom design the boring logs to include the pertinent information from the subsurface exploration and results of our laboratory analysis. The soil and laboratory information included on our logs is summarized below:

DEPTH AND ELEVATION

The depth below the ground surface and the corresponding elevation are shown in the first two columns.

SAMPLE TYPE

The method used to collect the sample is shown. The typical sampling methods include Split Spoon Sampling, Shelby Tube Sampling, Grab Samples, and Rock Core. A key is provided at the bottom of the log showing the graphic symbol for each sample type.

SAMPLE NUMBER

Each sample collected is numbered sequentially.

BLOWS PER INCREMENT, REC%, RQD%

When Standard Split Spoon sampling is used, the blows required to drive the sampler each 6-inch increment are recorded and shown in column 5. When rock core is obtained the recovery ration (REC%) and Rock Quality Designation (RQD%) is recorded.

SOIL DATA

Column 6 is a graphic representation of four different soil parameters. Each of the parameters use the same graph, however, the values of the graph subdivisions vary with each parameter. Each parameter presented on column 6 is summarized below:

- **N-value**- The Standard Penetration Test N-value, obtained by adding the number of blows required to drive the sampler the final 12 inches, is recorded . The graph labels range from 0 to 50.
- **Qu** – Unconfined Compressive Strength estimate from the Pocket Penetrometer test in tons per square foot (tsf). The graph labels range from 0 to 5 tsf.
- **Atterberg Limits** – The Atterberg Limits are plotted with the plastic limit to the left, and liquid limit to the right, connected by a horizontal line. The difference in the plastic and liquid limits is referred to as the Plasticity Index. The Atterberg Limits test results are also included in the Remarks column on the far right of the boring log. The Atterberg Limits graph labels range from 0 to 100%.
- **Moisture** – The Natural Moisture Content of the soil sample as determined in our laboratory.

SOIL DESCRIPTION

The soil description prepared in accordance with ASTM D2488, Visual Description of Soil Samples. The Munsel Color chart is used to determine the soil color. Strata changes are indicated by a solid line, with the depth of the change indicated on the left side of the line and the elevation of the change indicated on the right side of the line. If subtle changes within a soil type occur, a broken line is used. The Boring Termination or Auger Refusal depth is shown as a solid line at the bottom of the boring.

GRAPHIC

The graphic representation of the soil type is shown. The graphic used for each soil type is related to the Unified Soil Classification chart. A chart showing the graphic associated with each soil classification is included.

REMARKS

Remarks regarding borehole observations, and additional information regarding the laboratory results and groundwater observations.




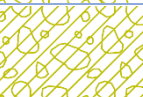

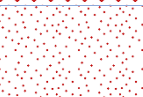
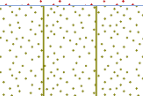
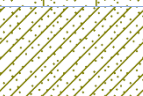

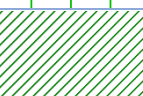
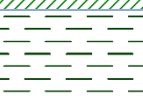

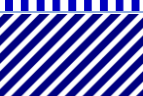

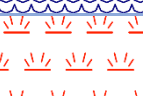
Major Divisions			Symbols		Group Name & Typical Description
			Lithology	Group	
<p>Coarse Grained Soils</p> <p>More than 50% of material is larger than No. 200 sieve size</p>	<p>Gravel and Gravelly Soils</p> <p>More than 50% of coarse fraction is larger than No. 4 sieve</p>	<p>Clean Gravels</p> <p>(Less than 5% fines)</p>		GW	Well-graded gravels, gravel – sand mixtures, little or no fines
				GP	Poorly-graded gravels, gravel – sand mixtures, little or no fines
		<p>Gravels with Fines</p> <p>(More than 12% fines)</p>		GM	Silty gravels, gravel – sand – silt mixtures
				GC	Clayey gravels, gravel – sand – clay mixtures
	<p>Sand and Sandy Soils</p> <p>More than 50% of coarse fraction is smaller than No. 4 sieve</p>	<p>Clean Sands</p> <p>(Less than 5% fines)</p>		SW	Well-graded sands, gravelly sands, little or no fines
					SP
		<p>Sands with Fines</p> <p>(More than 12% fines)</p>		SM	Silty sands, sand – silt mixtures
				SC	Clayey sands, sand – clay mixtures
<p>Fine Grained Soils</p> <p>More than 50% of material is smaller than No. 200 sieve size</p>	<p>Silts and Clays</p> <p>Liquid Limit less than 50</p>	<p>Inorganic</p>		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silt with slight plasticity
				CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		Organic		OL	Organic silts and organic silty clays of low plasticity
	<p>Silts and Clays</p> <p>Liquid Limit greater than 50</p>	<p>Inorganic</p>		MH	Inorganic silts, micaceous or diatomaceous fine sand, or silty soils
				CH	Inorganic clays of high plasticity
		Organic		OH	Organic clays of medium to high plasticity, organic silts
<p>Highly Organic Soils</p>				PT	Peat, humus, swamp soils with high organic contents

Table 1: Soil Classification Chart (based on ASTM D2487)

Building & Earth Sciences classifies soil in general accordance with the Unified Soil Classification System (USCS) presented in ASTM D2487. Table 1 and Figure 1 exemplify the general guidance of the USCS. Soil consistencies and relative densities are presented in general accordance with Terzaghi, Peck, & Mesri's (1996) method, as shown on Table 2, when quantitative field and/or laboratory data is available. Table 2 includes Consistency and Relative Density correlations with N-values obtained using either a manual hammer (60 percent efficiency) or automatic hammer (90 percent efficiency). The *Blows Per Increment* and *SPT N-values* displayed on the boring logs are the unaltered values measured in the field. When field and/or laboratory data is not available, we may classify soil in general accordance with the Visual Manual Procedure presented in ASTM D2488.

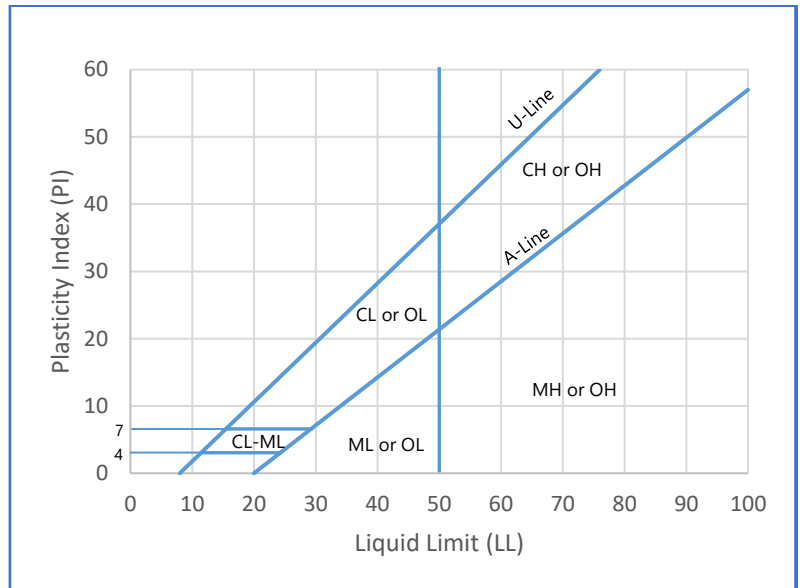


Figure 1: Plasticity Chart (based on ASTM D2487)

Non-cohesive: Coarse-Grained Soil		Cohesive: Fine-Grained Soil				
SPT Penetration (blows/foot)		Relative Density	SPT Penetration (blows/foot)		Consistency	Estimated Range of Unconfined Compressive Strength (tsf)
			Automatic Hammer*	Manual Hammer		
Automatic Hammer*	Manual Hammer		< 2	< 2	Very Soft	< 0.25
0 - 3	0 - 4	Very Loose	2 - 3	2 - 4	Soft	0.25 – 0.50
3 - 8	4 - 10	Loose	3 - 6	4 - 8	Medium Stiff	0.50 – 1.00
8 - 23	10 - 30	Medium Dense	6 - 12	8 - 15	Stiff	1.00 – 2.00
23 - 38	30 - 50	Dense	12 - 23	15 - 30	Very Stiff	2.00 – 4.00
> 38	> 50	Very Dense	> 23	> 30	Hard	> 4.00

Table 2: Soil Consistency and Relative Density (based on Terzaghi, Peck & Mesri, 1996)

* - Modified based on 80% hammer efficiency

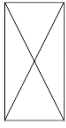
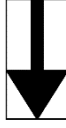

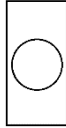




	Standard Penetration Test ASTM D1586 or AASHTO T-206		Dynamic Cone Penetrometer (Sower DCP) ASTM STP-399
	Shelby Tube Sampler ASTM D1587		No Sample Recovery
	Rock Core Sample ASTM D2113		Groundwater at Time of Drilling
	Auger Cuttings		Groundwater as Indicated

Table 1: Symbol Legend

Soil	Particle Size	U.S. Standard
Boulders	Larger than 300 mm	N.A.
Cobbles	300 mm to 75 mm	N.A.
Gravel	75 mm to 4.75 mm	3-inch to #4 sieve
Coarse	75 mm to 19 mm	3-inch to ¾-inch sieve
Fine	19 mm to 4.75 mm	¾-inch to #4 sieve
Sand	4.75 mm to 0.075 mm	#4 to #200 Sieve
Coarse	4.75 mm to 2 mm	#4 to #10 Sieve
Medium	2 mm to 0.425 mm	#10 to #40 Sieve
Fine	0.425 mm to 0.075 mm	#40 to #200 Sieve
Fines	Less than 0.075 mm	Passing #200 Sieve
Silt	Less than 5 µm	N.A.
Clay	Less than 2 µm	N.A.

Table 2: Standard Sieve Sizes





N-Value 	Standard Penetration Test Resistance calculated using ASTM D1586 or AASHTO T-206. Calculated as sum of original, field recorded values.	Atterberg Limits 	A measure of a soil's plasticity characteristics in general accordance with ASTM D4318. The soil Plasticity Index (PI) is representative of this characteristic and is bracketed by the Liquid Limit (LL) and the Plastic Limit (PL).
Qu 	Unconfined compressive strength, typically estimated from a pocket penetrometer. Results are presented in tons per square foot (tsf).	% Moisture 	Percent natural moisture content in general accordance with ASTM D2216.

Table 3: Soil Data

Hollow Stem Auger	Flights on the outside of the shaft advance soil cuttings to the surface. The hollow stem allows sampling through the middle of the auger flights.
Mud Rotary / Wash Bore	A cutting head advances the boring and discharges a drilling fluid to support the borehole and circulate cuttings to the surface.
Solid Flight Auger	Flights on the outside bring soil cuttings to the surface. Solid stem requires removal from borehole during sampling.
Hand Auger	Cylindrical bucket (typically 3-inch diameter and 8 inches long) attached to a metal rod and turned by human force.

Table 4: Soil Drilling Methods

Descriptor	Meaning
Trace	Likely less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

Table 5: Descriptors

Manual Hammer	The operator tightens and loosens the rope around a rotating drum assembly to lift and drop a sliding, 140-pound hammer falling 30 inches.
Automatic Trip Hammer	An automatic mechanism is used to lift and drop a sliding, 140-pound hammer falling 30 inches.
Dynamic Cone Penetrometer (Sower DCP) ASTM STP-399	Uses a 15-pound steel mass falling 20 inches to strike an anvil and cause penetration of a 1.5-inch diameter cone seated in the bottom of a hand augered borehole. The blows required to drive the embedded cone a depth of 1-3/4 inches have been correlated by others to N-values derived from the Standard Penetration Test (SPT).

Table 6: Sampling Methods

Non-plastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be re-rolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be re-rolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

Table 7: Plasticity

Dry	Absence of moisture, dusty, dry to the touch.
Moist	Damp but no visible water.
Wet	Visible free water, usually soil is below water table.

Table 8: Moisture Condition

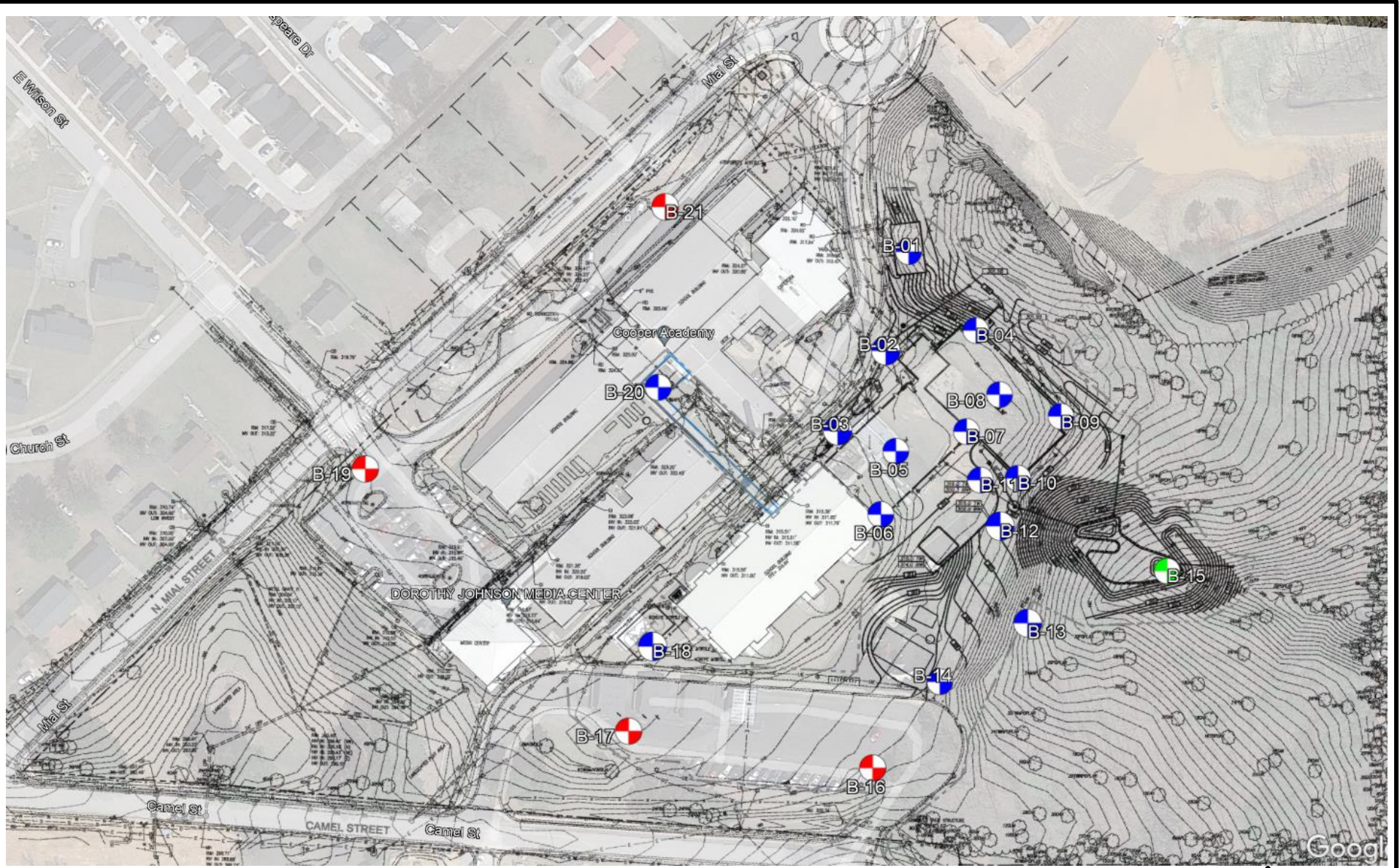
Stratified	Alternating layers of varying material or color with layers at least 1/2 inch thick.
Laminated	Alternating layers of varying material or color with layers less than 1/4 inch thick.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing.
Slickensides	Fracture planes appear polished or glossy, sometimes striated.
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown.
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay.
Homogeneous	Same color and appearance throughout.

Table 9: Structure

Hatch	Description	Hatch	Description	Hatch	Description
	GW - Well-graded gravels, gravel – sand mixtures, little or no fines		Asphalt		Clay with Gravel
	GP - Poorly-graded gravels, gravel – sand mixtures, little or no fines		Aggregate Base		Sand with Gravel
	GM - Silty gravels, gravel – sand – silt mixtures		Topsoil		Silt with Gravel
	GC - Clayey gravels, gravel – sand – clay mixtures		Concrete		Gravel with Sand
	SW - Well-graded sands, gravelly sands, little or no fines		Coal		Gravel with Clay
	SP - Poorly-graded sands, gravelly sands, little or no fines		CL-ML - Silty Clay		Gravel with Silt
	SM - Silty sands, sand – silt mixtures		Sandy Clay		Limestone
	SC - Clayey sands, sand – clay mixtures		Clayey Chert		Chalk
	ML - Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silt with slight plasticity		Low and High Plasticity Clay		Siltstone
	CL - Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays		Low Plasticity Silt and Clay		Till
	OL - Organic silts and organic silty clays of low plasticity		High Plasticity Silt and Clay		Sandy Clay with Cobbles and Boulders
	MH - Inorganic silts, micaceous or diatomaceous fine sand, or silty soils		Fill		Sandstone with Shale
	CH - Inorganic clays of high plasticity		Weathered Rock		Coral
	OH - Organic clays of medium to high plasticity, organic silts		Sandstone		Boulders and Cobbles
	PT - Peat, humus, swamp soils with high organic contents		Shale		Soil and Weathered Rock

Table 1: Key to Hatches Used for Boring Logs and Soil Profiles

BORING LOCATION PLAN




 Building Boring Location

 Pavement Boring Location

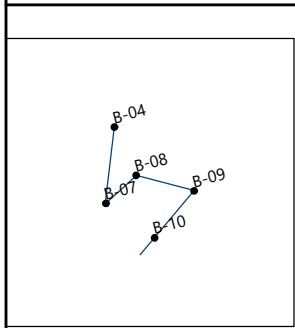
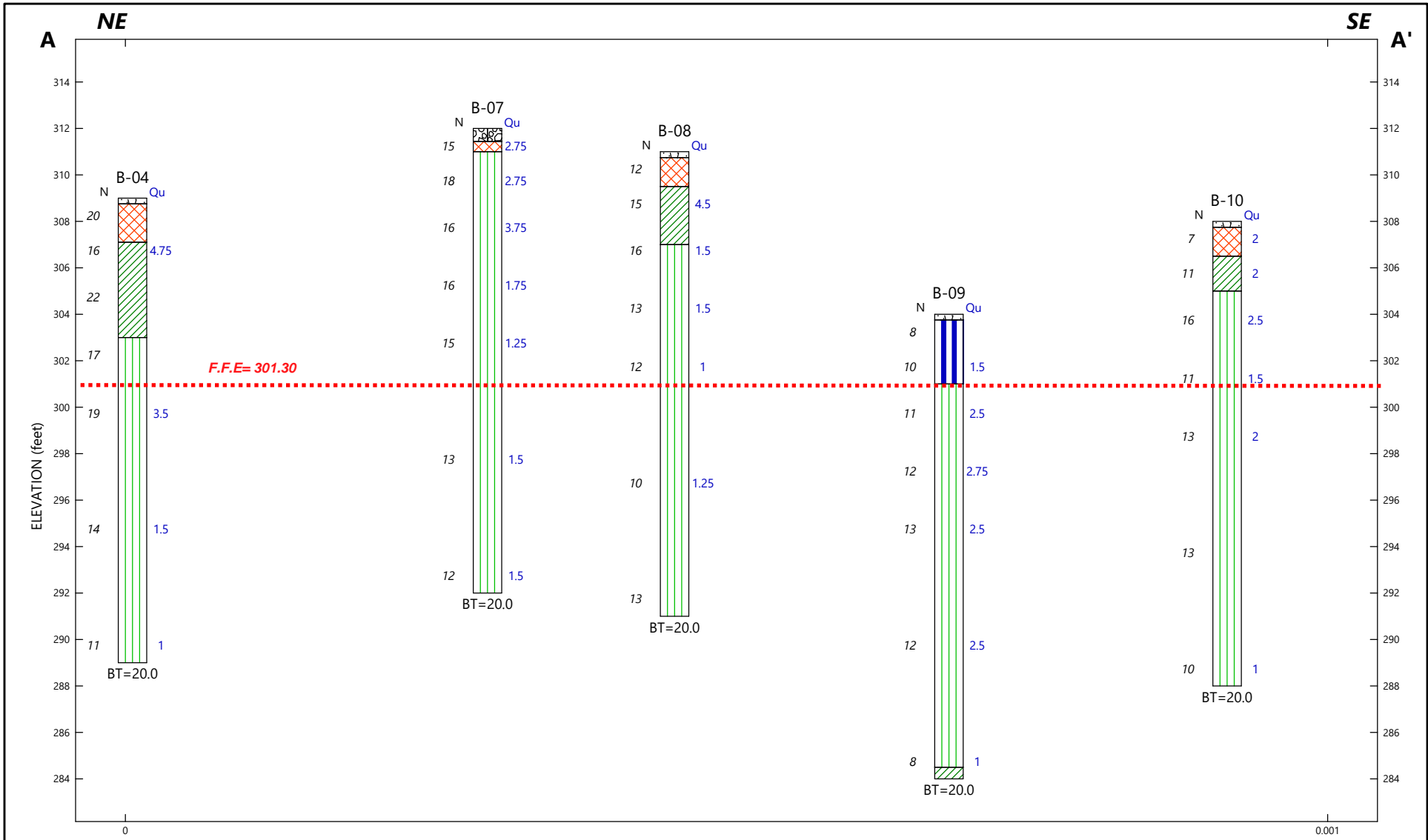
 Infiltration Boring Location



Boring Location Map

	BES Project #:	RD230492	Address:	849 N Mial St
	Drawing Source:	Boomerang Design (10/4/2023), Google Earth	City:	Clayton, NC
	Client:	Johnston County Public Schools	<h1>Figure 1</h1>	
	Project:	Cooper Academy Addition		

SUBSURFACE SOIL PROFILES



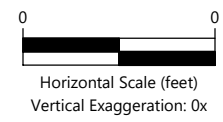
Site Map Scale 1 inch equals 0 feet

Key to Hatches

- Topsoil
- USCS Silt
- Fill
- Aggregate Base Material
- USCS Low Plasticity Clay
- USCS Elastic Silt

Legend

- BT=Boring Termination, TPT=Test Pit Terminated
- AR=Auger Refusal, ER=Excavation Refusal
- N=Standard Penetration Test N-Value
- Qu=Unconfined compressive strength estimate from pocket penetrometer test (tsf)
- ∇ Water Level Reading at time of drilling.
- ▼ Water Level Reading after drilling.



Building & Earth Sciences, Inc.

610 Spring Branch Road, Dunn, NC 28334

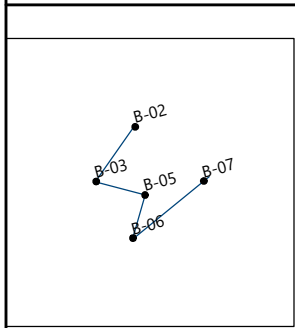
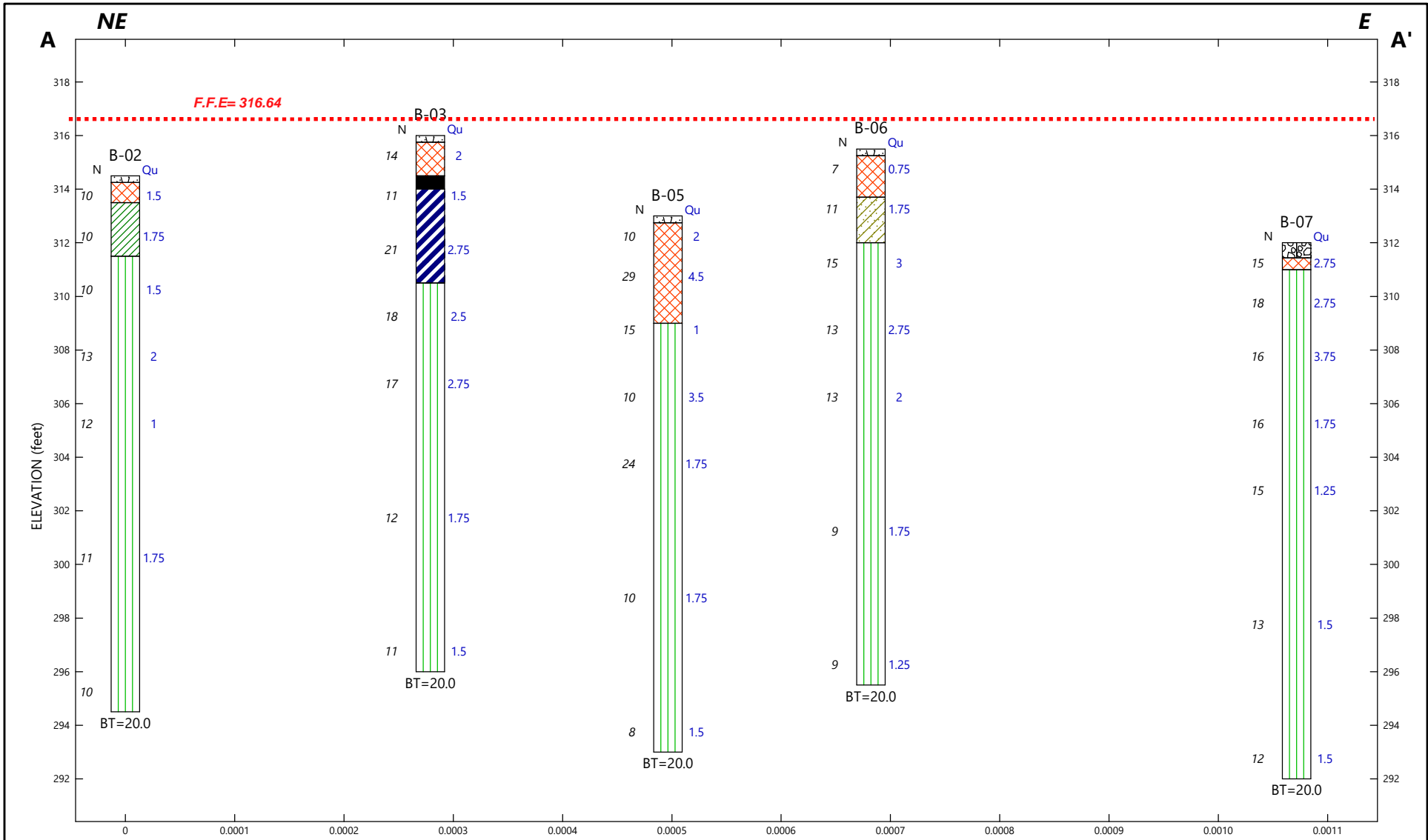
Cooper Academy Addition
Clayton, NC

Subsurface Profile 1

PROJECT NO: RD230492	PLATE NO: A-1	DATE: 11/16/23
----------------------	---------------	----------------



Geotechnical, Environmental, and Materials Engineers



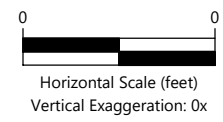
Site Map Scale 1 inch equals 0 feet

Key to Hatches

- Topsoil
- USCS Silt
- USCS Clayey Sand
- Fill
- Asphalt
- Aggregate Base Material
- USCS Low Plasticity Clay
- USCS High Plasticity Clay

Legend

- BT=Boring Termination, TPT=Test Pit Terminated
- AR=Auger Refusal, ER=Excavation Refusal
- N=Standard Penetration Test N-Value
- Qu=Unconfined compressive strength estimate from pocket penetrometer test (tsf)
- Water Level Reading at time of drilling.
- Water Level Reading after drilling.



Building & Earth Sciences, Inc.

610 Spring Branch Road, Dunn, NC 28334

Cooper Academy Addition
Clayton, NC

Subsurface Profile 2

PROJECT NO: RD230492 | PLATE NO: A-1 | DATE: 11/16/23



Geotechnical, Environmental, and Materials Engineers

BORING LOGS

PROJECT NAME: Cooper Academy Addition
 PROJECT NUMBER: RD230492
 DRILLING METHOD: Hollow Stem Auger
 EQUIPMENT USED: Diedrich D25
 HAMMER TYPE: Automatic
 BORING LOCATION: Equipment Pad

LOCATION: Clayton, NC
 DATE DRILLED: 10/11/23
 WEATHER: Clear, 60s
 ELEVATION: 307
 DRILL CREW: DR50
 LOGGED BY: G.Gonzalez

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	LAB DATA		SOIL DESCRIPTION	GRAPHIC	REMARKS
					□ N-Value □ 10 20 30 40	▲ Qu (tsf) ▲ 1 2 3 4			
0.3	306.8						TOPSOIL: approx. 3 inches		
1.9	305.1	S-1		3			CLAYEY SAND (SC): loose, brown, fine to medium grained, moist, existing fill; with fine gravel		
3.3		S-2		4			SANDY LEAN CLAY (CL): very stiff, reddish yellow, fine to medium grained, moist, with fine gravel wet stiff		
4.7		S-3		6					
6.5	300.5	S-4		10			SANDY SILT (ML): very stiff, red, tan, fine to medium grained, moist, with fine gravel		
7.9		S-5		3			light brown, red streaks		
9.3		S-6		4					
14.7	290			7					Boring cave-in at 14 feet
16.1				6					
17.5				7					Groundwater encountered at 18.6 feet (EL 288.4) at time of drilling and stabilized at 17.4 feet (EL 289.6).
18.9				6					
20.3	287.0	S-7		4					
21.7				6					
23.1				7					
20.0							Boring Terminated at 20 feet.		

Sample S-6
 LL: 36
 PL: 30
 PI: 6
 M: 30.1%
 F: 61%

SAMPLE TYPE Split Spoon

LL: LIQUID LIMIT M: NATURAL MOISTURE CONTENT
 PL: PLASTIC LIMIT F: PERCENT PASSING NO. 200 SIEVE
 PI: PLASTICITY INDEX

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

PROJECT NAME: Cooper Academy Addition
PROJECT NUMBER: RD230492
DRILLING METHOD: Hollow Stem Auger
EQUIPMENT USED: Diedrich D25
HAMMER TYPE: Automatic
BORING LOCATION: Retaining wall

LOCATION: Clayton, NC
DATE DRILLED: 10/12/23
WEATHER: Rainy, 60s
ELEVATION: 314.5
DRILL CREW: DR50
LOGGED BY: G.Gonzalez

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	LAB DATA				SOIL DESCRIPTION	GRAPHIC	REMARKS
					□ N-Value □	▲ Qu (tsf) ▲	Atterberg Limits				
					10 20 30 40	1 2 3 4	20 40 60 80	20 40 60 80			
0.3	314.3							TOPSOIL: approx. 3 inches			
1.0	313.5							CLAYEY SAND (SC): medium dense, brown, fine to medium grained, dry, existing fill; with fine gravel			
3.0	311.5							SANDY LEAN CLAY (CL): stiff, reddish yellow, fine to medium grained, moist			
5	310	S-1	S-2	S-3				SANDY SILT (ML): stiff, reddish yellow, fine to medium grained, moist			
								very stiff			
10	305	S-4	S-5					tan			
15	300	S-6						stiff			
20	295	S-7						Boring Terminated at 20 feet.		Boring cave-in at 19.6 feet	
	290									Borehole backfilled on date drilled unless otherwise noted. Consistency/Relative Density based on correction factor for Automatic hammer.	

Sample S-3
LL: 38
PL: 30
PI: 8
M: 22.6%
F: 61.1%

SAMPLE TYPE Split Spoon

LL: LIQUID LIMIT M: NATURAL MOISTURE CONTENT
PL: PLASTIC LIMIT F: PERCENT PASSING NO. 200 SIEVE
PI: PLASTICITY INDEX

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGT

PROJECT NAME: Cooper Academy Addition
PROJECT NUMBER: RD230492
DRILLING METHOD: Solid Flight Auger
EQUIPMENT USED: Diedrich D25
HAMMER TYPE: Automatic
BORING LOCATION: Building corner

LOCATION: Clayton, NC
DATE DRILLED: 10/12/23
WEATHER: Rainy, 60s
ELEVATION: 316
DRILL CREW: DR50
LOGGED BY: G.Gonzalez

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	LAB DATA				SOIL DESCRIPTION	GRAPHIC	REMARKS
					□ N-Value □	▲ Qu (tsf) ▲	Atterberg Limits				
					10	20	30	40			
					1	2	3	4			
					20	40	60	80			
					20	40	60	80			
315	315.8	S-1		5					0.3	TOPSOIL: approx. 3 inches	
	314.5	S-2		5					1.5	CLAYEY SAND (SC): medium dense, brown, fine to medium grained, moist, existing fill	
	314.0			6					2.0	ASPHALT	
5		S-3		4						SANDY FAT CLAY (CH): very stiff, brown, tan, fine to medium grained, moist, 2" seam of asphalt @ 3.5 feet	
				8							
				13							
310		S-4		5					5.5	SANDY SILT (ML): very stiff, reddish yellow, fine to medium grained, moist	
				7							
				11							
10		S-5		5						tan	
				7							
				10							
305											
15		S-6		3							
				5							
				7							
300											
20		S-7		4						stiff	Boring cave in at 18.4 feet
				4							
				7					20.0	Boring Terminated at 20 feet.	
295									296.0		Borehole backfilled on date drilled unless otherwise noted. Consistency/Relative Density based on correction factor for Automatic hammer.

SAMPLE TYPE Split Spoon

LL: LIQUID LIMIT M: NATURAL MOISTURE CONTENT
PL: PLASTIC LIMIT F: PERCENT PASSING NO. 200 SIEVE
PI: PLASTICITY INDEX

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

PROJECT NAME: Cooper Academy Addition
 PROJECT NUMBER: RD230492
 DRILLING METHOD: Hollow Stem Auger
 EQUIPMENT USED: Diedrich D25
 HAMMER TYPE: Automatic
 BORING LOCATION: Building corner

LOCATION: Clayton, NC
 DATE DRILLED: 10/11/23
 WEATHER: Clear, 60s
 ELEVATION: 315.5
 DRILL CREW: DR50
 LOGGED BY: G.Gonzalez

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	LAB DATA				SOIL DESCRIPTION	GRAPHIC	REMARKS
					□ N-Value □	▲ Qu (tsf) ▲	Atterberg Limits				
					10 20 30 40	1 2 3 4	20 40 60 80	20 40 60 80			
315		S-1		2					0.3	TOPSOIL: approx. 3 inches	315.3
		S-2		2					1.8	CLAYEY SAND (SC): loose, brown, fine to medium grained, moist, existing fill	313.7
		S-3		4					3.5	CLAYEY SAND (SC): medium dense, yellowish brown, fine to medium grained, moist	312.0
5		S-4		3						SANDY SILT (ML): very stiff, reddish yellow, fine to medium grained, moist	
10		S-5		3						tan	
15		S-6		3						stiff	
20		S-7		4					20.0	Boring Terminated at 20 feet.	295.5
											Boring cave in at 15.4 feet
											Borehole backfilled on date drilled unless otherwise noted. Consistency/Relative Density based on correction factor for Automatic hammer.

SAMPLE TYPE Split Spoon

LL: LIQUID LIMIT M: NATURAL MOISTURE CONTENT
 PL: PLASTIC LIMIT F: PERCENT PASSING NO. 200 SIEVE
 PI: PLASTICITY INDEX

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGT

PROJECT NAME: Cooper Academy Addition
 PROJECT NUMBER: RD230492
 DRILLING METHOD: Solid Flight Auger
 EQUIPMENT USED: Diedrich D25
 HAMMER TYPE: Automatic
 BORING LOCATION: Retaining wall

LOCATION: Clayton, NC
 DATE DRILLED: 10/13/23
 WEATHER: Clear, 70s
 ELEVATION: 312
 DRILL CREW: DR50
 LOGGED BY: G.Gonzalez

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	LAB DATA				SOIL DESCRIPTION	GRAPHIC	REMARKS	
					□ N-Value □	▲ Qu (tsf) ▲	Atterberg Limits					● % Moisture ●
					10 20 30 40	1 2 3 4	20 40 60 80	20 40 60 80				
310	310	S-1	4	6					0.6	AGGREGATE BASE	311.4	Pavement: approx. 6.75 inches of ABC
		S-2	3	8	●	▲	PL: 37	●	1.0	CLAYEY SAND (SC): medium dense, reddish brown, fine to medium grained, moist, existing fill; with fine gravel	311.0	
5		S-3	4	7						SANDY SILT (ML): very stiff, reddish yellow, fine to medium grained, moist, with fine gravel		
305		S-4	4	7						reddish gray		
10		S-5	4	6								
300		S-6	4	6								
15		S-7	4	5								
20									20.0	Boring Terminated at 20 feet.	292.0	Boring cave in at 19.5 feet
290												Borehole backfilled on date drilled unless otherwise noted. Consistency/Relative Density based on correction factor for Automatic hammer.

SAMPLE TYPE Split Spoon

LL: LIQUID LIMIT M: NATURAL MOISTURE CONTENT
 PL: PLASTIC LIMIT F: PERCENT PASSING NO. 200 SIEVE
 PI: PLASTICITY INDEX

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

PROJECT NAME: Cooper Academy Addition
PROJECT NUMBER: RD230492
DRILLING METHOD: Solid Flight Auger
EQUIPMENT USED: Diedrich D25
HAMMER TYPE: Automatic
BORING LOCATION: Center of building

LOCATION: Clayton, NC
DATE DRILLED: 10/12/23
WEATHER: Rainy, 60s
ELEVATION: 311
DRILL CREW: DR50
LOGGED BY: G.Gonzalez

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	LAB DATA				SOIL DESCRIPTION	GRAPHIC	REMARKS
					□ N-Value □	▲ Qu (tsf) ▲	Atterberg Limits				
					10 20 30 40	1 2 3 4	20 40 60 80	20 40 60 80			
310	310.8	S-1		5					0.3	TOPSOIL: approx. 3 inches	
305	309.5	S-2		6					1.5	CLAYEY SAND (SC): medium dense, light brown, fine to medium grained, moist, existing fill; with fine gravel	
300	307.0	S-3		4					4.0	SANDY LEAN CLAY (CL): very stiff, reddish yellow, fine to medium grained, moist	
295		S-4		4						SANDY SILT (ML): very stiff, reddish yellow, fine to medium grained, moist	
290		S-5		4						red	
285		S-6		3						stiff	
280		S-7		3						very stiff, brownish yellow, with fine gravel	
275									20.0	Boring Terminated at 20 feet.	

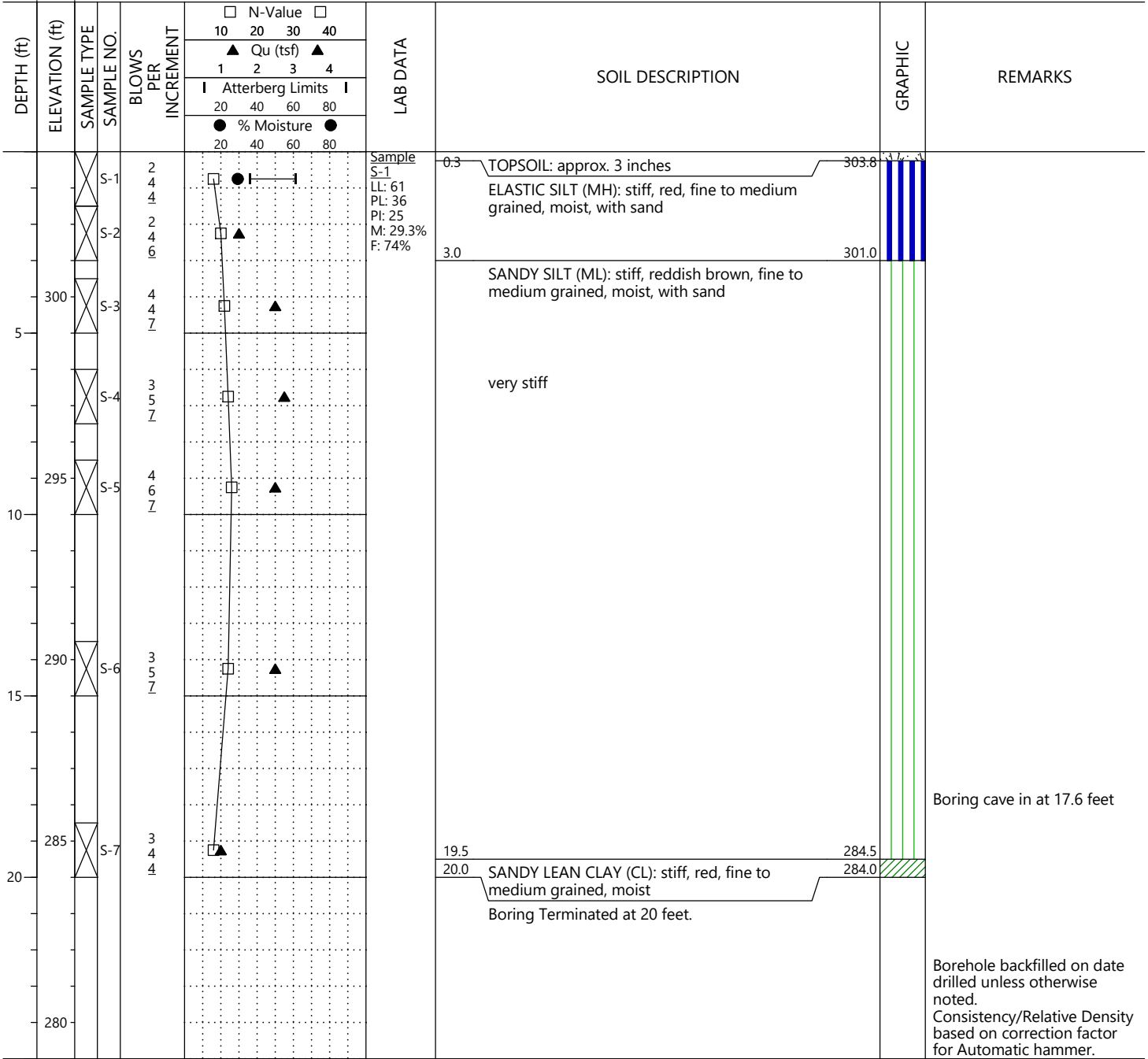
SAMPLE TYPE Split Spoon

LL: LIQUID LIMIT M: NATURAL MOISTURE CONTENT
PL: PLASTIC LIMIT F: PERCENT PASSING NO. 200 SIEVE
PI: PLASTICITY INDEX

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

PROJECT NAME: Cooper Academy Addition
 PROJECT NUMBER: RD230492
 DRILLING METHOD: Solid Flight Auger
 EQUIPMENT USED: Diedrich D25
 HAMMER TYPE: Automatic
 BORING LOCATION: Building corner

LOCATION: Clayton, NC
 DATE DRILLED: 10/16/23
 WEATHER: Clear, 60s
 ELEVATION: 304
 DRILL CREW: DR50
 LOGGED BY: G.Gonzalez



SAMPLE TYPE Split Spoon

LL: LIQUID LIMIT M: NATURAL MOISTURE CONTENT
 PL: PLASTIC LIMIT F: PERCENT PASSING NO. 200 SIEVE
 PI: PLASTICITY INDEX

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGT

PROJECT NAME: Cooper Academy Addition
PROJECT NUMBER: RD230492
DRILLING METHOD: Solid Flight Auger
EQUIPMENT USED: Diedrich D25
HAMMER TYPE: Automatic
BORING LOCATION: Building corner

LOCATION: Clayton, NC
DATE DRILLED: 10/16/23
WEATHER: Clear, 60s
ELEVATION: 308
DRILL CREW: DR50
LOGGED BY: G.Gonzalez

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	LAB DATA				SOIL DESCRIPTION	GRAPHIC	REMARKS
					□ N-Value □	▲ Qu (tsf) ▲	Atterberg Limits				
					10 20 30 40	1 2 3 4	20 40 60 80	20 40 60 80			
0.3	307.8										TOPSOIL: approx. 3 inches
1.5	306.5										CLAYEY SAND (SC): loose, dark brown, fine to medium grained, moist
3.0	305.0										SANDY LEAN CLAY (CL): stiff, red, fine to medium grained, moist, with fine gravel
5		S-1	3	3							SANDY SILT (ML): very stiff, reddish yellow, fine to medium grained, moist
		S-2	4	4							stiff
		S-3	4	7							
		S-4	4	5							
		S-5	4	6							
15		S-6	4	6							very stiff, yellow, black streaks
20		S-7	3	4							stiff
20.0	288.0										Boring Terminated at 20 feet.
											Boring cave in at 19.1 feet
											Borehole backfilled on date drilled unless otherwise noted. Consistency/Relative Density based on correction factor for Automatic hammer.

SAMPLE TYPE Split Spoon

LL: LIQUID LIMIT M: NATURAL MOISTURE CONTENT
PL: PLASTIC LIMIT F: PERCENT PASSING NO. 200 SIEVE
PI: PLASTICITY INDEX

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

PROJECT NAME: Cooper Academy Addition
 PROJECT NUMBER: RD230492
 DRILLING METHOD:
 EQUIPMENT USED: Diedrich D25
 HAMMER TYPE: Automatic
 BORING LOCATION: Playground

LOCATION: Clayton, NC
 DATE DRILLED: 10/16/23
 WEATHER: Clear, 60s
 ELEVATION: 310
 DRILL CREW: DR50
 LOGGED BY: G.Gonzalez

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	N-Value				LAB DATA	SOIL DESCRIPTION	GRAPHIC	REMARKS		
					□	10	20	30					40	□
					▲ Qu (tsf) ▲									
					1	2	3	4						
310											Drilling not performed due to located in playground area			
5	305													
10	300													
15	295													
20	290													
285											Borehole backfilled on date drilled unless otherwise noted. Consistency/Relative Density based on correction factor for Automatic hammer.			

SAMPLE TYPE

LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT
PL: PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE
PI: PLASTICITY INDEX

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

PROJECT NAME: Cooper Academy Addition
PROJECT NUMBER: RD230492
DRILLING METHOD: Solid Flight Auger
EQUIPMENT USED: Diedrich D25
HAMMER TYPE: Automatic
BORING LOCATION: Woods

LOCATION: Clayton, NC
DATE DRILLED: 10/16/23
WEATHER: Clear, 60s
ELEVATION: 308
DRILL CREW: DR50
LOGGED BY: G.Gonzalez

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	LAB DATA				SOIL DESCRIPTION	GRAPHIC	REMARKS
					□ N-Value □	▲ Qu (tsf) ▲	Atterberg Limits				
					10 20 30 40	1 2 3 4	20 40 60 80	20 40 60 80			
0.3	307.8										TOPSOIL: approx. 3 inches
1.5	306.5										CLAYEY SAND (SC): loose, brown, fine to medium grained, moist, with fine gravel
3.0	305.0										ELASTIC SILT (MH): very stiff, gray, yellow, fine to medium grained, moist, with fine gravel
5.0											SANDY SILT (ML): very stiff, yellowish brown, fine to medium grained, moist
7.0											reddish yellow
10.0											
15.0											
20.0											Boring Terminated at 20 feet.
20.0	288.0										Boring cave in at 18.3 feet
285											Borehole backfilled on date drilled unless otherwise noted. Consistency/Relative Density based on correction factor for Automatic hammer.

SAMPLE TYPE Split Spoon

LL: LIQUID LIMIT M: NATURAL MOISTURE CONTENT
PL: PLASTIC LIMIT F: PERCENT PASSING NO. 200 SIEVE
PI: PLASTICITY INDEX

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGT

PROJECT NAME: Cooper Academy Addition
 PROJECT NUMBER: RD230492
 DRILLING METHOD: Solid Flight Auger
 EQUIPMENT USED: Diedrich D25
 HAMMER TYPE: Automatic
 BORING LOCATION: Woods

LOCATION: Clayton, NC
 DATE DRILLED: 10/16/23
 WEATHER: Clear, 60s
 ELEVATION: 308
 DRILL CREW: DR50
 LOGGED BY: G.Gonzalez

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	LAB DATA				SOIL DESCRIPTION	GRAPHIC	REMARKS
					□ N-Value □	▲ Qu (tsf) ▲	Atterberg Limits				
					10 20 30 40	1 2 3 4	20 40 60 80	20 40 60 80			
0.3	307.8									TOPSOIL: approx. 3 inches	
2.0	306.0									CLAYEY SAND (SC): medium dense, brown, fine to medium grained, moist, existing fill	
5.5	302.5									SANDY LEAN CLAY (CL): very stiff, red, fine to medium grained, moist	
10.0										SANDY SILT (ML): stiff, reddish yellow, fine to medium grained, moist	
15.0										yellow, black streaks	
20.0	288.0									very stiff	
20.0										Boring Terminated at 20 feet.	
20.0										Boring cave in at 20 feet	
285										Borehole backfilled on date drilled unless otherwise noted. Consistency/Relative Density based on correction factor for Automatic hammer.	

SAMPLE TYPE Split Spoon

LL: LIQUID LIMIT M: NATURAL MOISTURE CONTENT
 PL: PLASTIC LIMIT F: PERCENT PASSING NO. 200 SIEVE
 PI: PLASTICITY INDEX

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

PROJECT NAME: Cooper Academy Addition
 PROJECT NUMBER: RD230492
 DRILLING METHOD: Hollow Stem Auger
 EQUIPMENT USED: Diedrich D25
 HAMMER TYPE: Automatic
 BORING LOCATION: Infiltration/SHWT

LOCATION: Clayton, NC
 DATE DRILLED: 10/16/23
 WEATHER: Clear, 60s
 ELEVATION: 279
 DRILL CREW: DR50
 LOGGED BY: G.Gonzalez

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	LAB DATA				SOIL DESCRIPTION	GRAPHIC	REMARKS
					□ N-Value □	▲ Qu (tsf) ▲	Atterberg Limits				
					10 20 30 40	1 2 3 4	20 40 60 80	20 40 60 80			
0.3	278.8								TOPSOIL: approx. 3 inches		
1.0	278.0								CLAYEY SAND (SC): medium dense, brown, fine to medium grained, moist, with fine gravel		
3.8	275.2								SANDY LEAN CLAY (CL): very stiff, red, fine to medium grained, moist, with fine gravel		
									SANDY SILT (ML): very stiff, reddish yellow, fine to medium grained, moist		
									stiff		
											Boring cave-in at 14.5 feet
									very stiff		
											Groundwater encountered at 28.6 feet (EL 250.4) at time of drilling and stabilized at 19.7 feet (EL 259.3).
									light brown, saturated		
									saturated		
											Borehole backfilled on date drilled unless otherwise noted. Consistency/Relative Density based on correction factor for Automatic hammer.
30.0	249.0								Boring Terminated at 30 feet.		

SAMPLE TYPE Split Spoon

LL: LIQUID LIMIT M: NATURAL MOISTURE CONTENT
 PL: PLASTIC LIMIT F: PERCENT PASSING NO. 200 SIEVE
 PI: PLASTICITY INDEX

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGT

PROJECT NAME: Cooper Academy Addition
PROJECT NUMBER: RD230492
DRILLING METHOD: Solid Flight Auger
EQUIPMENT USED: Diedrich D25
HAMMER TYPE: Automatic
BORING LOCATION: Parking lot (south)

LOCATION: Clayton, NC
DATE DRILLED: 10/12/23
WEATHER: Clear, 60s
ELEVATION: 307
DRILL CREW: DR50
LOGGED BY: G.Gonzalez

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	LAB DATA				SOIL DESCRIPTION	GRAPHIC	REMARKS
					□ N-Value □	▲ Qu (tsf) ▲	Atterberg Limits				
					10	20	30	40			
					1	2	3	4			
					20	40	60	80			
					20	40	60	80			
0.3	306.7								ASPHALT		
0.5	306.5								AGGREGATE BASE		
2.5	304.5	S-2	S-2	2					CLAYEY SAND (SC): loose, reddish brown, fine to medium grained, moist, existing fill; with fine gravel		Pavemnt: approx. 3.5 inches of asphalt and 2.25 inches of ABC
4.0	303.0	S-3	S-3	2					SILTY SAND (SM): medium dense, light brown, fine to medium grained, moist, existing fill; with fine gravel loose		
5.5	301.5	S-4	S-4	5					SANDY LEAN CLAY (CL): medium stiff, brownish yellow, fine to medium grained, moist		
10.0	297.0	S-5	S-5	4					SANDY SILT (ML): very stiff, reddish yellow, fine to medium grained, moist		Boring cave in at 9 feet
10.0	297.0								Boring Terminated at 10 feet.		

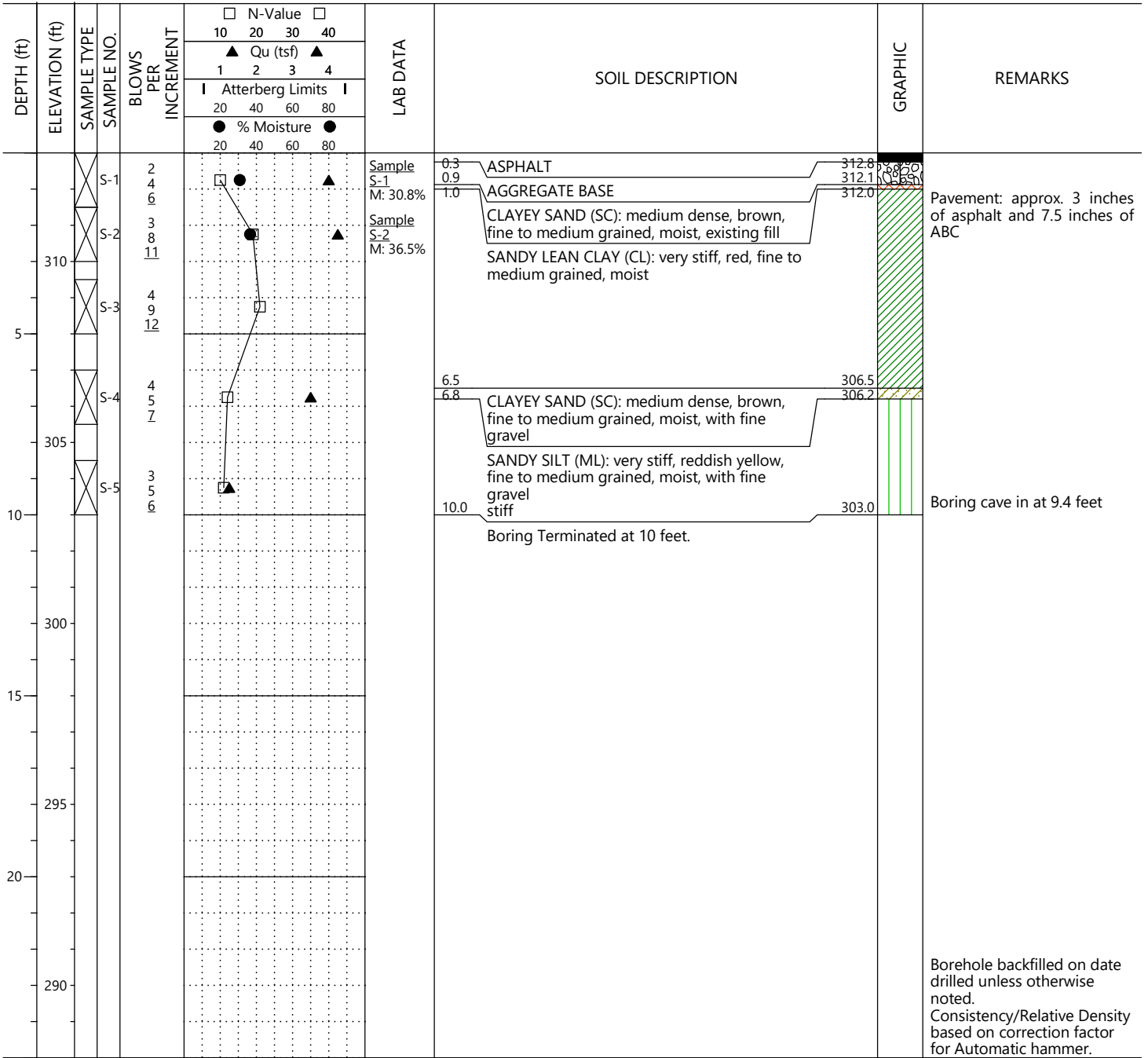
SAMPLE TYPE Split Spoon

LL: LIQUID LIMIT M: NATURAL MOISTURE CONTENT
PL: PLASTIC LIMIT F: PERCENT PASSING NO. 200 SIEVE
PI: PLASTICITY INDEX

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGT

PROJECT NAME: Cooper Academy Addition
PROJECT NUMBER: RD230492
DRILLING METHOD: Solid Flight Auger
EQUIPMENT USED: Diedrich D25
HAMMER TYPE: Automatic
BORING LOCATION: Parking lot (south)

LOCATION: Clayton, NC
DATE DRILLED: 10/12/23
WEATHER: Clear, 60s
ELEVATION: 313
DRILL CREW: DR50
LOGGED BY: G.Gonzalez



LL: LIQUID LIMIT M: NATURAL MOISTURE CONTENT
 PL: PLASTIC LIMIT F: PERCENT PASSING NO. 200 SIEVE
 PI: PLASTICITY INDEX

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

PROJECT NAME: Cooper Academy Addition
 PROJECT NUMBER: RD230492
 DRILLING METHOD: Solid Flight Auger
 EQUIPMENT USED: Diedrich D25
 HAMMER TYPE: Automatic
 BORING LOCATION: Building walkway

LOCATION: Clayton, NC
 DATE DRILLED: 10/12/23
 WEATHER: Clear, 60s
 ELEVATION: 316
 DRILL CREW: DR50
 LOGGED BY: G.Gonzalez

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	LAB DATA				SOIL DESCRIPTION	GRAPHIC	REMARKS
					□ N-Value □	▲ Qu (tsf) ▲	Atterberg Limits				
					10 20 30 40	1 2 3 4	20 40 60 80	20 40 60 80			
315		S-1		5					0.3 TOPSOIL: approx. 3 inches		
		S-2		3					0.8 CLAYEY SAND (SC): medium dense, brown, fine to medium grained, moist, with fine gravel		
		S-3		5					2.5 SANDY LEAN CLAY (CL): very stiff, reddish yellow, fine to medium grained, moist, with fine gravel		
5		S-4		4					SANDY SILT (ML): very stiff, reddish yellow, fine to medium grained, moist		
310		S-5		3							
		S-6		3							
10		S-7		2							
305				4							
				4							
15				2							
300				4							
				4							
20				4					stiff		
				4					20.0		
295									296.0		
											Boring Terminated at 20 feet.

SAMPLE TYPE Split Spoon

LL: LIQUID LIMIT M: NATURAL MOISTURE CONTENT
 PL: PLASTIC LIMIT F: PERCENT PASSING NO. 200 SIEVE
 PI: PLASTICITY INDEX

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

PROJECT NAME: Cooper Academy Addition
PROJECT NUMBER: RD230492
DRILLING METHOD: Hand Auger
EQUIPMENT USED: Hang Auger/DCP
HAMMER TYPE: Manual
BORING LOCATION: Building walkway

LOCATION: Clayton, NC
DATE DRILLED: 10/16/23
WEATHER: Clear, 60s
ELEVATION: 323
DRILL CREW: DR50
LOGGED BY: G.Gonzalez

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	LAB DATA				SOIL DESCRIPTION	GRAPHIC	REMARKS
					□ N-Value □	▲ Qu (tsf) ▲	Atterberg Limits				
					10 20 30 40	1 2 3 4	20 40 60 80	20 40 60 80			
0.3	322.8									DCP	
2.0	321.0										
5.0	318.0										
5											
315											
10											
310											
15											
305											
20											
300											

SAMPLE TYPE  Grab Sample

Borehole backfilled on date drilled unless otherwise noted.
Consistency/Relative Density based on correction factor for Manual hammer.

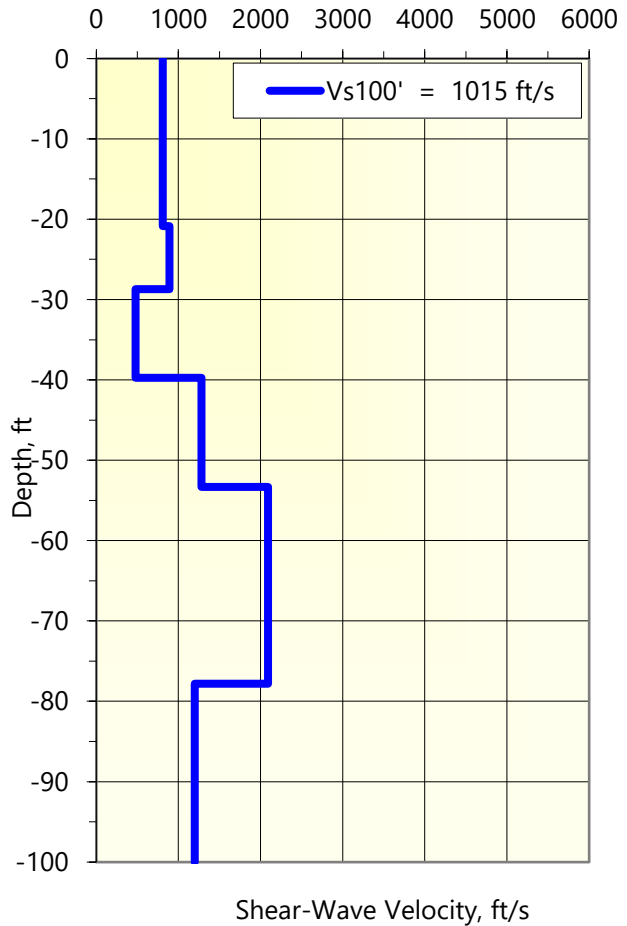
LL: LIQUID LIMIT M: NATURAL MOISTURE CONTENT
PL: PLASTIC LIMIT F: PERCENT PASSING NO. 200 SIEVE
PI: PLASTICITY INDEX

Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

SEISMIC SITE CLASS

Geogiga Surface Plus 9.3 ReMi Survey Results

Depth (ft)	Shear Wave Velocity Vs (ft/sec)
0.00	808.50
-20.87	808.50
-20.87	890.70
-28.72	890.70
-28.72	477.70
-39.75	477.70
-39.75	1282.70
-53.32	1282.70
-53.32	2092.00
-77.82	2092.00
-77.82	1197.60
-100.00	1197.60

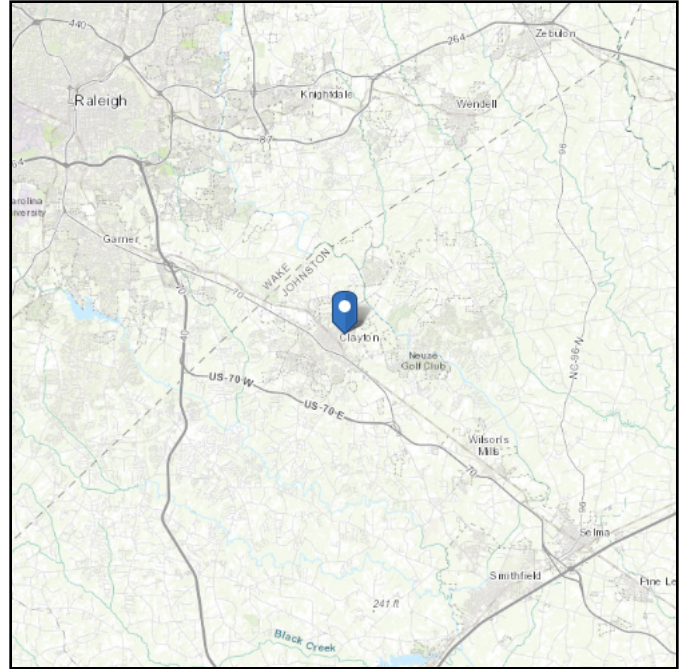
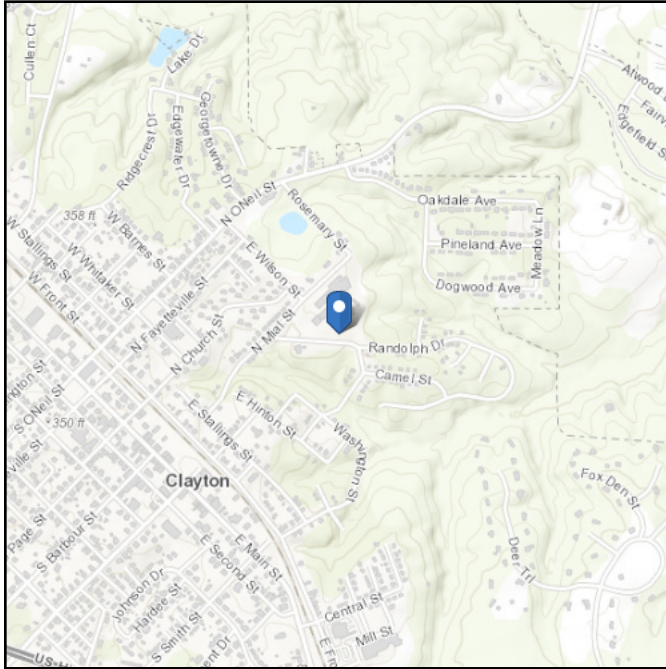


ASCE 7 Hazards Report

Address:
No Address at This Location

Standard: ASCE/SEI 7-16
Risk Category: III
Soil Class: D - Stiff Soil

Latitude: 35.654858
Longitude: -78.451119
Elevation: 310.0864129148909 ft (NAVD 88)

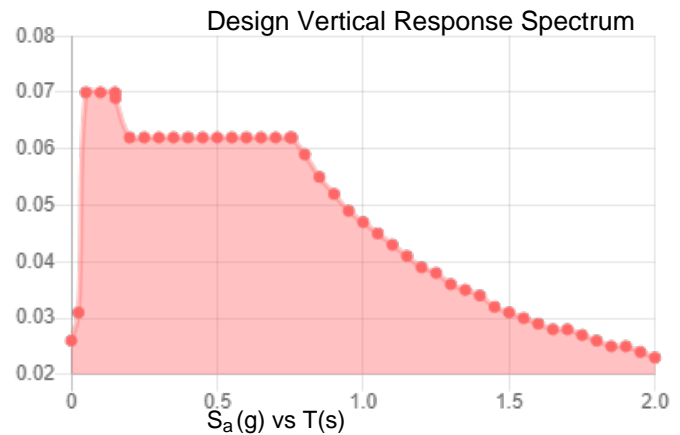
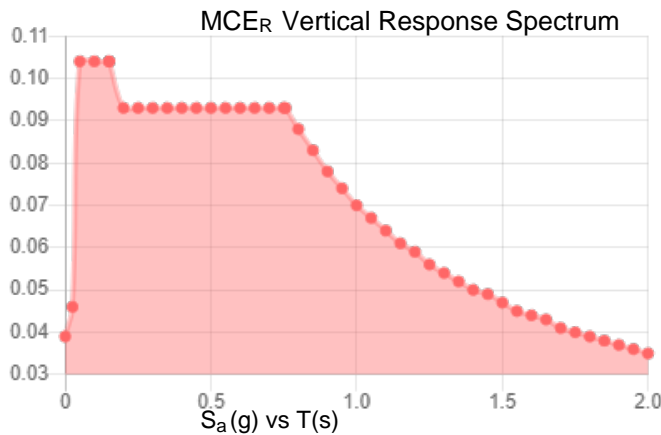
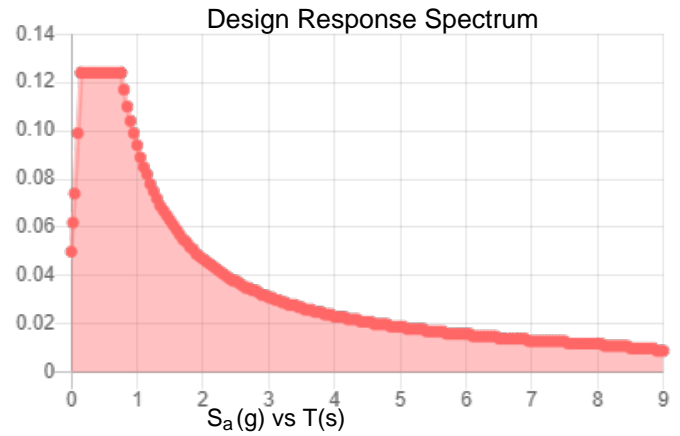
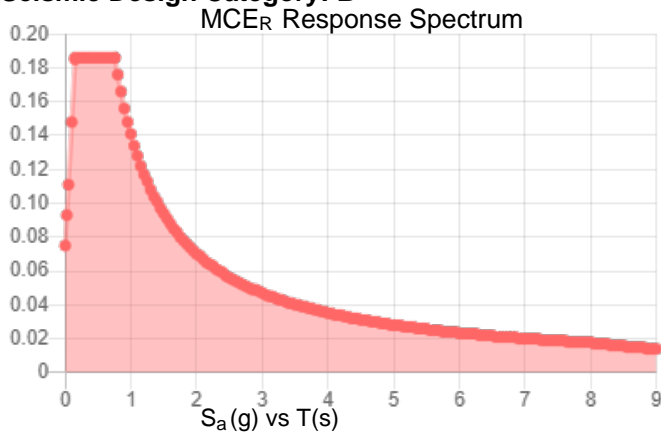


Site Soil Class:

Results:

S_s :	0.116	S_{D1} :	0.094
S_1 :	0.059	T_L :	8
F_a :	1.6	PGA :	0.056
F_v :	2.4	PGA _M :	0.089
S_{MS} :	0.186	F_{PGA} :	1.6
S_{M1} :	0.141	I_e :	1.25
S_{DS} :	0.124	C_v :	0.7

Seismic Design Category: B



Data Accessed: Thu Dec 07 2023

Date Source:

USGS Seismic Design Maps based on ASCE/SEI 7-16 and ASCE/SEI 7-16 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-16 Ch. 21 are available from USGS.

The ASCE 7 Hazard Tool is provided for your convenience, for informational purposes only, and is provided “as is” and without warranties of any kind. The location data included herein has been obtained from information developed, produced, and maintained by third party providers; or has been extrapolated from maps incorporated in the ASCE 7 standard. While ASCE has made every effort to use data obtained from reliable sources or methodologies, ASCE does not make any representations or warranties as to the accuracy, completeness, reliability, currency, or quality of any data provided herein. Any third-party links provided by this Tool should not be construed as an endorsement, affiliation, relationship, or sponsorship of such third-party content by or from ASCE.

ASCE does not intend, nor should anyone interpret, the results provided by this Tool to replace the sound judgment of a competent professional, having knowledge and experience in the appropriate field(s) of practice, nor to substitute for the standard of care required of such professionals in interpreting and applying the contents of this Tool or the ASCE 7 standard.

In using this Tool, you expressly assume all risks associated with your use. Under no circumstances shall ASCE or its officers, directors, employees, members, affiliates, or agents be liable to you or any other person for any direct, indirect, special, incidental, or consequential damages arising from or related to your use of, or reliance on, the Tool or any information obtained therein. To the fullest extent permitted by law, you agree to release and hold harmless ASCE from any and all liability of any nature arising out of or resulting from any use of data provided by the ASCE 7 Hazard Tool.

LABORATORY TEST PROCEDURES

A brief description of the laboratory tests performed is provided in the following sections.

DESCRIPTION OF SOILS (VISUAL-MANUAL PROCEDURE) (ASTM D2488)

The soil samples were visually examined by our engineer and soil descriptions were provided. Representative samples were then selected and tested in accordance with the aforementioned laboratory-testing program to determine soil classifications and engineering properties. This data was used to correlate our visual descriptions with the Unified Soil Classification System (USCS).

POCKET PENETROMETER

Pocket Penetrometer tests were performed on cohesive soil samples. The pocket penetrometer provides a consistency classification, and an indication of the soils unconfined compressive strength (Q_u).

NATURAL MOISTURE CONTENT (ASTM D2216)

Natural moisture contents (M%) were determined on selected samples. The natural moisture content is the ratio, expressed as a percentage, of the weight of water in a given amount of soil to the weight of solid particles.

ATTERBERG LIMITS (ASTM D4318)

The Atterberg Limits test was performed to evaluate the soil's plasticity characteristics. The soil Plasticity Index (PI) is representative of this characteristic and is bracketed by the Liquid Limit (LL) and the Plastic Limit (PL). The Liquid Limit is the moisture content at which the soil will flow as a heavy viscous fluid. The Plastic Limit is the moisture content at which the soil is between "plastic" and the semi-solid stage. The Plasticity Index ($PI = LL - PL$) is a frequently used indicator for a soil's potential for volume change. Typically, a soil's potential for volume change increases with higher plasticity indices.

GRAIN-SIZE DISTRIBUTION (ASTM D6913)

Soil grain-size distribution includes determining percentages of material sizes for the soils sample. The wash determines the amount of material finer than the openings on the No. 200 sieve (0.075 mm) by washing soil over it. After drying in the oven, the soils retained on the No. 200 sieve are separated into specified grain sizes by running through sieves with consecutively smaller openings. The result is a distribution of particle sized that make up the bulk sample. Results are presented on the boring logs and Laboratory Results section included in this report.

STANDARD PROCTOR COMPACTION TEST (ASTM D698)

Standard Proctor compaction tests were performed to determine the maximum dry density and optimum moisture content for the soil, for use as a comparative basis during fill placement. The Standard Proctor test consists of the compaction of soil with known moisture content into a steel mold of fixed height and diameter. The soil is compacted in the mold in three lifts of equal volume using a 5.5 lb. manual hammer with a 12-inch free fall, to produce a consistent

compactive effort. The test procedure is repeated on samples at several different moisture contents until a curve showing the relationship between moisture content and dry density of the soil is established. From this curve, the maximum dry density (peak density value) and optimum moisture content (moisture content correlating to the maximum dry density) are obtained.

LABORATORY CALIFORNIA BEARING RATIO (ASTM D1883)

The California Bearing Ratio, usually abbreviated CBR, is a punching shear test. The CBR value is a semi-empirical index of the soil's strength and deflection characteristics and has been correlated with pavement performance to establish design curves for pavement thickness. The tests were performed on six-inch diameter, five-inch thick disks of compacted soil, confined in steel cylinders. The specimens were soaked for at least 96 hours prior to testing. A piston, approximately two inches in diameter, was forced into the soaked soil at a standard rate to determine the soil's resistance to penetration. The CBR value is the ratio, expressed as a percentage, of the actual load required to produce a 0.1-inch deflection to that required for the same deflection in a certain standard crushed stone.

TRIAxIAL SHEAR TEST (CONSOLIDATED-UNDRAINED) (ASTM D4767)

Triaxial Shear tests are used to determine the shear strength of soil samples under various loading conditions. A consolidated-undrained triaxial shear test was completed on a relatively undisturbed sample extruded from a Shelby tube. The data from this test was used in analyzing the shear strength parameters of the soil. Portions of the samples were placed in six (6) inch long tube molds and then subjected to deviator stresses at different confining pressures. The various confining pressures help determine the shear strength of the soil at different depths.

LABORATORY TEST RESULTS

The results of the laboratory testing are presented in the following tables.

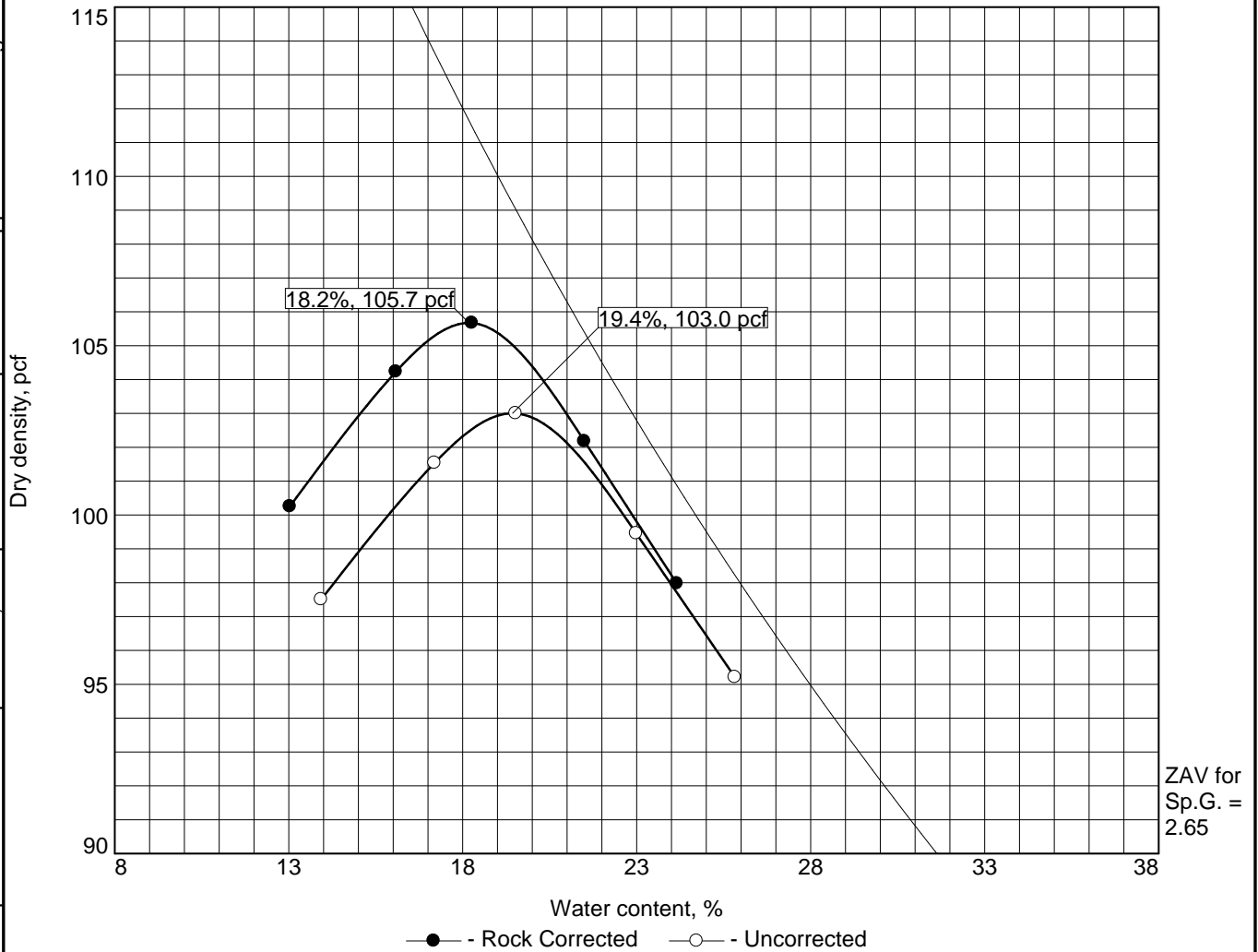
Boring or Test Pit Location	Sample Depth (ft)	LL	PL	PI	% Passing #200 Sieve	Moisture Content (%)
B-07/B-08	(bulk)	43	29	14	54	15.1
B-01	13.5-15	36	30	6	61	30.1
B-02	3.5-5	38	30	8	61.1	22.6
B-05	0-1.5	--	--	--	--	10.2
B-05	1.5-3	--	--	--	--	10.2
B-05	3.5-5	--	--	--	--	12.5
B-05	6-7.5	--	--	--	--	25.9
B-05	8.5-10	--	--	--	--	26.3
B-05	13.5-15	--	--	--	--	30.1
B-05	18.5-20	--	--	--	--	32.4
B-07	1.5-5	43	37	6	61.6	20.5
B-09	0-3	61	36	25	74	29.3
B-12	0-1.5	37	19	18	35	14.2
B-15	6-7.5	--	--	--	--	27.7
B-16	1.5-3	--	--	--	--	15.9
B-16	1.5-3	--	--	--	--	13.6
B-17	0-1.5	--	--	--	--	30.8
B-17	1.5-3	--	--	--	--	36.5
B-19	0-1.5	--	--	--	--	31.7
B-19	1.5-3	--	--	--	--	26.8
B-21	15.2	--	--	--	--	15.2
B-21	14.2	--	--	--	--	14.2

Table A-1: General Soil Classification Test Results

Soils with a Liquid Limit (LL) greater than 50 and Plasticity Index (PI) greater than 25 usually exhibit significant volume change with varying moisture content and are considered to be highly plastic. Soils with a LOI value greater than 3 percent are usually not suitable for supporting building and pavement sections.

Results relate only to the identified sample tested. This report shall not be reproduced, except in full without prior written approval of Building & Earth Sciences.

COMPACTION TEST REPORT



Test specification: ASTM D 698-12 Method A Standard
 ASTM D4718-15 Oversize Corr. Applied to Each Test Point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
3.5-5'	ML	A-7-6(6)	15.1		43	14	6.5	53.9

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 105.7 pcf	103.0 pcf	Light brown red sandy silt
Optimum moisture = 18.2 %	19.4 %	

Project No. RD230492 Project: Cooper Academy Additions (GEO) Clayton, NC	Client: Johnston County Schools Date: 10-23-23	Remarks:
Location: Bulk sample Sample Number: 23-0184-01		



Checked By: John Dailly

Results relate only to the identified sample tested. This report shall not be reproduced, except in full without prior written approval of Building & Earth Sciences.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	1	5	3	8	29	54	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100		
1	100		
.75	99		
.375	99		
#4	94		
#10	91		
#20	86		
#40	83		
#60	79		
#140	62		
#200	54		

* (no specification provided)

Material Description

Light brown red sandy silt

Atterberg Limits

PL= 29 LL= 43 PI= 14

Coefficients

D₉₀= 1.6542 D₈₅= 0.6270 D₆₀= 0.0975
D₅₀= D₃₀= D₁₅=
D₁₀= C_u= C_c=

Classification

USCS= ML AASHTO= A-7-6(6)

Remarks

As-received water content=15.1%

Location: Bulk sample
Sample Number: 23-0184-01

Depth: 3.5-5'

Date: 10-23-23

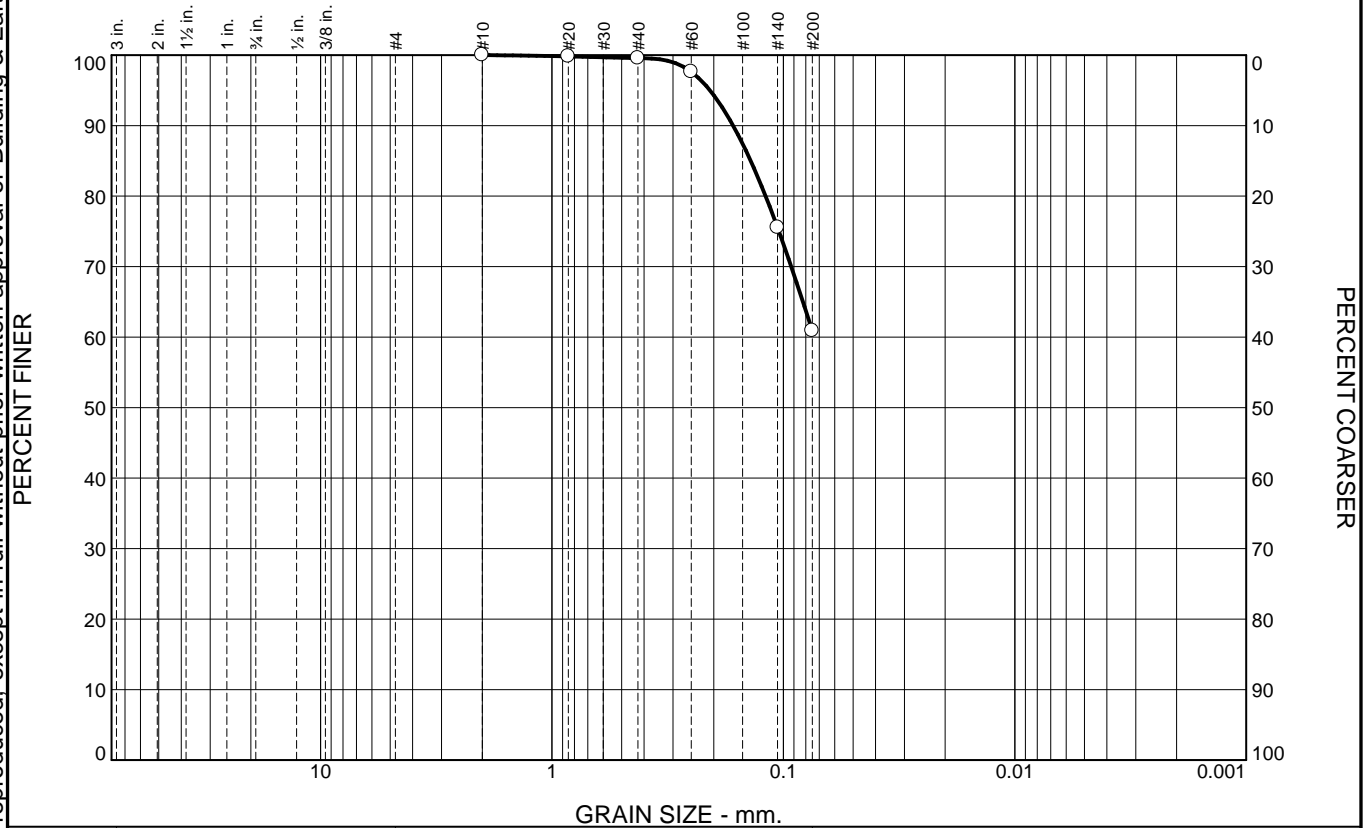


Client: Johnston County Schools
Project: Cooper Academy Additions (GEO) Clayton, NC
Project No: RD230492

Checked By: John Dailly

Results relate only to the identified sample tested. This report shall not be reproduced, except in full without prior written approval of Building & Earth Sciences.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	0	39	61	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100		
#20	100		
#40	100		
#60	98		
#140	76		
#200	61		

* (no specification provided)

Material Description

sandy silt

Atterberg Limits

PL= 30 LL= 36 PI= 6

Coefficients

D₉₀= 0.1649 D₈₅= 0.1385 D₆₀=
D₅₀= D₃₀= D₁₅=
D₁₀= C_u= C_c=

Classification

USCS= ML AASHTO= A-4(3)

Remarks

As-received water content=30.1%

Location: B-01, S-06

Sample Number: 23-0184-02

Depth: 13.5-15'

Date: 10-23-23



Client: Johnston County Schools

Project: Cooper Academy Additions (GEO) Clayton, NC

Project No: RD230492

Checked By: John Dailly

Results relate only to the identified sample tested. This report shall not be reproduced, except in full without prior written approval of Building & Earth Sciences.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.8	38.1	61.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	99.8		
#40	99.2		
#60	95.7		
#140	72.1		
#200	61.1		

* (no specification provided)

Material Description

sandy silt

Atterberg Limits

PL= 30 LL= 38 PI= 8

Coefficients

D₉₀= 0.1902 D₈₅= 0.1588 D₆₀=
D₅₀= D₃₀= D₁₅=
D₁₀= C_u= C_c=

Classification

USCS= ML AASHTO= A-4(4)

Remarks

As-received water content=22.6%

Location: B-02, S-03
Sample Number: 23-0184-03

Depth: 3.5-5'

Date: 10-23-23

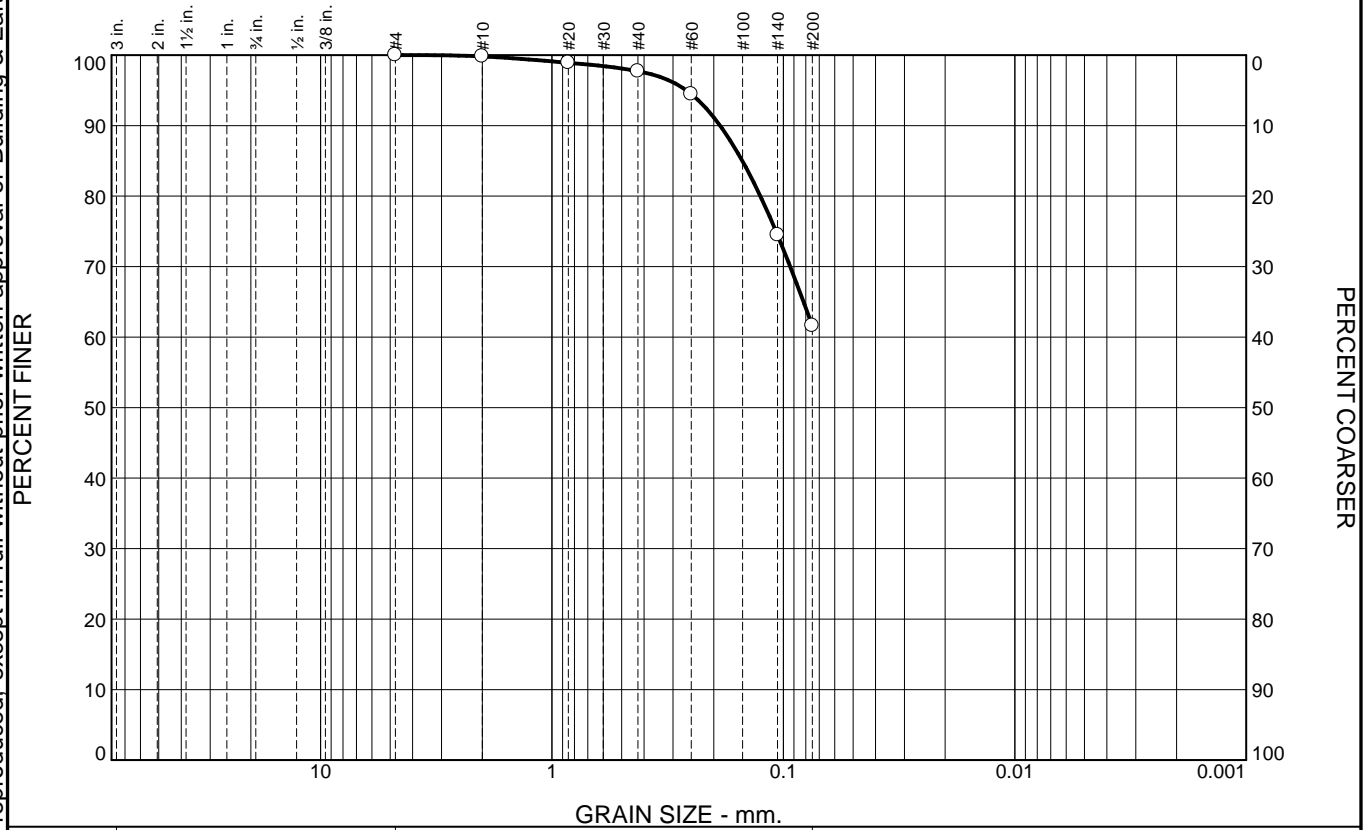


Client: Johnston County Schools
Project: Cooper Academy Additions (GEO) Clayton, NC
Project No: RD230492

Checked By: John Dailly

Results relate only to the identified sample tested. This report shall not be reproduced, except in full without prior written approval of Building & Earth Sciences.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.2	2.1	36.1	61.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.8		
#20	98.9		
#40	97.7		
#60	94.5		
#140	74.5		
#200	61.6		

* (no specification provided)

Material Description

sandy silt

Atterberg Limits

PL= 37 LL= 43 PI= 6

Coefficients

D₉₀= 0.1878 D₈₅= 0.1505 D₆₀=
D₅₀= D₃₀= D₁₅=
D₁₀= C_u= C_c=

Classification

USCS= ML AASHTO= A-5(4)

Remarks

As-received water content=20.5%

Location: B-07, S-02 & S-03 composite
Sample Number: 23-0184-11 **Depth:** 1.5-5

Date: 10-23-23

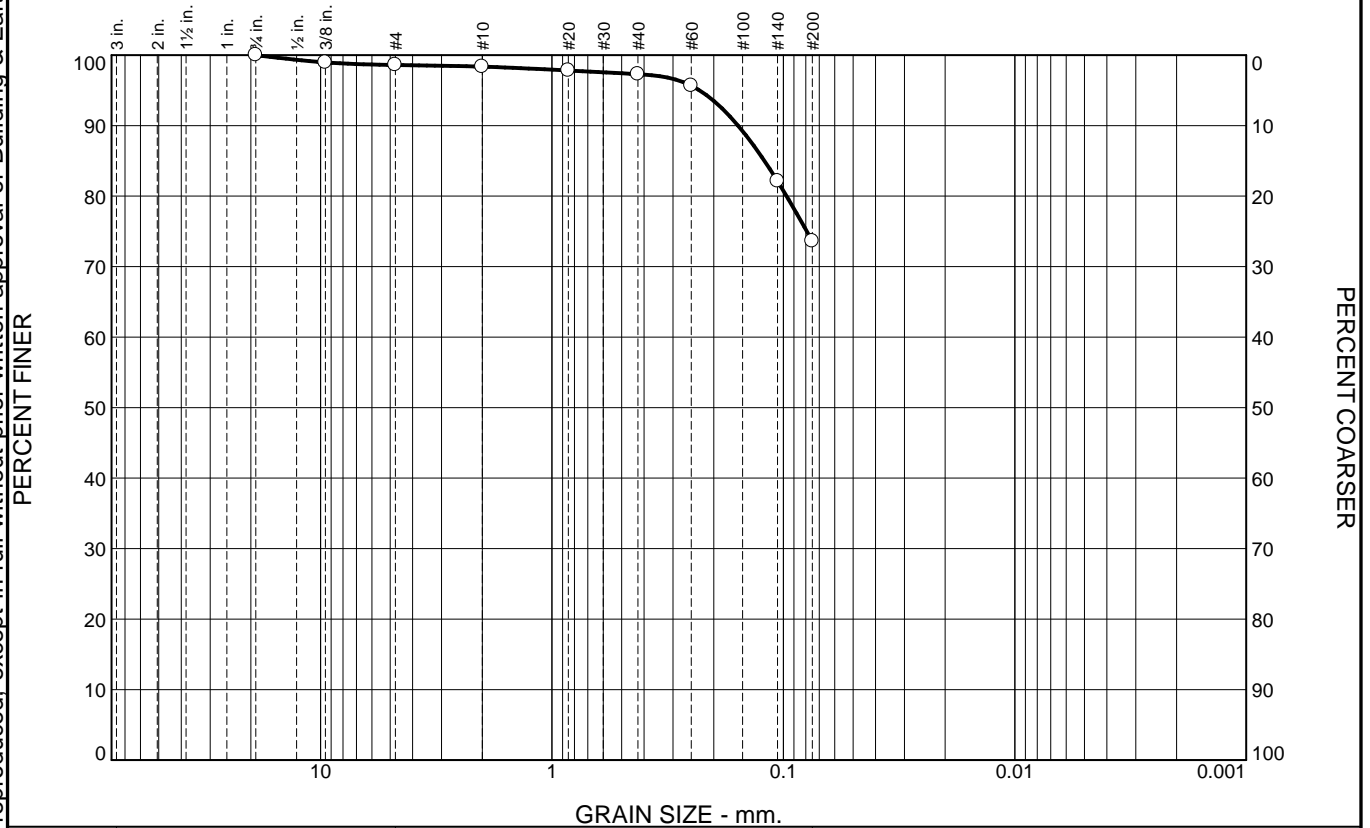


Client: Johnston County Schools
Project: Cooper Academy Additions (GEO) Clayton, NC
Project No: RD230492

Checked By: John Dailly

Results relate only to the identified sample tested. This report shall not be reproduced, except in full without prior written approval of Building & Earth Sciences.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	1	1	1	23	74	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.750	100		
.375	99		
#4	99		
#10	98		
#20	98		
#40	97		
#60	96		
#140	82		
#200	74		

* (no specification provided)

Material Description

elastic silt with sand

Atterberg Limits

PL= 36 LL= 61 PI= 25

Coefficients

D₉₀= 0.1571 D₈₅= 0.1208 D₆₀=
D₅₀= D₃₀= D₁₅=
D₁₀= C_u= C_c=

Classification

USCS= MH AASHTO= A-7-5(21)

Remarks

As-received water content=29.3%

Location: B-09, S-01 & S-02 composite
Sample Number: 23-0184-12 **Depth:** 0-3'

Date: 10-23-23

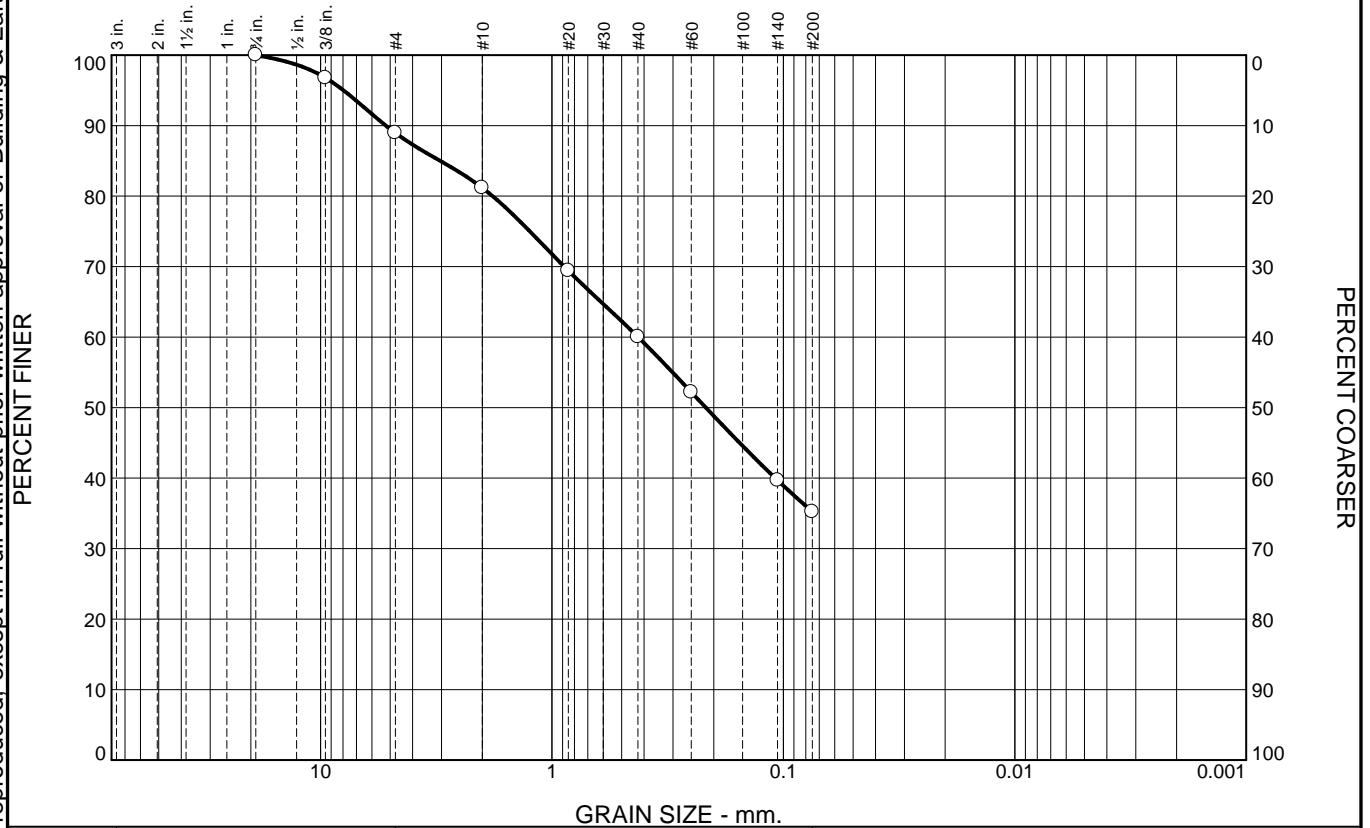


Client: Johnston County Schools
Project: Cooper Academy Additions (GEO) Clayton, NC
Project No: RD230492

Checked By: John Dailly

Results relate only to the identified sample tested. This report shall not be reproduced, except in full without prior written approval of Building & Earth Sciences.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	11	8	21	25	35	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.750	100		
.375	97		
#4	89		
#10	81		
#20	69		
#40	60		
#60	52		
#140	40		
#200	35		

* (no specification provided)

Material Description

clayey sand

Atterberg Limits

PL= 19 LL= 37 PI= 18

Coefficients

D₉₀= 5.2195 D₈₅= 3.0418 D₆₀= 0.4244
D₅₀= 0.2163 D₃₀= D₁₅=
D₁₀= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(2)

Remarks

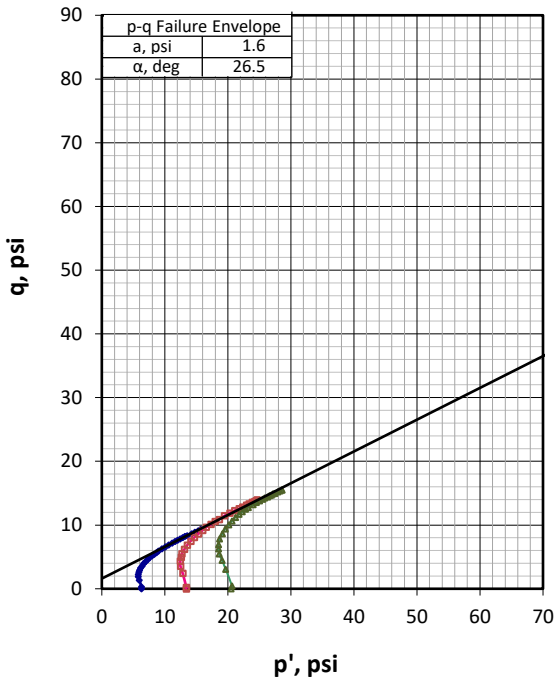
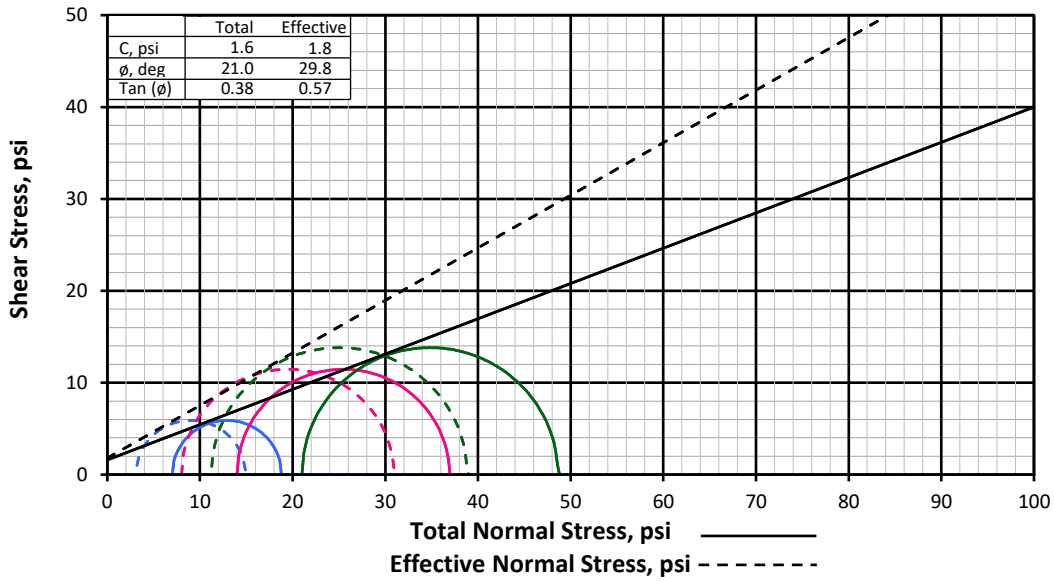
As-received water content=14.2%

Location: B-12, S-01 Sample Number: 23-0184-13 Depth: 0-1.5 Date: 10-23-23



Client: Johnston County Schools
Project: Cooper Academy Additions (GEO) Clayton, NC
Project No: RD230492

Checked By: John Dailly



Sample No.	1	2	3	
Initial	Water Content, %	20.5	20.4	19.9
	Dry Density, pcf	98.4	97.5	97.6
	Saturation, %	78	75.8	74.0
	Void Ratio	0.7115	0.7273	0.7257
	Diameter, in.	2.85	2.85	2.85
	Height, in.	6.00	6.05	6.10
At Test	Water Content, %	28.2	27.8	26.9
	Dry Density, pcf	95.7	96.3	97.6
	Saturation, %	100	100	100
	Void Ratio	0.7606	0.7503	0.7264
	Diameter, in.	2.90	2.08	2.87
	Height, in.	5.96	6.00	6.03
Strain rate, in./min.	0.004	0.004	0.004	
Back Pressure, psi	68.0	68.0	68	
Cell Pressure, psi	75.0	82.0	89	
Failure Total Stress, psi	18.8	36.9	48.6	
	Total Pore Pr., psi	72.2	75.1	77.8
Failure Dev. Stress, psi	11.8	22.9	27.6	
Failure Stress Ratio	4.81	3.86	3.47	
$\bar{\sigma}_1$ Failure, psi	14.9	30.9	38.8	
$\bar{\sigma}_3$ Failure, psi	3.1	8.0	11.2	

Type of Test: CU with Pore Pressures
Sample Type: Undisturbed
Description: Red Brown Sandy Silty Clay (CL-ML)

Specific Gravity = 2.7
Remarks:

Client:

Project: Midland

Location: 0

Sample No: 0

Depth: 3-5'

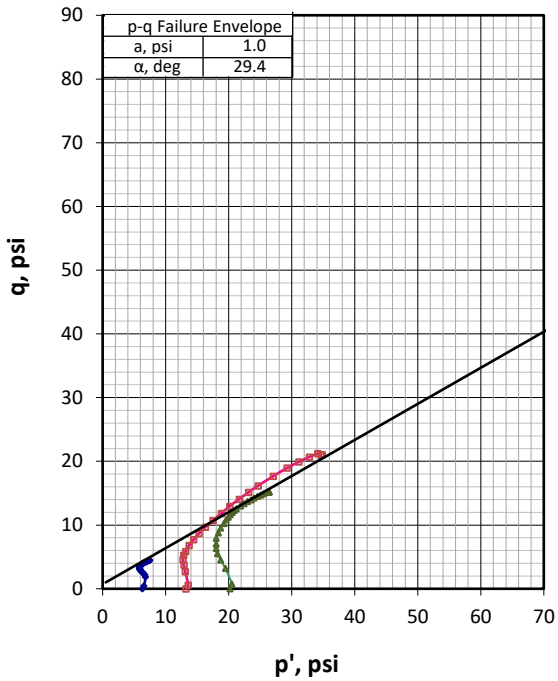
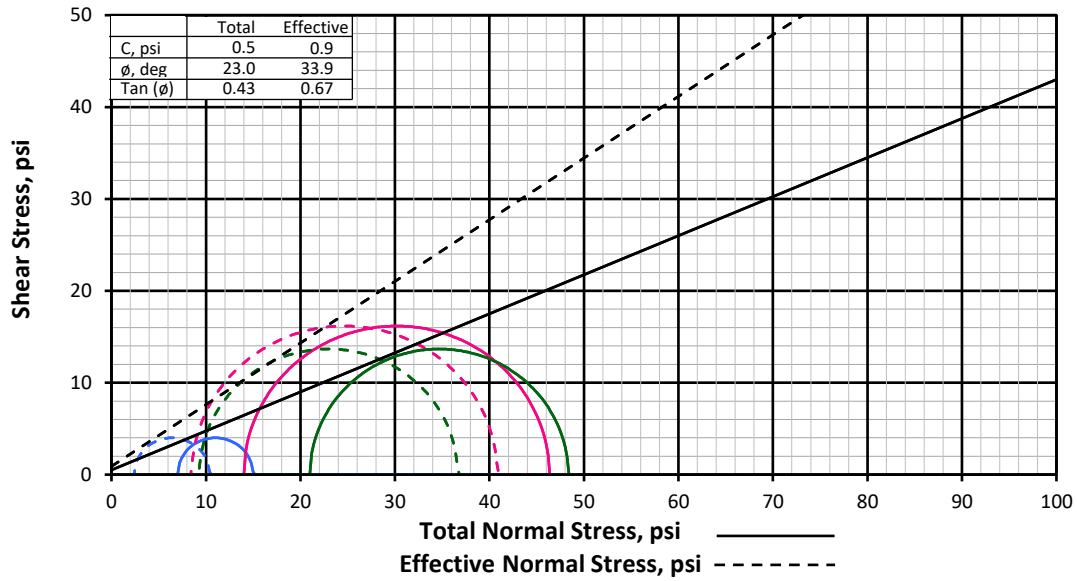
Project No: RD230492

Date: 11/13/2023



Geotechnical, Environmental, and Materials Engineers

TRIAxIAL SHEAR TEST REPORT



Sample No.	1	2	3	
Initial	Water Content, %	27.1	23.0	23.7
	Dry Density, pcf	79.4	87.0	86.5
	Saturation, %	65	66.5	67.6
	Void Ratio	1.1215	0.9357	0.9478
	Diameter, in.	2.85	2.85	2.85
	Height, in.	5.15	5.79	5.80
At Test	Water Content, %	37.4	29.2	33.0
	Dry Density, pcf	83.9	94.3	89.1
	Saturation, %	100	100	100
	Void Ratio	1.0083	0.7866	0.8904
	Diameter, in.	2.78	2.07	2.83
	Height, in.	5.11	5.71	5.70
Strain rate, in./min.	0.0064	0.0064	0.0064	
Back Pressure, psi	68.0	68.0	68	
Cell Pressure, psi	75.0	82.0	89	
Failure Total Stress, psi	15.0	46.3	48.3	
	Total Pore Pr., psi	72	75.1	79.7
Failure Dev. Stress, psi	8.0	32.3	27.3	
Failure Stress Ratio	4.34	4.80	3.94	
$\bar{\sigma}_1$ Failure, psi	10.4	40.8	36.6	
$\bar{\sigma}_3$ Failure, psi	2.4	8.5	9.3	

Type of Test: CU with Pore Pressures
Sample Type: Compacted
Description: Red Yellow Silty, Clayey Sand (SC-SM)

Specific Gravity = 2.7

Remarks:

Client: Johnston County Public Schools
Project: Cooper Academy Addition (GEO) Clayton, NC
Location: B-04
Sample No: 5 **Depth:** 8.5-10'
Project No: RD230492 **Date:** 10/25/2023



TRIAXIAL SHEAR TEST REPORT

0.0
0.0

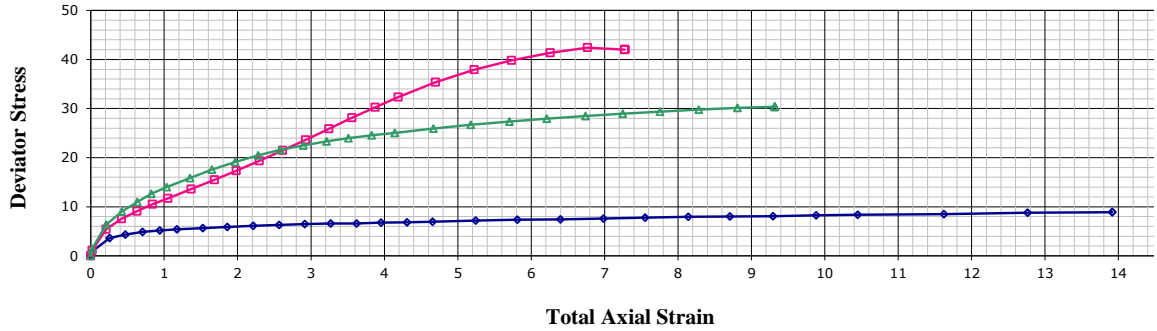
R

Consolidated-Undrained Triaxial Compression Test

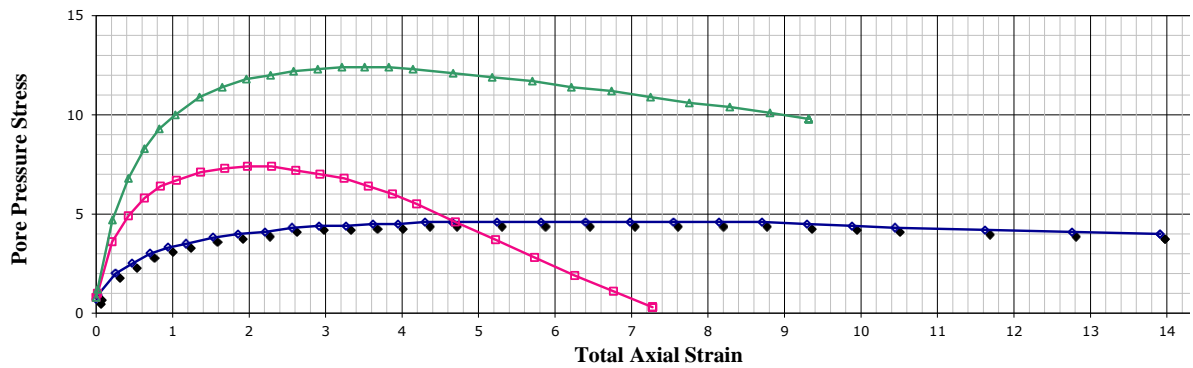
ASTM
Oct

Boring #B-04 @ 8.5 - 10.5'

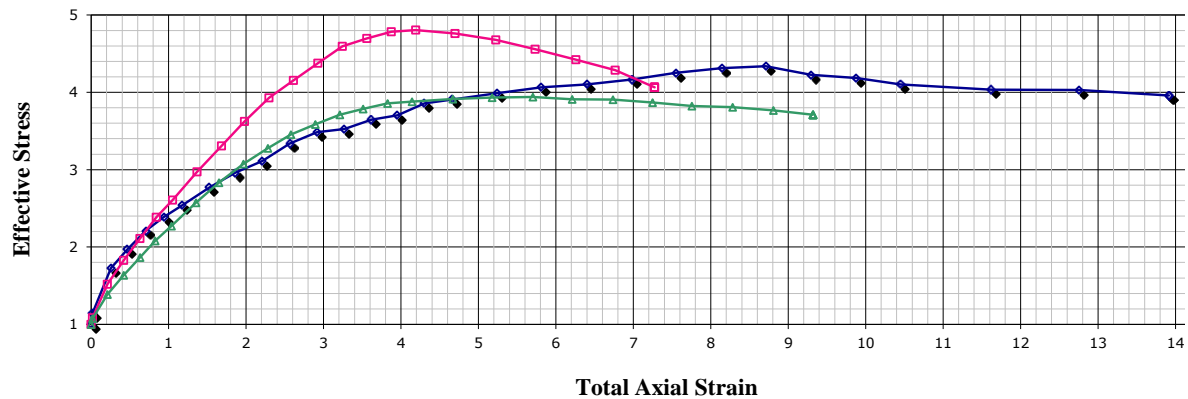
Deviator Stress vs. Total Axial Strain



Pore Pressure vs. Total Axial Strain



Effective Stress vs. Total Axial Strain



0.0
0.0

R

Consolidated-Undrained Triaxial Compression Test

ASTM

Oct

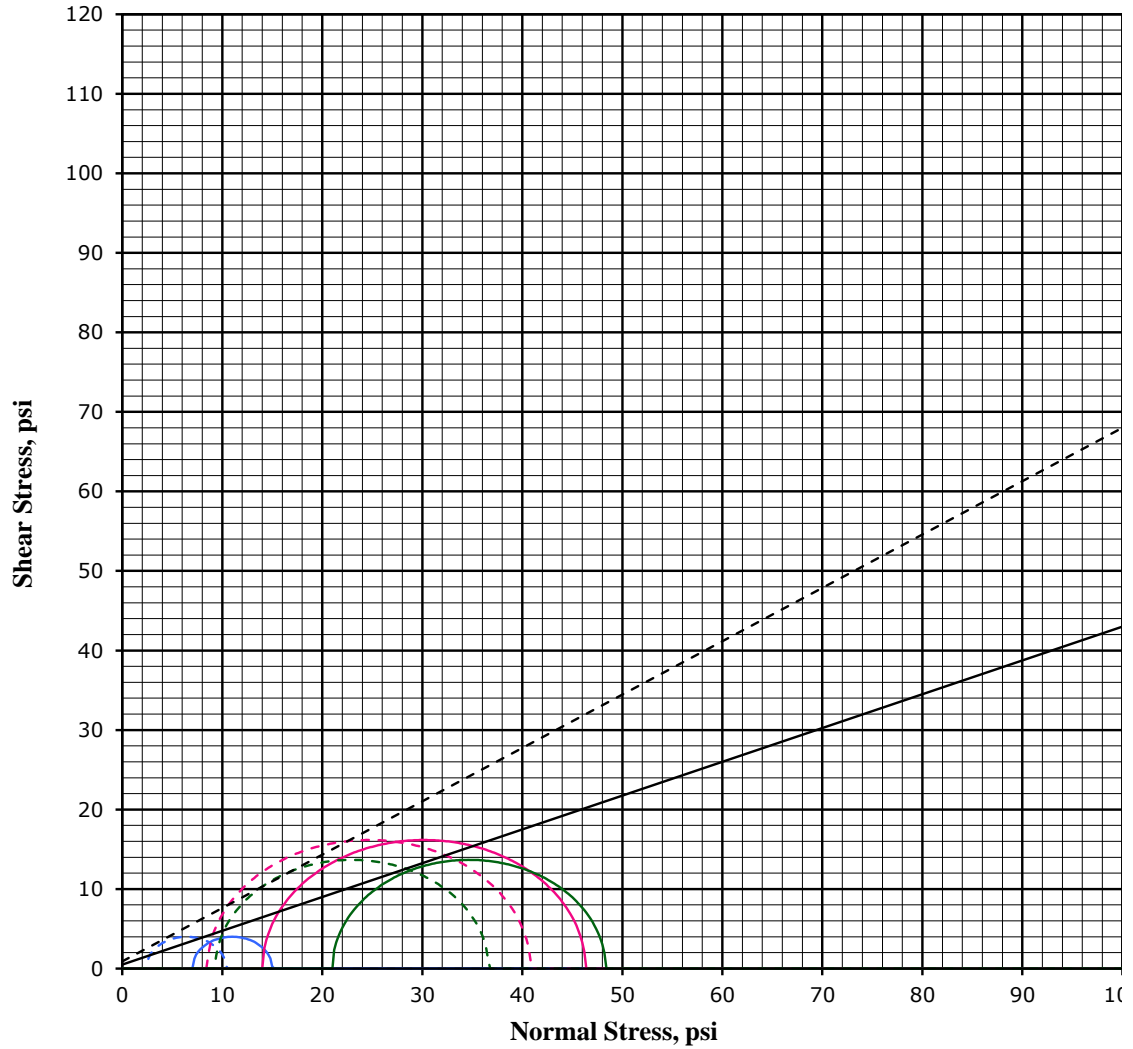
Boring #B-04 @ 8.5 - 10.5'

Red Yellow Silty, Clayey Sand (SC-SM)

Sample Type: Compacted

Strength Parameters		
	ϕ	C
Effective	33.9°	0.9 psi
Total	23.0°	0.5 psi

Total and Effective Mohr's Circles



	Stg. 1	Stg. 2	Stg. 3
Effective Consolidation Stress, psi	7.0	14.0	21.0
Deviator Stress at Failure, psi	8.0	32.3	27.3
Effective Minor Principal Stress at Failure, psi	2.4	8.5	9.3
Effective Major Principal Stress at Failure, psi	10.4	40.8	36.6
Axial Strain at Failure, psi	8.71	4.19	5.70

0.0
0.0

R

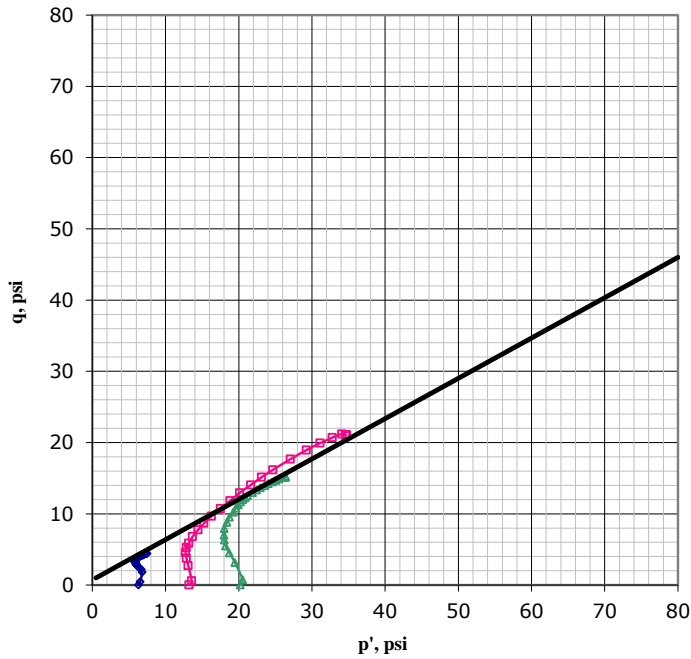
Consolidated-Undrained Triaxial Compression Test

ASTM
Oct

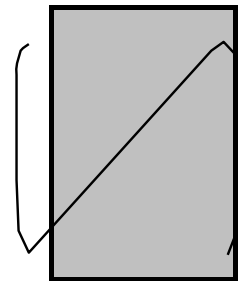
Boring #B-04 @ 8.5 - 10.5'
Red Yellow Silty, Clayey Sand (SC-SM)
Sample Type: Compacted

Parameters
 $\alpha = 29.4^\circ$
a = 1.0 psi

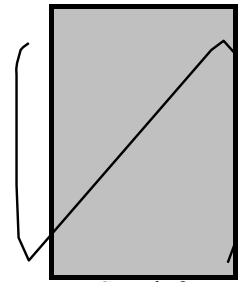
p' vs q Chart



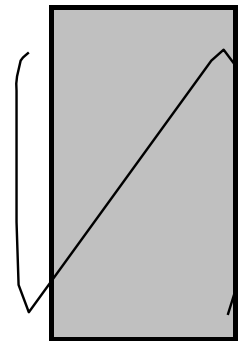
Failure Sketches



Sample 1



Sample 2



Sample 3

Method followed for sample saturation: Wet
Failure criterion used: Max. Eff. Stress Ratio (σ'_1 / σ'_3)
Specific Gravity: 2.70 (ASTM D 854)
Method for cross-sectional determination after consolidation: B
Method for soil classification: ASTM D 2488 (visual-manual procedure)

Remarks

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you — should apply this report for any purpose or project except the one originally contemplated.*

Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an

assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by:* the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final*, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly

problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time to perform additional study.* Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help

others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Environmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold- prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical- engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you GBC-Member geotechnical engineer for more information.



8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@geoprofessional.org www.geoprofessional.org

Copyright 2015 by Geoprofessional Business Association (GBA). Duplication, reproduction, or copying of this document, or its contents, in whole or in part, by any means whatsoever, is strictly prohibited, except with GBA's specific written permission. Excerpting, quoting, or otherwise extracting wording from this document is permitted only with the express written permission of GBA, and only for purposes of scholarly research or book review. Only members of GBA may use this document as a complement to or as an element of a geotechnical-engineering report. Any other firm, individual, or other entity that so uses this document without being a GBA member could be committing negligent or intentional (fraudulent) misrepresentation.



ROY COOPER
Governor

ELIZABETH S. BISER
Secretary

RICHARD E. ROGERS, JR.
Director

December 4, 2023

DWR Project 23-374
Wake County

Matthew V. Johnson
Johnston County Public Schools
PO Box 1336
Smithfield, NC 27557
Via email to: matthewvjohnston@johnston.k12.nc.us

Subject: On-Site Determination for Applicability to the Neuse Buffer Rules (15A NCAC 02B .0714)

Project Name: Cooper Academy

Site Address / Location: 849 Mial Street, Clayton, NC

Dear Mr. Johnston:

On November 27, 2023, DWR staff Tyler Clark conducted an on-site review of features located on the subject property to determine the applicability of the above-noted state regulations.

The Division of Water Resources has determined that streams listed in the table below and identified on the attached maps are shown on either the most recently *published* NRCS Soil Survey of Johnston County and/or the USGS National Map at a scale that incorporates the National Hydrography Dataset High Resolution data at 1:24,000 scale. Streams that are listed as "Subject" on the below table have been located on the ground at the site and possess characteristics that qualify them to be at least intermittent streams in accordance with the NC Stream Identification Manual v.4.11 and therefore subject to the Neuse Buffer Rules. **Please be aware that features identified as "not subject" may be considered jurisdictional according to the US Army Corps of Engineers and subject to the Clean Water Act.**

Feature ID	E/I/P/ Other	Subject to Buffer Rules	Start @	Stop @	Depicted on Soil Survey	Depicted on USGS Topo
Feature A	E	No	Inside property boundary	Property boundary	yes	no

(1) E = Ephemeral, I = Intermittent, P = Perennial, NP = Not Present, N/A=Not Applicable

(2) Refers to State riparian buffer rules only. Stream, wetland, or pond impacts are still subject to applicable water quality standards and permitting requirements.



North Carolina Department of Environmental Quality | Division of Water Resources
512 North Salisbury Street | 1611 Mail Service Center | Raleigh, North Carolina 27699-1611
919.707.9000


DWR 23-374
 Matthew Johnston
 PO BOX 1336
 Smithfield, NC 27557, Johnston County
 Page 2 of 2

This on-site determination shall expire five (5) years from the date of this letter. The owner (or future owners) should notify the Division (and other relevant agencies) of this decision in any future correspondences concerning this property. Landowners or affected parties that dispute this determination made by the Division may request a determination by the Director of Water Resources. **This determination is final and binding, unless an appeal request is made within sixty (60) calendar days of the date of this letter to the Director in writing.**

<p><i>If sending via U.S. Postal Service:</i> Stephanie Goss - DWR 401 & Buffer Permitting Branch Supervisor 1617 Mail Service Center Raleigh, NC 27699-1617</p>	<p><i>If sending via delivery service (UPS, FedEx, etc.)</i> Stephanie Goss -DWR 401 & Buffer Permitting Branch Supervisor 512 N Salisbury St. Raleigh, NC 27604</p>
--	--

This letter only addresses the applicability of the stated regulations on the features identified on the subject property and/or within the proposed project area. This letter does not approve any activity within buffers or within waters of the state. There may be other regulated waters, streams or other features located on the property that do not appear on the maps or table referenced above. Any waters, streams, or other features on the site, including the features identified in this letter, may be considered jurisdictional according to the US Army Corps of Engineers and subject to the Clean Water Act. If you have any additional questions or require additional information, please contact DWR staff Tyler Clark at 919-791-4242 or timothy.clark@deq.nc.gov. This determination is subject to review as provided in Articles 3 & 4 of G.S. 150B.

Sincerely,

DocuSigned by:

 B2916E6AB32144F...

Vanessa Manuel
 Assistant Regional Supervisor
 DWR Raleigh Regional Office

Enclosures: USGS Topographical Map
 published NRCS Soil Survey

Electronic cc: DWR, Raleigh Regional Office



Cooper Academy, 849 Mail Street
Clayton, NC 27520—DWR Project # 23-374




Feature A
Not shown
Not subject

USGS Topographical Map

2023

Legend:

-Proposed Project Boundary 



:: Locations are approximate
and are provided for refer-
ence only ::



**Cooper Academy, 849 Mail Street
Clayton, NC 27520—DWR Project # 23-374**




**Feature A
Not subject**

NRCS Soil Survey Sheet

Wake County., NC 1970

Legend:

-Proposed project boundary: 



:: Locations are approximate
and are provided for refer-
ence only ::





United States Department of the Interior



FISH AND WILDLIFE SERVICE

Raleigh Field Office
P.O. Box 33726
Raleigh, NC 27636-3726

Date: _____

Self-Certification Letter

Project Name _____

IPaC Project Code: _____ IPaC Record Locator # _____

Dear Applicant:

Thank you for using the U.S. Fish and Wildlife Service (Service) Raleigh Ecological Services online project review process. By printing this letter in conjunction with your project review package, you are certifying that you have completed the online project review process for the project named above in accordance with all instructions provided, using the best available information to reach your conclusions. This letter, and the enclosed project review package, completes the review of your project in accordance with the Endangered Species Act of 1973 (16 U.S.C. 1531-1544, 87 Stat. 884), as amended (ESA), and the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c, 54 Stat. 250), as amended (Eagle Act). This letter also provides information for your project review under the National Environmental Policy Act of 1969 (P.L. 91-190, 42 U.S.C. 4321-4347, 83 Stat. 852), as amended. A copy of this letter and the project review package must be submitted to this office for this certification to be valid. This letter and the project review package will be maintained in our records.

The species conclusions table in the enclosed project review package summarizes your ESA and Eagle Act conclusions. Based on your analysis, mark all the determinations that apply:

- “no effect” determinations for proposed/listed species and/or proposed/designated critical habitat; and/or
- “may affect, not likely to adversely affect” determinations for proposed/listed species and/or proposed/designated critical habitat; and/or
- “no Eagle Act permit required” determinations for eagles.

Species Conclusions Table

Project Name: Cooper Academy

Date: 12/1/2023

Species / Resource Name	Conclusion	ESA Section 7 / Eagle Act Determination	Notes / Documentation
Tricolored bat <i>Perimyotis subflavus</i>	Suitable habitat present No critical habitat present	May Effect	Trees present on site capable of supporting tricolored bat.
Bald Eagle <i>Haliaeetus leucocephalus</i>	Unlikely to disturb nesting bald eagles No critical habitat present	No Effect	Action area not within 600 feet of a bald eagle nest as identified by NCNHP report and trees within the site are not capable of supporting a bald eagle nest. No eagles or nests were observed during site visit.
Red cockaded woodpecker <i>Picoides borealis</i>	Suitable habitat not present No critical habitat present	No Effect	No stands of mature pine present capable of supporting the red-cockaded woodpecker
Neuse River Waterdog <i>Necturus lewisi</i>	Suitable habitat not present No critical habitat present	No Effect	No streams capable of supporting this species are located on site. Appropriate sediment and erosion control devices will be utilized to reduce potential for impacts to adjacent streams.
Carolina madtom <i>Noturus furiosus</i>	Suitable habitat not present No critical habitat present	No Effect	No streams capable of supporting this species are located on site. Appropriate sediment and erosion control devices will be utilized to reduce potential for impacts to adjacent streams.
Atlantic pigtoe <i>Fusconaia masoni</i>	Suitable habitat not present No critical habitat present	No effect	No streams capable of supporting this species are located on site. Appropriate sediment and erosion control devices will be utilized to reduce potential for impacts to adjacent streams.
Dwarf wedgemussel <i>Alasmidonta heterodon</i>	Suitable habitat not present No critical habitat present	No effect	No streams capable of supporting this species are located on site. Appropriate sediment and erosion control devices will

			be utilized to reduce potential for impacts to adjacent streams.
Green floater <i>Lasmigona subviridis</i>	Suitable habitat not present No critical habitat present	No effect	No streams capable of supporting this species are located on site. Appropriate sediment and erosion control devices will be utilized to reduce potential for impacts to adjacent streams.
Monarch butterfly <i>Danaus plexippus</i>	Suitable habitat present No critical habitat present	No Effect	No milkweed was identified on site.

Acknowledgement: I agree that the above information about my proposed project is true. I used all of the provided resources to make an informed decision about impacts in the immediate and surrounding areas

Ashley Bentz

12/1/2023

Signature /Title

Date

We certify that use of the online project review process in strict accordance with the instructions provided as documented in the enclosed project review package results in reaching the appropriate determinations. Therefore, we concur with the “no effect” or “not likely to adversely affect” determinations for proposed and listed species and proposed and designated critical habitat; the “may affect” determination for Northern long-eared bat; and/or the “no Eagle Act permit required” determinations for eagles. Additional coordination with this office is not needed. Candidate species are not legally protected pursuant to the ESA. However, the Service encourages consideration of these species by avoiding adverse impacts to them. Please contact this office for additional coordination if your project action area contains candidate species. Should project plans change or if additional information on the distribution of proposed or listed species, proposed or designated critical habitat, or bald eagles becomes available, this determination may be reconsidered. This certification letter is valid for 1 year. Information about the online project review process including instructions, species information, and other information regarding project reviews within North Carolina is available at our website <http://www.fws.gov>. If you have any questions, you can write to us at Raleigh@fws.gov or please contact Leigh Mann of this office at 919-856-4520, ext. 10.

Sincerely,

/s/Pete Benjamin

Pete Benjamin
Field Supervisor
Raleigh Ecological Services

Enclosures - project review package



December 1, 2023

United States Department of the Interior
Fish and Wildlife Service – Eastern North Carolina Field Office
PO Box 33726
Raleigh, North Carolina 27636

Reference: **Protected Species Habitat Assessment
Cooper Academy Expansion**
Clayton, Johnston County, North Carolina
S&ME Project No. 23050591

S&ME, Inc. (S&ME) is conducting an environmental review of the proposed Cooper Academy expansion site on behalf of Johnston County Schools. The information contained herein was prepared as part of an evaluation of potential impacts to migratory birds, threatened, endangered, and proposed species, and critical habitat.

◆ SITE DESCRIPTION

The site is the location of an expansion of Cooper Academy located at 849 Mial Street in Clayton, Johnston County, North Carolina and is further identified as Johnston County Property Identification Number 166914-33-1988. The location of the site is depicted on the attached Vicinity Map (**Figure 1**), United States Geological Service (USGS) Topographic Map (**Figure 2**), and Site Map (**Figure 3**).

A site visit was conducted on October 11, 2023, by S&ME natural resources personnel. The site is partially developed as an elementary school with the remainder undeveloped. Within the footprint of the site that has been developed, vegetation is limited and consists primarily of species commonly used in landscaping. The undeveloped portion of the site is wooded with a mix of deciduous and evergreen vegetation. Woody species present included loblolly pine (*Pinus taeda*), white oak (*Quercus alba*), water oak (*Q. nigra*), northern red oak (*Q. rubra*), southern red oak (*Q. falcata*), pignut hickory (*Carya glabra*), sourwood (*Oxydendron arboreum*), black cherry (*Prunus serotina*), flowering dogwood (*Cornus florida*), red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*), and American holly (*Ilex opaca*). Greenbrier (*Smilax* sp.), Japanese honeysuckle (*Lonicera japonica*), Virginia creeper (*Parthenocissus quinquefolia*), grape (*Vitis* sp.), and bush clover (*Lespedeza bicolor*). Representative photos of the undeveloped areas are shown as **photos 1-4** in the attached photographic log.

◆ MIGRATORY BIRDS

The following migratory bird information is intended to identify site area land uses that may be related to potential impacts to migratory birds. The information is based on map/photograph review.

The USGS quadrangle map and a 2021 aerial photograph (obtained from NC Onemap), and July 2023 Google Earth imagery were reviewed to determine the general land uses within a one-mile radius of the Site location. The



site is located just northeast of downtown Clayton with a mix of commercial, institutional and residential development. To the north, east, and southeast by a mixture of undeveloped and residential development. Little Creek and unnamed tributaries of the Neuse River are located within one mile of the project site. In addition to these, there are also approximately six ponds that could be conducive to migratory bird concentrations.

◆ **SPECIES EVALUATION**

Existing federal-listed species information and site habitat observations were reviewed to determine the likely occurrence of protected (threatened, endangered), candidate, and proposed species at the proposed site. The USFWS website indicates that no designated critical habitat has been reported as occurring within the proposed Site. As listed in Table 1 below, several federally-protected species are listed within the vicinity of the Site in Johnston County, North Carolina.

Table 1 – Federal Species of Concern

Common Name	Scientific Name	Federal Listing
Tricolored bat	<i>Perimyotis subflavus</i>	PE
Red-Cockaded Woodpecker	<i>Picoides borealis</i>	E
Neuse River waterdog	<i>Necturus lewisi</i>	T
Carolina madtom	<i>Noturus furiosus</i>	E
Atlantic pigtoe	<i>Fusconaia masoni</i>	T
Dwarf wedgemussel	<i>Alasmidonta heterodon</i>	E
Green floater	<i>Lasmigona subviridis</i>	PT
Bald eagle	<i>Haliaeetus leucocephalus</i>	BGEPA
Monarch butterfly	<i>Danaus plexippus</i>	C

E = Federal Endangered T = Federal Threatened P = Proposed Threatened
BGEPA = Bald and Golden Eagle Protection Act C = Candidate

Tricolored Bat

Status: Proposed Federally- Endangered

Biological Determination: NOT APPLICABLE TO PROPOSED SPECIES; May Affect, Not Likely to Adversely Affect (If clearing moratoriums are followed)

The tricolored bat is a small bat species reaching between 7 and 8 centimeters in length. The tricolored bat is named after the coloration of each strand of hair, which is dark at the base, blends to yellow midshaft, and ends in a brown tip. The species’ current range is eastern North America, though the tricolored bat is in great decline from its historic range and population numbers.

The tricolored bat is a generalist feeder that preys on insects using echolocation. The tricolored bat hibernates in caves or abandoned mines. This species is known to hibernate in man-made structures such as road-side culverts.



During spring, summer, and fall seasons the tricolored bat roosts in trees and leaf clusters. The tricolored bat tends to hibernate alone and roost singly, though has been known to share hibernacula with other bat species.

Additional consultation with the USFWS is not currently necessary because the tricolored bat is not a protected species at this time. As a result, a biological determination is not applicable to this species. However, the listing of this species is expected around the end of 2023 or beginning of 2024. If the tricolored bat becomes listed as an endangered species, further consultation with the USFWS may be required as tree removal may affect this species. If this species is listed, clearing moratoriums would likely be required during the typical active season for this species which extends from April 1 through October 15 or acoustic surveys would need to be conducted in accordance with USFWS survey protocols to determine the presence or absence of the tricolored bat at the site. If this clearing moratorium is observed, the determination for this species could be "may affect, not likely to adversely affect."

Red-cockaded Woodpecker

Status: Federally- Endangered

Biological Determination: No effect

The red-cockaded woodpecker is a small bird measuring approximately seven inches in length. The bird is identified by the black and white barred back, white cheek patch, and by the red "cockade" feathers. These red feathers are limited to the male birds of the species and can only be seen when the male bird is disturbed or otherwise excited. Red-cockaded woodpeckers require open mature forests of pine, generally approximately 60-120 years old, for roosting. These birds need large, live older pines in which they can excavate their nesting cavities. Long leaf pines are preferred, but other species of pine can also be acceptable. Dense stands or stands with dense understories are avoided. The red-cockaded woodpecker forages in pine and pine hardwood stands 30 years old or older, preferring stands with pine trees 10 inches or larger in diameter. Clusters of cavity trees can include one or more cavity trees with an average of 10 cavities on 3-60 acres. Sufficient foraging habitat can be provided on 80-125 acres.

There are no suitable pine stands within the site and therefore there is no habitat for the red-cockaded woodpecker.

Neuse River Waterdog

Status: Federally- Threatened

Biological Determination: No effect

The Neuse River waterdog is a permanently aquatic salamander. This species of salamander can grow up to 11 inches long with a reddish-brown body and irregular pattern of large blue or black spots. The waterdog has a laterally compressed tail the same coloration as the body. The belly is typically a dull brown or gray color with similar spots to those elsewhere on the body. Adults of the species have elongated heads with squared-off noses, cylindrical trunks, and tails that are laterally compressed and ridged. Three dark red gills extend from either side of the head and a dark line runs through the eye. Unlike most other salamanders, the front and hind feet have four



toes each. This species prefers low to moderate gradient streams and low current velocity. The water must be clean and have high dissolved oxygen concentrations and is usually found in streams wider than 15 meters. This species is more active in cold water with decreasing activity above temperatures above 18 degrees (°) Celsius, spending approximately 85 percent (%) of their time under large granite rocks or in burrows. During early spring, these salamanders move into leaf beds over mud banks on the low-energy side of riffles. These leaf beds contain leaves that are intact or only slightly decomposed and have high numbers of macroinvertebrates.

There are no streams on site and therefore, there is no habitat for the Neuse River waterdog.

Carolina Madtom

Status: Federally- Endangered

Biological Determination: No effect

The Carolina madtom is a small catfish with a maximum length of approximately five inches. This species of catfish has a short, chunky body with three dark saddles along its back. These saddles connect a wide, black stripe along the side of the fish extending from its snout to the base of the tail. The adipose fin has a dark spot that does not reach the edge of the fin. The saddles are spaced by yellowish to tan blotches and the remainder of the fish is tan colored. The tail has crescent shaped banks near the edge and center. The pectoral fins have well-defined serrated projections along the margins and contain stinging spines. This fish occurs in riffles, runs, and pools in medium to large streams and rivers. They prefer water with continuous flow, year-round flow and moderate gradient. Their preferred substrates are silt free, stable, gravel and cobble bottoms with cover for nesting sites. Examples of suitable cover include shells, logs, pieces of bark, or rocks.

There are no streams on site and therefore, there is no habitat for the Carolina madtom.

Atlantic Pigtoe

Status: Federally-Threatened

Biological Determination: No effect

The Atlantic pigtoe has a rhombus shaped outer shell which is yellow to dark brown in color with a parchment-like texture. The inner shell is iridescent blue to salmon, white, or orange. This species rarely exceeds two inches in length. Young individuals have greenish rays across the shell. This species is also known for interlocking hinge-like teeth on the inside of the shell to keep the valves in proper alignment. The Atlantic pigtoe prefers coarse gravel and sand substrate and is rarely found in silt or detritus. Historically, this species was identified in small creeks to larger rivers with excellent water quality with flows sufficient to maintain clean, silt-free substrates.

There are no streams on site and therefore, there is no habitat for the Atlantic pigtoe.



Dwarf Wedgemussel

Status: Federally-Listed Endangered

Biological Determination: No effect

The Tar River spiny mussel has shiny shells that are usually yellowish-brown and often have greenish rays streaking outward from the hinge area. Older individuals are more brown in color and the rays have faded. This mussel rarely exceeds two inches in length. The Tar River spiny mussel requires streams that are relatively silt-free beds of coarse sand and gravel in relatively fast-flowing, well oxygenated streams.

There are no streams on site and therefore, there is no suitable habitat for the dwarf wedgemussel.

Green Floater

Status: Proposed Federally- Threatened

Biological Determination: NOT APPLICABLE TO PROPOSED SPECIES; No effect due to lack of habitat

The green floater is a freshwater mussel approximately 2.2 inches in length. The shell is small and the mussel has a subovate or trapezoidal shape. The color of the outer shell varies from a dull yellow to green with many dark green rays visible, especially in young individuals. This species prefers streams with slow to medium flows and good water quality. They are frequently found in pools and eddies with small gravel and sand substrate in depths of one to four feet.

There are no streams on site and therefore, there is no suitable habitat for the green floater.

Bald Eagle

Status: Bald and Golden Eagle Protection Act

Biological Determination: No effect

The bald eagle prefers to nest in large mature trees within half a mile of coastlines, rivers, or large lakes which provide adequate feeding grounds. The nearest waterbody able to support a bald eagle is a large pond approximately 1.3 miles south of the site or the Neuse River located approximately 1.5 miles east of the site. In addition, no bald eagles or bald eagle nests were observed in the vicinity of the site. Therefore, the project will have no effect on the bald eagle.



Monarch Butterfly

Status: Federally Listed Candidate

Biological Determination: Not Applicable to Candidate Species

The Monarch butterfly is under consideration for official listing for which there is sufficient information to support listing (candidate listing). There are generally no section 7 requirements for candidate species. Adult monarch butterflies are large and conspicuous, with bright orange wings surrounded by a black border and covered with black veins. The black border has a double row of white spots, present on the upper side of the wings. Adult monarchs are sexually dimorphic, with males having narrower wing venation and scent patches. The bright coloring of a monarch serves as a warning to predators that eating them can be toxic. During the breeding season, monarchs lay their eggs on their obligate milkweed host plant (primarily *Asclepias* spp.) and the larvae feed on milkweed. Milkweed species are commonly found in open areas such as meadows, old fields, woodland edges, roadsides, utility lines, and other open areas. No species of milkweed were identified during the site reconnaissance.

No critical habitat has been designated for this species and as a candidate species, there is no federal protection afforded for the monarch butterfly. However, the USFWS appreciates its inclusion in assessments. Marginal suitable habitat exists along the woodland edges. No individuals of monarch butterfly or milkweed were observed during the habitat assessment. A biological determination for the monarch butterfly is not applicable to the proposed project as the monarch butterfly is a candidate species.

◆ CONCLUSIONS

Based on the readily available information and a review of habitat conditions for the tricolored bat, red-cockaded woodpecker, Neuse River waterdog, Carolina madtom, Atlantic pigtoe, dwarf wedgemussel, green floater, bald eagle, and monarch butterfly. There is no suitable habitat present for the red-cockaded woodpecker, Neuse River waterdog, Carolina madtom, Atlantic pigtoe, dwarf wedgemussel, green floater, or bald eagle, resulting in a “no effect” determination for these species. The remaining two species, the tricolored bat and monarch butterfly, are currently proposed to be listed under the Endangered Species Act. While these species both have potential habitat on site, they are not currently afforded protection under the Endangered Species Act. In the event that these species are listed prior to the initiation of the project, additional consultation with the USFWS may be required.



◆ CLOSING

If there are questions concerning the evaluation, please contact Ashley Bentz at 919-896-0758, or abentz@smeinc.com.

Handwritten signature of Ashley Bentz in blue ink.

Ashley Bentz, PWS
S&ME Project Scientist

Handwritten signature of Walter Cole in blue ink.

Walter Cole, LSS, REHS
S&ME Senior Project Manager

Attachments

Qualifications

The field survey was led by Ashley Bentz of S&ME. Ms. Bentz is a biologist and staff scientist with eleven years of experience in environmental and natural resources consulting. Ms. Bentz is proficient in conducting wetland delineations, environmental permitting activities, and habitat assessments, including protected species surveys. She holds a B.S. degree in Environmental Studies from Elon University with minors in Biology and Geographic Information Systems and has a Master of Natural Resources degree from North Carolina State University with a focus on ecological restoration. She possesses the knowledge and competence in evaluating impacts of construction projects on wildlife, fish, and flora and their habitats.

Attachments



United States Department of the Interior



FISH AND WILDLIFE SERVICE
Raleigh Ecological Services Field Office
Post Office Box 33726
Raleigh, NC 27636-3726
Phone: (919) 856-4520 Fax: (919) 856-4556

In Reply Refer To:
Project Code: 2024-0005418
Project Name: Cooper Academy

October 16, 2023

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*). If your project area contains suitable habitat for any of the federally-listed species on this species list, the proposed action has the potential to adversely affect those species. If suitable habitat is present, surveys should be conducted to determine the species' presence or absence within the project area. The use of this species list and/or North Carolina Natural Heritage program data should not be substituted for actual field surveys.

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered

species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

<https://www.fws.gov/sites/default/files/documents/endangered-species-consultation-handbook.pdf>

Migratory Birds: In addition to responsibilities to protect threatened and endangered species under the Endangered Species Act (ESA), there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). For more information regarding these Acts, see <https://www.fws.gov/program/migratory-bird-permit/what-we-do>.

The MBTA has no provision for allowing take of migratory birds that may be unintentionally killed or injured by otherwise lawful activities. It is the responsibility of the project proponent to comply with these Acts by identifying potential impacts to migratory birds and eagles within applicable NEPA documents (when there is a federal nexus) or a Bird/Eagle Conservation Plan (when there is no federal nexus). Proponents should implement conservation measures to avoid or minimize the production of project-related stressors or minimize the exposure of birds and their resources to the project-related stressors. For more information on avian stressors and recommended conservation measures, see <https://www.fws.gov/library/collections/threats-birds>.

In addition to MBTA and BGEPA, Executive Order 13186: *Responsibilities of Federal Agencies to Protect Migratory Birds*, obligates all Federal agencies that engage in or authorize activities that might affect migratory birds, to minimize those effects and encourage conservation measures that will improve bird populations. Executive Order 13186 provides for the protection of both migratory birds and migratory bird habitat. For information regarding the implementation of Executive Order 13186, please visit <https://www.fws.gov/partner/council-conservation-migratory-birds>.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Code in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List
- USFWS National Wildlife Refuges and Fish Hatcheries
- Bald & Golden Eagles
- Migratory Birds

OFFICIAL SPECIES LIST

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Raleigh Ecological Services Field Office

Post Office Box 33726
Raleigh, NC 27636-3726
(919) 856-4520

PROJECT SUMMARY

Project Code: 2024-0005418
Project Name: Cooper Academy
Project Type: New Constr - Above Ground
Project Description: proposed improvements - school facility
Project Location:

The approximate location of the project can be viewed in Google Maps: <https://www.google.com/maps/@35.65571385,-78.45062621751542,14z>



Counties: Johnston County, North Carolina

ENDANGERED SPECIES ACT SPECIES

There is a total of 8 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries¹, as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

-
1. [NOAA Fisheries](#), also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

MAMMALS

NAME	STATUS
Tricolored Bat <i>Perimyotis subflavus</i> No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/10515	Proposed Endangered

BIRDS

NAME	STATUS
Red-cockaded Woodpecker <i>Picoides borealis</i> No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/7614	Endangered

AMPHIBIANS

NAME	STATUS
Neuse River Waterdog <i>Necturus lewisi</i> There is final critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/6772	Threatened

FISHES

NAME	STATUS
Carolina Madtom <i>Noturus furiosus</i> There is final critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/528	Endangered

CLAMS

NAME	STATUS
Atlantic Pigtoe <i>Fusconaia masoni</i> There is final critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/5164	Threatened
Dwarf Wedgemussel <i>Alasmidonta heterodon</i> No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/784	Endangered
Green Floater <i>Lasmigona subviridis</i> There is proposed critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/7541	Proposed Threatened

INSECTS

NAME	STATUS
Monarch Butterfly <i>Danaus plexippus</i> No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate

CRITICAL HABITATS

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

YOU ARE STILL REQUIRED TO DETERMINE IF YOUR PROJECT(S) MAY HAVE EFFECTS ON ALL ABOVE LISTED SPECIES.

USFWS NATIONAL WILDLIFE REFUGE LANDS AND FISH HATCHERIES

Any activity proposed on lands managed by the [National Wildlife Refuge](#) system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS OR FISH HATCHERIES WITHIN YOUR PROJECT AREA.

BALD & GOLDEN EAGLES

Bald and golden eagles are protected under the Bald and Golden Eagle Protection Act¹ and the Migratory Bird Treaty Act².

Any person or organization who plans or conducts activities that may result in impacts to bald or golden eagles, or their habitats³, should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

1. The [Bald and Golden Eagle Protection Act](#) of 1940.

2. The [Migratory Birds Treaty Act](#) of 1918.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

There are bald and/or golden eagles in your project area.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
Bald Eagle <i>Haliaeetus leucocephalus</i> This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Sep 1 to Jul 31

PROBABILITY OF PRESENCE SUMMARY

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read the supplemental information and specifically the FAQ "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Green bars; the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during that week of the year.

Breeding Season (■)

Yellow bars; liberal estimate of the timeframe inside which the bird breeds across its entire range.

Survey Effort (|)

Vertical black lines; the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps.

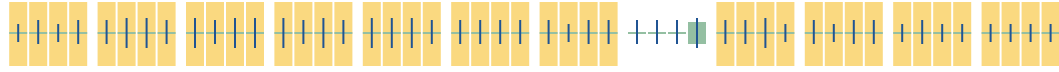
No Data (—)

A week is marked as having no data if there were no survey events for that week.

■ probability of presence ■ breeding season | survey effort — no data

SPECIES JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

Bald Eagle
Non-BCC
Vulnerable



Additional information can be found using the following links:

- Eagle Management <https://www.fws.gov/program/eagle-management>
- Measures for avoiding and minimizing impacts to birds <https://www.fws.gov/library/collections/avoiding-and-minimizing-incident-take-migratory-birds>
- Nationwide conservation measures for birds <https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf>
- Supplemental Information for Migratory Birds and Eagles in IPaC <https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action>

MIGRATORY BIRDS

Certain birds are protected under the Migratory Bird Treaty Act¹ and the Bald and Golden Eagle Protection Act².

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats³ should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

-
1. The [Migratory Birds Treaty Act](#) of 1918.
 2. The [Bald and Golden Eagle Protection Act](#) of 1940.
 3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
American Kestrel <i>Falco sparverius paulus</i> This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/9587	Breeds Apr 1 to Aug 31
Bald Eagle <i>Haliaeetus leucocephalus</i> This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Sep 1 to Jul 31

NAME	BREEDING SEASON
Brown-headed Nuthatch <i>Sitta pusilla</i> This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/9427	Breeds Mar 1 to Jul 15
Chimney Swift <i>Chaetura pelagica</i> This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9406	Breeds Mar 15 to Aug 25
Eastern Whip-poor-will <i>Antrostomus vociferus</i> This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/10678	Breeds May 1 to Aug 20
Prairie Warbler <i>Dendroica discolor</i> This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9513	Breeds May 1 to Jul 31
Prothonotary Warbler <i>Protonotaria citrea</i> This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9439	Breeds Apr 1 to Jul 31
Red-headed Woodpecker <i>Melanerpes erythrocephalus</i> This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9398	Breeds May 10 to Sep 10
Wood Thrush <i>Hylocichla mustelina</i> This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9431	Breeds May 10 to Aug 31

PROBABILITY OF PRESENCE SUMMARY

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read the supplemental information and specifically the FAQ "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Green bars; the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during that week of the year.

Breeding Season (■)

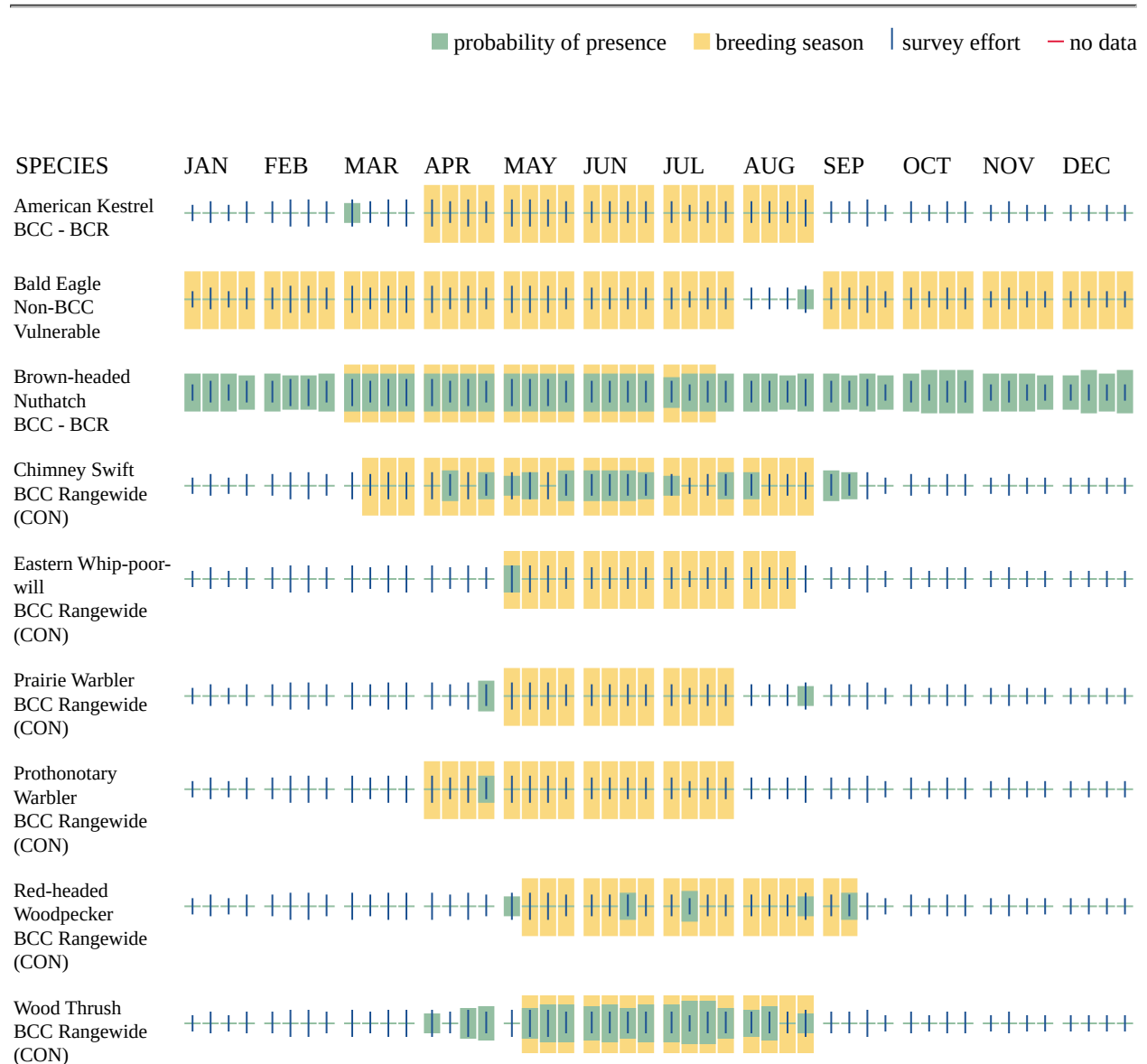
Yellow bars; liberal estimate of the timeframe inside which the bird breeds across its entire range.

Survey Effort (|)

Vertical black lines; the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps.

No Data (-)

A week is marked as having no data if there were no survey events for that week.



Additional information can be found using the following links:

- Eagle Management <https://www.fws.gov/program/eagle-management>

- Measures for avoiding and minimizing impacts to birds <https://www.fws.gov/library/collections/avoiding-and-minimizing-incident-take-migratory-birds>
 - Nationwide conservation measures for birds <https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf>
 - Supplemental Information for Migratory Birds and Eagles in IPaC <https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action>
-

IPAC USER CONTACT INFORMATION

Agency: S&ME, Inc.

Name: Ashley Bentz

Address: 3201 Spring Forest Road

City: Raleigh

State: NC

Zip: 27616

Email abentz@smeinc.com

Phone: 9198960758



Roy Cooper, Governor

D. Reid Wilson, Secretary

Misty Buchanan
Deputy Director, Natural Heritage Program

NCNHDE-22728

July 20, 2023

Ashley Bentz
S&ME, Inc.
3201 Spring Forest Road
Raleigh, NC 27616
RE: Cooper Academy

Dear Ashley Bentz:

The North Carolina Natural Heritage Program (NCNHP) appreciates the opportunity to provide information about natural heritage resources for the project referenced above.

Based on the project area mapped with your request, a query of the NCNHP database indicates that there are no records for rare species, important natural communities, natural areas, and/or conservation/managed areas within the proposed project boundary. Please note that although there may be no documentation of natural heritage elements within the project boundary, it does not imply or confirm their absence; the area may not have been surveyed. The results of this query should not be substituted for field surveys where suitable habitat exists. In the event that rare species are found within the project area, please contact the NCNHP so that we may update our records.

The attached 'Potential Occurrences' table summarizes rare species and natural communities that have been documented within a one-mile radius of the property boundary. The proximity of these records suggests that these natural heritage elements may potentially be present in the project area if suitable habitat exists. Tables of natural areas and conservation/managed areas within a one-mile radius of the project area, if any, are also included in this report.

If a Federally-listed species is found within the project area or is indicated within a one-mile radius of the project area, the NCNHP recommends contacting the US Fish and Wildlife Service (USFWS) for guidance. Contact information for USFWS offices in North Carolina is found here: <https://www.fws.gov/offices/Directory/ListOffices.cfm?statecode=37>.

Please note that natural heritage element data are maintained for the purposes of conservation planning, project review, and scientific research, and are not intended for use as the primary criteria for regulatory decisions. Information provided by the NCNHP database may not be published without prior written notification to the NCNHP, and the NCNHP must be credited as an information source in these publications. Maps of NCNHP data may not be redistributed without permission.

The NC Natural Heritage Program may follow this letter with additional correspondence if a Dedicated Nature Preserve, Registered Heritage Area, Land and Water Fund easement, or Federally-listed species are documented near the project area.

If you have questions regarding the information provided in this letter or need additional assistance, please contact Rodney A. Butler at rodney.butler@ncdcr.gov or 919-707-8603.

Sincerely,
NC Natural Heritage Program

Natural Heritage Element Occurrences, Natural Areas, and Managed Areas Within a One-mile Radius of the Project Area
 Cooper Academy
 July 20, 2023
 NCNHDE-22728

Element Occurrences Documented Within a One-mile Radius of the Project Area

Taxonomic Group	EO ID	Scientific Name	Common Name	Last Observation Date	Element Occurrence Rank	Accuracy	Federal Status	State Status	Global Rank	State Rank
Dragonfly or Damselfly	33753	Somatochlora georgiana	Coppery Emerald	2004-Pre	H?	5-Very Low	---	Significantly Rare	G3G4	S1?

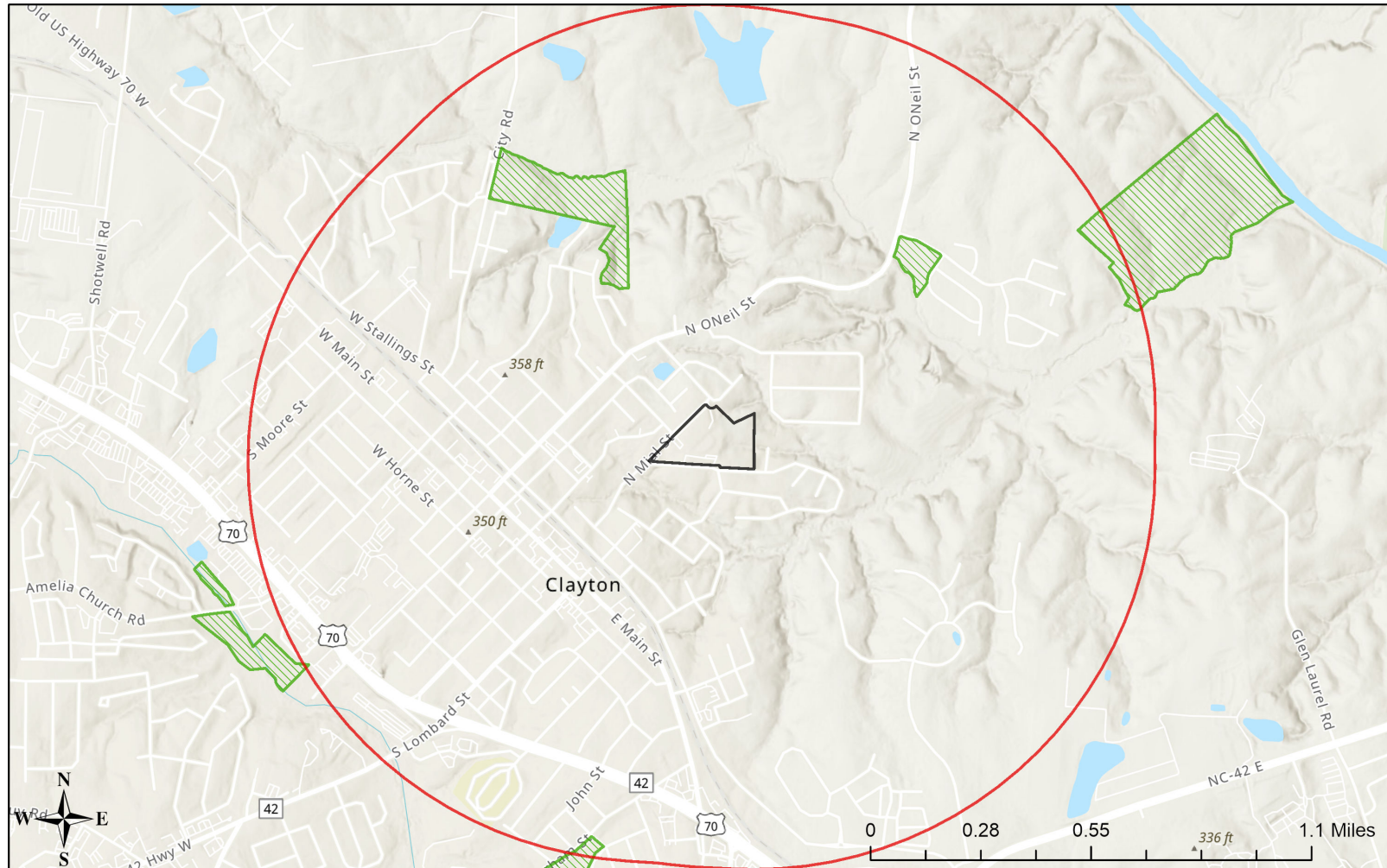
No Natural Areas are Documented Within a One-mile Radius of the Project Area

Managed Areas Documented Within a One-mile Radius of the Project Area




Managed Area Name	Owner	Owner Type
Town of Clayton - Legend Park	Town of Clayton	Local Government
Town of Clayton Open Space	Town of Clayton	Local Government
Town of Clayton Open Space	Town of Clayton	Local Government
Town of Clayton Open Space	Town of Clayton	Local Government
Town of Clayton Open Space	Town of Clayton	Local Government

Definitions and an explanation of status designations and codes can be found at <https://ncnhde.natureserve.org/help>. Data query generated on July 20, 2023; source: NCNHP, Spring (April) 2023. Please resubmit your information request if more than one year elapses before project initiation as new information is continually added to the NCNHP database.

NCNHDE-22728: Cooper Academy



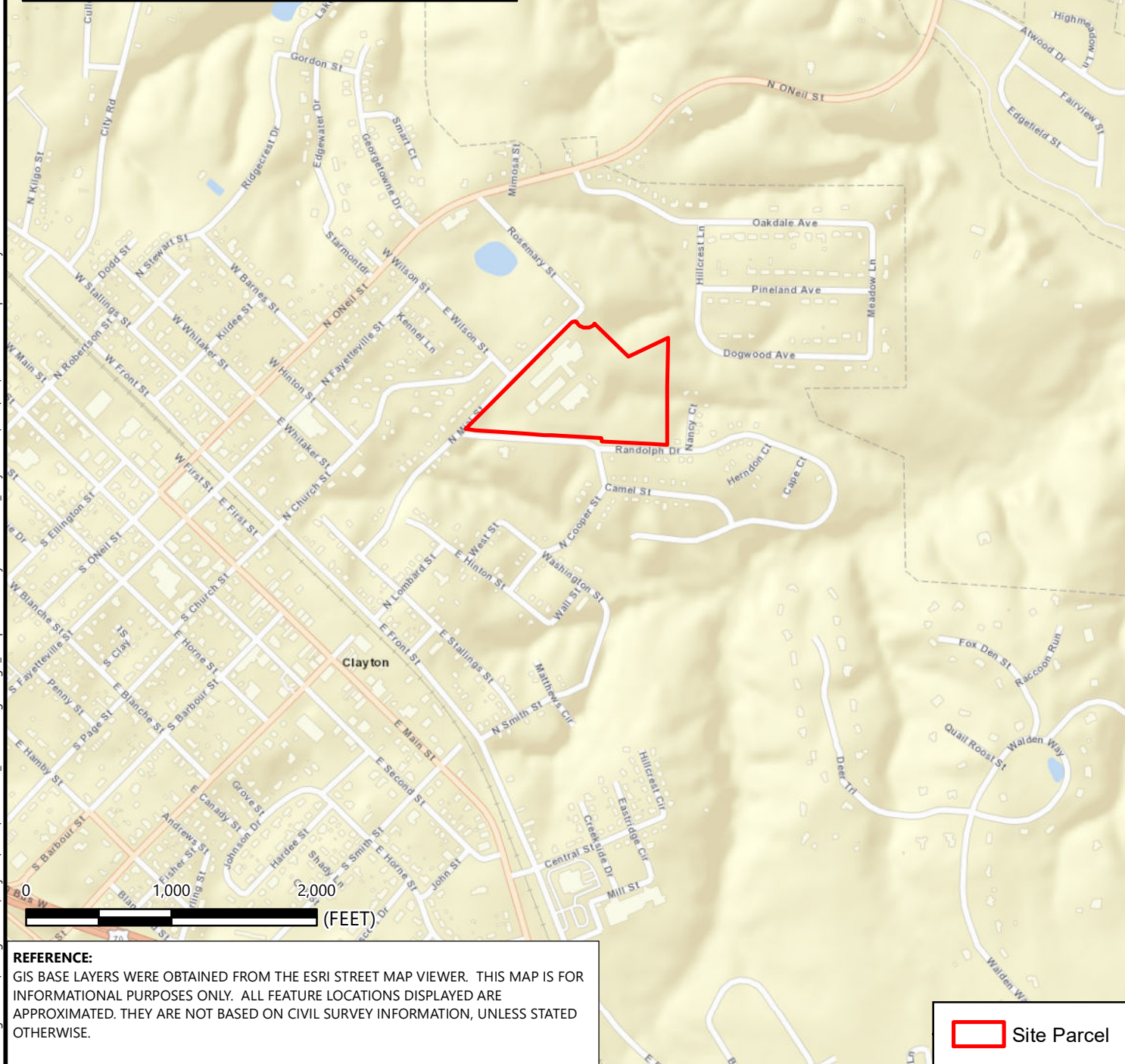
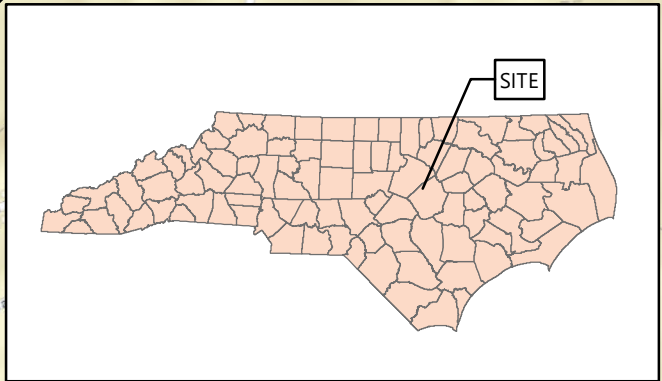
July 20, 2023

-  Managed Area (MAREA)
-  Buffered Project Boundary
-  Project Boundary

Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community
Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

Attachment I – Additional Figures

Drawing Path: T:\Raleigh-1050\Projects\2023\23050591_Boomerang Design_Cooper Academy NRB and TE, Clayton NC\EN\GIS\VICINITY.mxd plotted by abentz 12-01-2023



REFERENCE:
GIS BASE LAYERS WERE OBTAINED FROM THE ESRI STREET MAP VIEWER. THIS MAP IS FOR INFORMATIONAL PURPOSES ONLY. ALL FEATURE LOCATIONS DISPLAYED ARE APPROXIMATED. THEY ARE NOT BASED ON CIVIL SURVEY INFORMATION, UNLESS STATED OTHERWISE.

 Site Parcel



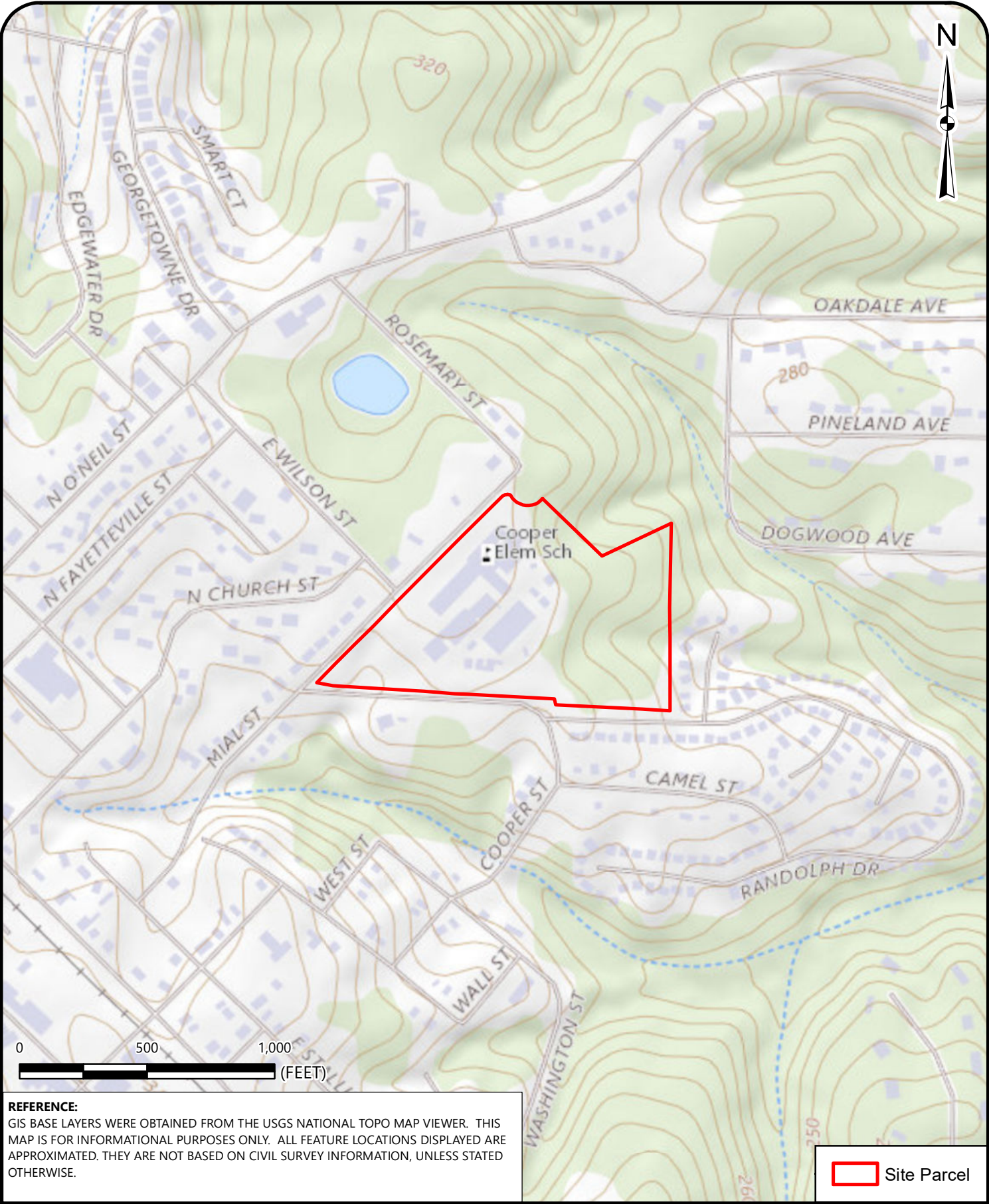
VICINITY EXHIBIT

COOPER ACADEMY
849 MIAL STREET
CLAYTON, JOHNSTON COUNTY, NORTH CAROLINA

SCALE:
1" = 1,000'
DATE:
12-1-23
PROJECT NUMBER
23050591


FIGURE NO.
1

Drawing Path: T:\Raleigh-1050\Projects\2023\23050591_Boomerang Design_Cooper Academy NRB and TE, Clayton NC\EN\GIS\USGS.mxd plotted by abentz 12-01-2023

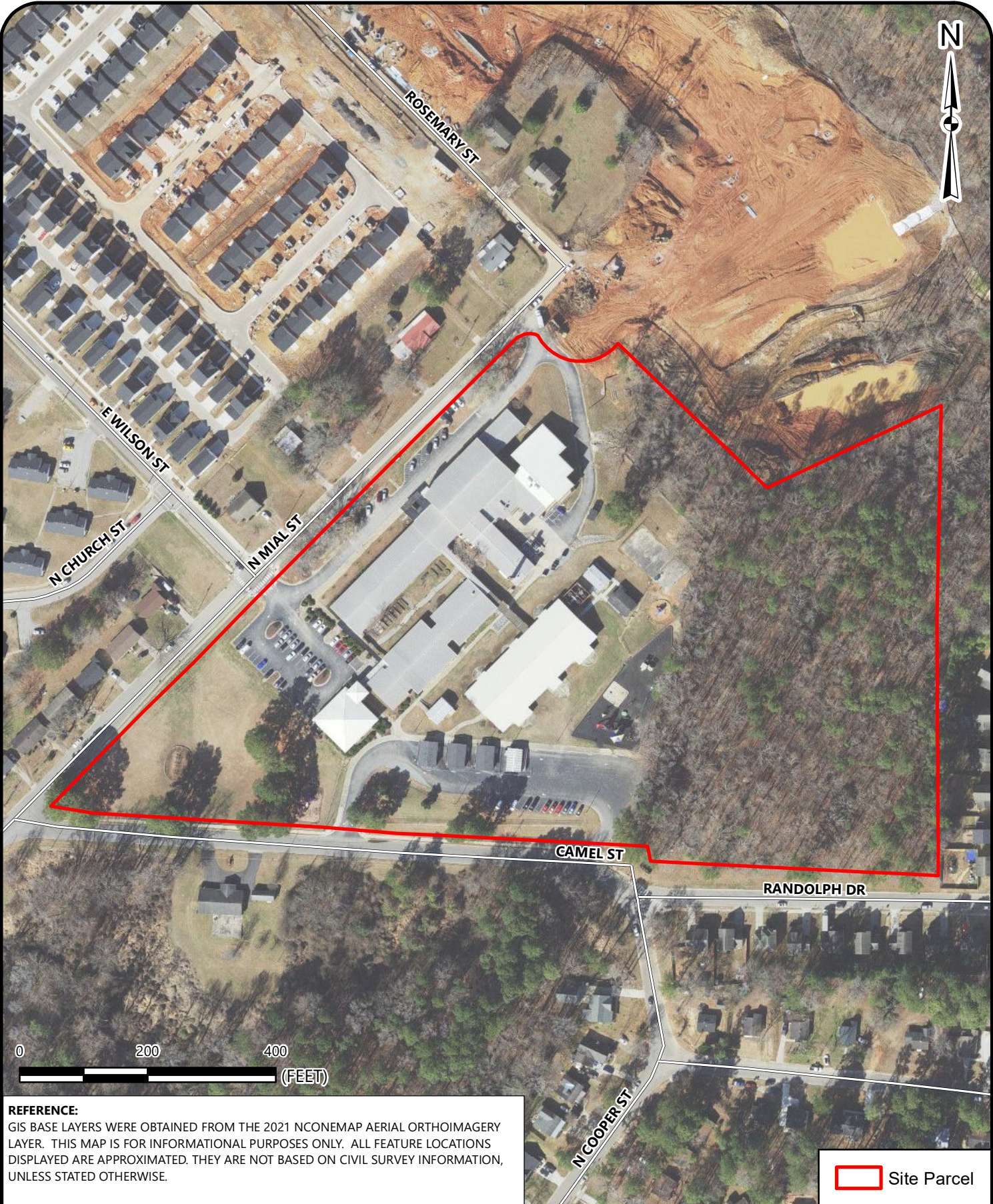


REFERENCE:
 GIS BASE LAYERS WERE OBTAINED FROM THE USGS NATIONAL TOPO MAP VIEWER. THIS MAP IS FOR INFORMATIONAL PURPOSES ONLY. ALL FEATURE LOCATIONS DISPLAYED ARE APPROXIMATED. THEY ARE NOT BASED ON CIVIL SURVEY INFORMATION, UNLESS STATED OTHERWISE.

 Site Parcel

	USGS TOPOGRAPHIC EXHIBIT		SCALE: 1" = 500'	FIGURE NO. <h1 style="font-size: 2em;">2</h1>
	COOPER ACADEMY 849 MIAL STREET		DATE: 12-1-23	
	CLAYTON, JOHNSTON COUNTY, NORTH CAROLINA		PROJECT NUMBER 23050591	

Drawing Path: T:\Raleigh-1050\Projects\2023\23050591_Boomerang Design_Cooper Academy NRB and TE_Clayton NC\EN\GIS\SITE.mxd plotted by abentz 12-01-2023



REFERENCE:
 GIS BASE LAYERS WERE OBTAINED FROM THE 2021 NCONEMAP AERIAL ORTHOIMAGERY LAYER. THIS MAP IS FOR INFORMATIONAL PURPOSES ONLY. ALL FEATURE LOCATIONS DISPLAYED ARE APPROXIMATED. THEY ARE NOT BASED ON CIVIL SURVEY INFORMATION, UNLESS STATED OTHERWISE.

 Site Parcel



SITE EXHIBIT

COOPER ACADEMY
 849 MIAL STREET
 CLAYTON, JOHNSTON COUNTY, NORTH CAROLINA

SCALE:
 1" = 200'

DATE:
 12-1-23
 PROJECT NUMBER
 23050591

FIGURE NO.

3

Attachment II – Photo Log



1 View of ephemeral drainage within crenulation in project site.



2 Representative view of wooded area within project site.



3 Representative view of wooded area within project site.



4 Representative view of wooded area within project site.



**Site Photographs
Cooper Academy
Clayton, Johnston County, North Carolina**

S&ME Project No. 23050591

Taken by: W. Cole

Date Taken: 10/11/2023

SECTION 00 63 13 – CONTRACTOR’S REQUEST FOR INTERPRETATION FORM

Project:	JCPS Cooper Academy Additions & Renovations	BD Project No.: 2307
To:	Boomerang Design	Requested by:
		Contract For: _____
Attn.:	Duane Hutchins	Date: _____
		Section Name: _____
Email:	dhutchins@thinkboomerang.com	Section Number & Paragraph _____
		Related Drawings: _____

Contractor’s Inquiry:

Contractor’s Recommended Solution:

Architect’s response to RFI will be by Architect’s Supplemental Instruction (ASI)

END OF DOCUMENT 00 63 13

SECTION 00 65 14 – CERTIFICATION OF NON-USE OF ASBESTOS CONTAINING PRODUCTS

JCPS Cooper Academy Additions & Renovations

Clayton, NC

Boomerang Design Project # 2307

Date _____

Project _____

Address _____

I hereby certify that to the best of my knowledge the projects and materials incorporated into the above referenced project are free of asbestos and asbestos-containing materials

Company _____
(name of firm or corporation making certification)

Represented By _____
(person authorized to sign)

Title _____
(owner/partner/president/vice president)

Address _____

License No. _____

Federal ID No. _____

Attest:

By _____

Title _____

END OF DOCUMENT 00 65 14

SECTION 00 65 19.13 – AFFIDAVIT OF DEBTS AND CLAIMS

Project: **JCPS Cooper Academy Additions & Renovations**
Contract For: **WIMCO Corporation**
Contract Date: **[INSERT DATE OF OWNER/CONTRACTOR AGREEMENT]**

To: Johnston County Public Schools

The undersigned, pursuant to Article 36 of the General Conditions of the Contract, hereby certifies that, he has paid in full or has otherwise satisfied all obligations for all materials and equipment furnished, for all work, labor and services performed, and for all known indebtedness and claims against the contractor for damages arising in any manner in connection with the performance of the contract referenced above for which the owner or his property might in any way be held responsible.

SUPPORTING DOCUMENTS ATTACHED HERETO:

Consent of Surety to Final Payment. Whenever surety is involved, Consent of Surety is required.

Indicate attachment: Yes ___ No ___

The following supporting documents should be attached hereto if required by the owner:

- a. Contractor's Release or Waiver of Liens, conditional upon receipt of final payment.
- b. Separate Releases or Waivers of Liens from subcontractors and material and equipment suppliers to the extent required by the Owner, accompanied by a list thereof.
- c. Contractor's Affidavit of Release of Liens.

Contractor: _____
By: _____
Address: _____

Subscribed and sworn to before me this ____ day of _____, 20__

Notary Public

My Commission Expires: _____, 20__ .

END OF DOCUMENT 00 65 19.13

SECTION 00 65 19.16 – CONTRACTOR'S AFFIDAVIT OF RELEASE OF LIENS

Project: **JCPS Cooper Academy Additions & Renovations**
Contract For: **WIMCO Corporation**
Contract Date: **[INSERT DATE OF OWNER/CONTRACTOR AGREEMENT]**

To: Johnston County Public Schools

The undersigned, pursuant to Article 36 of the General Conditions of the Contract, hereby certifies that to the best of his knowledge, information and belief, the Releases or Waivers of Lien attached hereto include the contractor, all subcontractors, all suppliers of materials and equipment, and all performers of work, labor or services who have or may have liens against any property of the owner arising in any manner out of the performance of the contract referenced above.

Supporting Documents Attached Hereto:

Contractor: _____
By: _____
Address: _____

Subscribed and sworn to before me this ____ day of _____, 20__

Notary Public

My Commission Expires: _____, 20__ .

END OF DOCUMENT 00 65 19.16

SECTION 00 65 36 – CONTRACTOR’S GENERAL WARRANTY/CERTIFICATION

**JCPS Cooper Academy Additions & Renovations
Clayton, NC**

The undersigned Contractor hereby warrants, in accordance with the applicable provisions and terms set forth in the Contract Documents, all materials and workmanship incorporated in the **JCPS Cooper Academy Additions & Renovations** _____, against any and all defects due to faulty materials or workmanship or negligence for a period of 12 months, or such longer periods as set forth in the Contract Documents, from the effective date of this warranty. This Contractor further warrants all work incorporated in this project to remain leakproof and watertight at all points for a period of 24 months from the effective date of this Warranty.

This Warranty shall be binding where defects occur due to normal usage conditions and does not cover willful or malicious damage, damage caused by acts of God or other casualty beyond the control of the Contractor.

This Warranty shall be in addition to other warranties or guarantees set forth in the Contract Documents, and shall not act to constitute a waiver of additional protection of the Owner afforded, where applicable, by consumer protection and product liability provisions of law, and these stipulations shall not constitute waiver of any additional rights or remedies available to the Owner under the law.

Signed: _____

Name: _____

Title: _____

Date: _____

(corporate seal)

Subscribed and sworn before me this
_____ day of _____, 20____.

(Notary Public)

END OF DOCUMENT 00 65 36

DIVISION 01
GENERAL REQUIREMENTS

SECTION 01 10 00 – SUMMARY**PART 1 - GENERAL****1.1 WORK COVERED BY CONTRACT DOCUMENTS**

- A. Project Identification: Project consists of new 2-Story classroom addition & interior renovations.
1. Project Location: Cooper Academy Elementary School, 849 Mial St. Clayton NC 27520.
 2. Owner: Johnston County Public Schools, 2320 US Highway 70 Business East, Smithfield NC 27577.
- B. Architect Identification: The Contract Documents, dated October 18th, 2023, were prepared for Project by Boomerang Design, 6131 Falls of Neuse Road, Suite 204, Raleigh, NC 27609
- C. The Work consists of New 35,260 sq ft 2 story classroom building, New 3,391 sq ft connector building, 465 sq ft addition to existing classroom building, 2,795 sq ft level II interior alteration to existing building.
- D. The Work includes:
1. Selective demolition.
 2. Site clearing, excavating, grading.
 3. Site storm sewer. Site sanitary sewer. Domestic water service. Domestic fire protection water service. Electrical power service. Gas service.
 4. Hot-mix asphalt paving. Concrete paving. Fences. Lawns and grasses. Trees and shrubs.
 5. Concrete foundations and floor slabs. Concrete retaining wall.
 6. Structural steel framing. Steel joists. Steel roof deck.
 7. Loadbearing Brick and concrete masonry cavity wall and concrete masonry interior walls and partitions.
 8. Metal wall panels.
 9. Metal roof panels.
 10. Aluminum curtainwall.. Aluminum storefront framing. Aluminum entrance systems.
 11. Steel doors and frames.
 12. Ceramic tile, Luxury Vinyl Tile, Sealed Concrete, Carpet.
 13. Acoustical ceiling panels. Quartz windowsills. Paint. Epoxy coatings. Vinyl & PVC wall graphics.
 14. Specialties, including: Markerboards and tackboards. Toilet compartments. Interior signs. Exterior signs. Metal Storage Shelving.
 15. Equipment, including Residential appliances.
 16. Plastic Laminate Casework.
 17. Plumbing work.
 18. Heating, ventilating and air conditioning work.
 19. Electrical work.
 20. Fire Alarm System. Security system. Communication Systems. CCTV Surveillance System.
 21. Fire suppression (sprinkler).
- E. The building is defined under the International Building Code as Type II-B Sprinklered & II-B Un-Sprinklered. Occupancy is Educational.

1.2 CONTRACTS

- A. Project will be constructed under a general construction contract.

1.3 WORK SEQUENCE

1. Construction shall be a single phase and commence on April 8th 2024 and complete on August 4th 2025.

1.4 USE OF PREMISES

- A. General: Contractor shall have full use of premises for construction operations, including use of Project site, during construction period. Contractor's use of premises is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

1.5 WORK UNDER OTHER CONTRACTS

- A. Separate Contract: Owner **[will award]** a separate contract for performance of certain construction operations at Project site. Those operations are scheduled to be substantially complete before work under this Contract begins. The separate contract **[will include]** the following:
1. Relocation of Modular Classroom Buildings:
A separate contract will be awarded to TBD to remove several modular classroom buildings with associated ramps and fencing.

- B. Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract.

1.6 FUTURE WORK

- A. Future Contract: Owner will award a separate contract for additional work to be performed at the site after Substantial Completion. Completion of that work will depend on successful completion of preparatory work under this Contract. The Contract for future work will include the following:
1. Classroom and educational furnishings package:
A separate contract will be awarded to TBD for procurement and installation of furniture package.

1.7 PRODUCTS ORDERED IN ADVANCE

- A. General: Owner has negotiated Purchase Orders with suppliers of material and equipment to be incorporated into the Work. Owner has assigned these Purchase Orders to Contractor. Costs for receiving, handling, storage if required, and installation of material and equipment are included in the Contract Sum.
1. Contractor's responsibilities are the same as if Contractor had negotiated Purchase Orders, including responsibility to renegotiate purchase and to execute final Purchase-Order agreements.
 2. The Schedule of Products Ordered in Advance is included at the end of this Section.

1.8 OWNER-FURNISHED PRODUCTS

- A. Owner will furnish toilet accessories, educational & classroom furniture. The Work includes providing support systems to receive Owner's equipment [and plumbing, mechanical, and electrical connections].
1. Owner will arrange for and deliver Shop Drawings, Product Data, and Samples to Contractor.
 2. Owner will arrange and pay for delivery of Owner-furnished items according to Contractor's Construction Schedule.
 3. After delivery, Owner will inspect delivered items for damage. Contractor shall be present for and assist in Owner's inspection.
 4. If Owner-furnished items are damaged, defective, or missing, Owner will arrange for replacement.
 5. Owner will arrange for manufacturer's field services and for delivery of manufacturer's warranties to Contractor.
 6. Owner will furnish Contractor the earliest possible delivery date for Owner-furnished products. Using Owner-furnished earliest possible delivery dates, Contractor shall designate delivery dates of Owner-furnished items in Contractor's Construction Schedule.
 7. Contractor shall review Shop Drawings, Product Data, and Samples and return them to Architect noting discrepancies or anticipated problems in use of product.
 8. Contractor is responsible for receiving, unloading, and handling Owner-furnished items at Project site.
 9. Contractor is responsible for protecting Owner-furnished items from damage during storage and handling, including damage from exposure to the elements.
 10. If Owner-furnished items are damaged as a result of Contractor's operations, Contractor shall repair or replace them.

1.9 SPECIFICATION FORMATS AND CONVENTIONS

- A. Specification Format: The Specifications are organized into Divisions and Sections using the 50-Division format of CSI/CSC's "MasterFormat" 2004 Edition numbering system.
- B. 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. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
 2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.
 - a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF OWNER FURNISHED PRODUCTS

- A. The Owner will provide the following products under the provisions of this contract:

- 1. Toilet Accessories; noted at “owner provided” on schedules.
- 2. Classroom Furnishings
- 3. _____.
- 4. _____.
- 5. _____.
- 6. _____.
- 7. _____.
- 8. _____.
- 9. _____.
- 10. _____.

END OF SECTION 01 00 00

SECTION 01 14 00 – WORK RESTRICTIONS (NEW)

PART 1 - GENERAL

1.1 USE OF PREMISES

- A. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of site beyond areas in which the Work is indicated.
 - 1. Limits: Confine constructions operations to limits of construction shown on the drawings.
- B. Toilet and Breakroom Facilities: Provide temporary facilities. Do not use owner's permanent facilities.
- C. Storage: Provide temporary facilities for storage of materials.
- D. Possession of weapons of any kind on the project site is forbidden.
- E. Possession of alcohol or controlled substances, or presence onsite of personnel who are under the influence of alcohol or controlled substances, is forbidden.
- F. Smoking inside the building is forbidden.

1.2 OCCUPANCY REQUIREMENTS

- A. Partial Owner Occupancy: Owner reserves the right to occupy and to place and install equipment in completed areas of building, before Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and partial occupancy shall not constitute acceptance of the total Work.
 - 1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied before Owner occupancy.
 - 2. Obtain a Certificate of Occupancy from authorities having jurisdiction before Owner occupancy.
 - 3. Before partial Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will provide, operate, and maintain mechanical and electrical systems serving occupied portions of building.
 - 4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of building.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 14 00

SECTION 01 14 01 – WORK RESTRICTIONS (RENOVATIONS)

PART 1 - GENERAL

1.1 USE OF PREMISES

- A. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of site beyond areas in which the Work is indicated.
 - 1. Limits: Confine constructions operations to limits of construction shown on the drawings.
 - 2. Owner Occupancy: Allow for Owner occupancy of site and use by the public.
 - 3. Driveways 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.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
 - c. When requested, schedule deliveries outside of normal daily periods for arrival and departure of building occupants.
- B. Use of Existing Building: Maintain existing building in a weathertight condition throughout construction period. Repair damage caused by construction operations. Protect building and its occupants during construction period.
- C. Fire Egress: Maintain unobstructed egress paths within building and dry, level pedestrian path from all egress doors to nearest public street. Comply with requirements of officials having jurisdiction.
- D. Toilet and Breakroom Facilities: Provide temporary facilities. Do not use owner's permanent facilities.
- E. Storage: Provide temporary facilities for storage of materials. Do not use owner's existing facilities.
- F. Possession of weapons of any kind on the project site is forbidden.
- G. Possession of alcohol or controlled substances, or presence onsite of personnel who are under the influence of alcohol or controlled substances, is forbidden.
- H. Smoking inside the building is forbidden.
- I. Use of radios on site is prohibited during school hours.
- J. Coordination with owner will be required on state assessment testing days, noise making activities may be limited during these days or coordinated to occur outside of the testing hours.

1.2 OCCUPANCY REQUIREMENTS

- A. Full Owner Occupancy: Owner will occupy site and existing building during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations.
- B. Partial Owner Occupancy: Owner reserves the right to occupy and to place and install equipment in completed areas of building, before Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and partial occupancy shall not constitute acceptance of the total Work.
 - 1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied before Owner occupancy.
 - 2. Obtain a Certificate of Occupancy from authorities having jurisdiction before Owner occupancy.
 - 3. Before partial Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will provide, operate, and maintain mechanical and electrical systems serving occupied portions of building.
 - 4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of building.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 14 01

SECTION 01 21 00 – ALLOWANCES**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes administrative and procedural requirements governing allowances.
 - 1. Certain materials and equipment are specified in the Contract Documents by allowances. In some cases, these allowances include installation. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation. If necessary, additional requirements will be issued by Change Order.
- B. Types of allowances include the following:
 - 1. Lump-sum allowances.
 - 2. Unit-cost allowances.
 - 3. Contingency allowances.
 - 4. Quantity allowances.
- C. Related Sections include the following:
 - 1. Division 01, Section "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
 - 2. Division 01, Section "Unit Prices" for procedures for using unit prices.

1.2 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.
- B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by Architect from the designated supplier.

1.3 SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.
- B. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

1.4 CONTINGENCY ALLOWANCES

- A. Use the contingency allowance only as directed by Architect for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.
- B. Contractor's overhead, profit, and related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation, taxes, insurance, equipment rental, and similar costs.
- C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit margins.
- D. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

1.5 UNUSED MATERIALS

- A. Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
 - 1. If requested by Architect, prepare unused material for storage by Owner when it is not economically practical to return the material for credit. If directed by Architect, deliver unused material to Owner's storage space. Otherwise, disposal of unused material is Contractor's responsibility.
 - 2. If allowance is not used in whole or in part, the owner shall remove an allowance from the construction contract by change order based on the value listed for the associated unit price.

PART 2 - PRODUCTS (Not Used)**PART 3 - EXECUTION**

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

3.2 PREPARATION

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

3.3 SCHEDULE OF ALLOWANCES - [GENERAL CONSTRUCTION CONTRACT]

- A. Refer to Construction Manager (CM) Bidding Forms for Allowances

END OF SECTION 01 21 00

SECTION 01 22 00 – UNIT PRICES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for unit prices.
- B. Related Sections include the following:
 - 1. Division 01, Section "Allowances" for procedures for using unit prices to adjust quantity allowances.
 - 2. Division 01, Section "Contract Modification Procedures" for procedures for submitting and handling Change Orders.

1.2 DEFINITIONS

- A. Unit price is an amount proposed by bidders, stated on the Bid Supplement Form, as a price per unit of measurement for materials or services added to or deducted from the Contract Sum by appropriate modification, if estimated quantities of Work required by the Contract Documents are increased or decreased.

1.3 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
- B. Measurement and Payment: Refer to individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
- C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
- D. List of Unit Prices: A list of unit prices is included at the end of this Section. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 LIST OF UNIT PRICES

- A. Refer to Construction Managers (CM) for Unit Prices.

END OF SECTION 01 22 00

SECTION 01 23 00 – ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

- A. This 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 Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.3 PROCEDURES

- A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.
- C. Execute accepted alternates under the same conditions as other work of the Contract.
- D. Schedule: A Schedule of Alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

- A. Alternate No. 1: State an alternate price to provide
 - 1. Owner’s preferred hardware items only by manufacturers described in Division 08, Section “Door Hardware”.
 - 2. _____
 - 3. _____
- B. Alternate No. 2: State an alternate price to
 - 1. Construct the connecting corridor as indicated and described in drawings.
 - 2. _____
 - 3. _____
- C. Alternate No. 3: State an alternate price to
 - 1. Renovate the existing building as indicated and described in the drawings.
 - 2. _____
 - 3. _____
- D. Alternate No. 4: State an alternate price to provide
 - 1. Paving and milling as indicated and described in drawings.
 - 2. _____
 - 3. _____
- E. Alternate No.5: Division 23-Provide Owner’s Preferred BAS Controls: Schneider Electric
- F. Alternate No. 6: Division 26- Provide Owner’s Preferred Electrical Panel Gear: Square D

END OF SECTION 01 23 00

SECTION 01 29 00 – PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Sections include the following:
 - 1. Division 01, Section "Allowances" for procedural requirements governing handling and processing of allowances.
 - 2. Division 01, Section "Unit Prices" for administrative requirements governing use of unit prices.
 - 3. Division 01, Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 4. Division 01, Section "Construction Progress Documentation" for administrative requirements governing preparation and submittal of Contractor's Construction Schedule and Submittals Schedule.

1.2 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.
 - 1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with Continuation Sheets.
 - b. Submittals Schedule.
 - c. Products and Subcontractors List
 - 2. Submit the Schedule of Values in electronic format to Architect at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
 - 3. Where the Work is separated on two or more sites or buildings as described in Division 01, Section "Summary," provide separate schedules for each site or building.
 - 4. Subschedules: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values correlated with each phase of payment.
- B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.
 - 1. Identification: Include the following Project identification on the Schedule of Values:
 - a. Project name and location.
 - b. Name of Contract.
 - c. Name of Architect.
 - d. Architect's project number.
 - e. Contractor's name and address.
 - f. Date of submittal.
 - 2. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value.
 - 1) Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
 - 3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents and project schedule line items of work. Provide several line items for principal subcontract amounts, where appropriate.
 - 4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
 - 5. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. Include evidence of insurance or bonded warehousing if required.

6. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. Allowances: Provide a separate line item in the Schedule of Values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
8. 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.
9. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.3 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The date for each progress payment is indicated in the Owner/Contractor Agreement. The period covered by each Application for Payment starts on the day following the end of the preceding period and ends 15 days before the date for each progress payment.
- C. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
 2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- E. Transmittal: Submit an electronic copy of each Application for Payment, signed and notarized to the Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
 1. Transmit with a transmittal form listing attachments and recording appropriate information about application.
 2. When an application shows completion of an item, submit final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
- F. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
 1. List of subcontractors.
 2. List of Products and Suppliers.
 3. Submittals Schedule (preliminary if not final).
 4. Schedule of Values.
 5. Contractor's Construction Schedule (preliminary if not final).
 6. List of Contractor's staff assignments with qualifications.
 7. List of Contractor's principal consultants.
 8. Copies of building permits.
 9. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 10. Initial progress report.
 11. Certificates of insurance and insurance policies.
 12. Initial settlement survey and damage report if required.
 13. [North Carolina MWBE Form Appendix E per GS 143-128 required with each application for payment.]
- G. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
 1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- H. Final Payment Application: Submit final Application for Payment in electronic format 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 Substantial Completion 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 01 29 00

SECTION 01 31 00 – PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General project coordination procedures.
 - 2. Conservation.
 - 3. Coordination Drawings.
 - 4. Administrative and supervisory personnel.
 - 5. Project meetings.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 01, Section "Construction Progress Documentation" for preparing and submitting the Contractor's Construction Schedule.
 - 2. Division 01, Section "Execution Requirements" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 3. Division 01, Section "Closeout Procedures" for coordinating Contract closeout.

1.2 COORDINATION

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
 - 4. Cooperate with overall project scheduling activities of Project Coordinator.
 - 5. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 6. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
 - 7. Make adequate provisions to accommodate items scheduled for later installation.
- B. Administrative Procedures: The Contractors shall coordinate project schedule and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 - 1. Preparation of Contractor's Construction Schedule.
 - 2. Preparation of the Schedule of Values.
 - 3. Installation and removal of temporary facilities and controls.
 - 4. Delivery and processing of submittals.
 - 5. Progress meetings.
 - 6. Preinstallation conferences.
 - 7. Project closeout activities.
- C. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.
 - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work.
 - 2. Make maximum use of available, cost-effective means of recycling construction waste as an alternative to the use of local landfills. Recyclable waste materials may include:
 - a. Concrete and masonry.
 - b. Metals including debris from construction personnel.
 - c. Wood materials including pallets.
 - d. Corrugated cardboard cartons.
 - e. Glass materials including debris from construction personnel.

1.3 SUBMITTALS

- A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.
 - 1. Indicate relationship of components shown on separate Shop Drawings.
 - 2. Indicate required installation sequences.
 - 3. Refer to Division 23 Section "Basic Mechanical Materials and Methods" and Division 26 Section "Basic Electrical Materials and Methods" for specific Coordination Drawing requirements for mechanical and electrical installations.
- B. Staff Names: Within 15 days of starting construction operations, submit a list of principal staff assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
 - 1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone.

1.4 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
 - 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
 - 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 - 3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within 3 days of the meeting.
- B. Pre-Construction Conference: Architect shall schedule a pre-construction conference before starting construction, at a time convenient to Owner, and Architect, but no later than 15 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.
 - 1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent or all prime contracts major subcontractors; manufacturers; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Phasing.
 - c. Critical work sequencing.
 - d. Designation of responsible personnel.
 - e. Procedures for processing field decisions and Change Orders.
 - f. Procedures for processing Applications for Payment.
 - g. Distribution of the Contract Documents.
 - h. Submittal procedures.
 - i. Preparation of Record Documents.
 - j. Use of the premises.
 - k. Responsibility for temporary facilities and controls.
 - l. Parking availability.
 - m. Office, work, and storage areas.
 - n. Equipment deliveries and priorities.
 - o. First aid.
 - p. Security.
 - q. Progress cleaning.
 - r. Working hours.
- C. Pre-Installation Conferences: Contractor shall conduct a pre-installation 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 of scheduled meeting dates.
 - 2. Record significant conference discussions, agreements, and disagreements.
 - 3. 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: Contractor shall conduct progress meetings at regular intervals as appropriate to the work, but not less than monthly. Coordinate dates of meetings with preparation of payment requests.
1. Attendees: In addition to representatives of Owner, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Work hours.
 - 10) Hazards and risks.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Change Orders.
 - 14) Documentation of information for payment requests.
 3. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.
 - 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 01 31 00

SECTION 01 32 00 – CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Preliminary Construction Schedule.
 - 2. Contractor's Construction Schedule.
 - 3. Submittals Schedule.
 - 4. Daily construction reports.
 - 5. Field condition reports.
 - 6. Special reports.
- B. Related Sections include the following:
 - 1. Division 01, Section "Payment Procedures" for submitting the Schedule of Values.
 - 2. Division 01, Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes.
 - 3. Division 01, Section "Submittal Procedures" for submitting schedules and reports.
 - 4. Division 01, Section "Quality Requirements" for submitting a schedule of tests and inspections.
 - 5. Division 01, Section "Closeout Procedures" for submitting photographic negatives as Project Record Documents at Project closeout.

1.2 SUBMITTALS

- A. Qualification Data: For firms and persons specified in "Quality Assurance" Article and in-house scheduling personnel 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. Submittals Schedule: Submit schedule in electronic format. Arrange the following information in a tabular format:
 - 1. Scheduled date for first submittal.
 - 2. Specification Section number and title.
 - 3. Submittal category (action or informational).
 - 4. Name of subcontractor.
 - 5. Description of the Work covered.
 - 6. Activity or event number, if applicable.
 - 7. Scheduled date for Architect's final release or approval.
- C. Preliminary Construction Schedule: Submit schedule in electronic format.
- D. Contractor's Construction Schedule: Submit schedule in electronic format, scaled to show entire schedule for entire construction period.
- E. Daily Construction Reports: Submit in electronic format at weekly intervals.
- F. Field Condition Reports: Submit in electronic format at time of discovery of differing conditions.
- G. Special Reports: Submit in electronic format at time of unusual event.

1.3 QUALITY ASSURANCE

- A. Pre-Scheduling Conference: Conduct conference at Project site to comply with requirements in Division 01, Section "Project Management and Coordination." Review methods and procedures related to the Preliminary Construction Schedule and Contractor's Construction Schedule, including, but not limited to, the following:
 - 1. Review content and format for reports.
 - 2. Verify availability of qualified personnel needed to develop and update schedule.
- B. Retain applicable factors below:
 - 1. Discuss constraints, including phasing area separations interim milestones and partial Owner occupancy.
 - 2. Review delivery dates for Owner-furnished products.
 - 3. Review schedule for work of Owner's separate contracts.
 - 4. Review time required for review of submittals and resubmittals.
 - 5. Review requirements for tests and inspections by independent testing and inspecting agencies.
 - 6. Review time required for completion and startup procedures.
 - 7. Review and finalize list of construction activities to be included in schedule.

8. Review submittal requirements and procedures.
9. Review procedures for updating schedule.

1.4 COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.
- B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, list of products and suppliers, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
 1. Secure time commitments for performing critical elements of the Work from parties involved.
 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.
- C. Auxiliary Services: Cooperate with photographer and provide auxiliary services requested, including access to Project site and use of temporary facilities including temporary lighting.

PART 2 - PRODUCTS

2.1 SUBMITTALS SCHEDULE

- A. Preparation: Submit a schedule in electronic format of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.
 1. Coordinate Submittals Schedule with list of subcontracts, the list of products and suppliers, the Schedule of Values, and Contractor's Construction Schedule.
 2. Initial Submittal: Submit concurrently with preliminary schedule submittal. Include submittals required during the first 60 days of construction. List those required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's Construction Schedule.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."
- B. Time Frame: Extend schedule from date established for the Notice to Proceed to dates of Substantial Completion and 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.
- C. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
 1. Activity Duration: Define activities so no activity is longer than 10 days, unless specifically allowed by Architect.
 2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 - a. Face brick.
 - b. Structural steel and steel joists.
 - c. Steel doors and frames and door hardware.
 - d. Casework.
 3. Submittal Review Time: Include review and resubmittal times indicated in Division 01, Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
 4. Insert appropriate number of days for startup and testing. Review whether this time period may be allowed to overlap with such activities as installation of owner-provided furniture and equipment.
 5. Startup and Testing Time: Include not less than 15 days for startup and testing.
 6. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
 1. Phasing: Arrange list of activities on schedule by phase.
 2. Work under More Than One Contract: Include a separate activity for each contract.
 3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 4. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 01, Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 5. Work Restrictions: Show the effect of the following items on the schedule:

- a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use of premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations, including anticipated adverse weather days.
 - h. Environmental control.
6. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
- a. Subcontract awards.
 - b. Submittals.
 - c. Purchases.
 - d. Mockups.
 - e. Fabrication.
 - f. Sample testing.
 - g. Deliveries.
 - h. Installation.
 - i. Tests and inspections.
 - j. Adjusting.
 - k. Curing.
 - l. Startup and placement into final use and operation.
- E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to:
1. Notice to Proceed.
 2. Underground utilities complete.
 3. Footings and foundations complete.
 4. Structural steel complete.
 5. Interior slab on grade complete.
 6. Masonry complete.
 7. Building dried in and secure.
 8. Roofing complete.
 9. Above ceiling inspection.
 10. Interior finishes complete.
 11. Substantial Completion.
 12. Final Completion.

2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

- A. Gantt-Chart Schedule: Submit in electronic format a comprehensive, fully developed, horizontal Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for the Notice to Proceed. Base schedule on the Preliminary Construction Schedule and whatever updating and feedback was received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
1. For construction activities that require 2 months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

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 at Project site.
 2. List of separate contractors at Project site.
 3. Approximate count of personnel at Project site.
 4. High and low temperatures and general weather conditions.
 5. Accidents.
 6. Meetings and significant decisions.
 7. Unusual events (refer to special reports).

8. Stoppages, delays, shortages, and losses.
 9. Meter readings and similar recordings.
 10. Emergency procedures.
 11. Orders and requests of authorities having jurisdiction.
 12. Change Orders received and implemented.
 13. Construction Change Directives received.
 14. Services connected and disconnected.
 15. Equipment or system tests and startups.
 16. Partial Completions and occupancies.
 17. Substantial Completions authorized.
- B. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare a detailed report. Submit in electronic format with a Request for Interpretation. 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 in electronic format directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's 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 Actual Completion percentage for each activity.
- B. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, 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 01 32 00

SECTION 01 33 00 – SUBMITTAL PROCEDURES**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other miscellaneous information submittals.
- B. Submittals (excluding material samples) will only be accepted **ELECTRONICALLY**.
- C. Related Sections include the following:
 - 1. Division 01, Section "Payment Procedures" for submitting Applications for Payment.
 - 2. Division 01, Section "Project Management and Coordination" for submitting Coordination Drawings.
 - 3. Division 01, Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule and the Submittals Schedule and construction photographs.
 - 4. Division 01, Section "Quality Requirements" for submitting test and inspection reports and Delegated-Design Submittals and for erecting mockups.
 - 5. Division 01, Section "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information that requires Architect's responsive action.
- B. Informational Submittals: Written information that does not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

1.3 SUBMITTAL PROCEDURES

- A. Submittals shall only be submitted per specification section and shall not be combined with other specification divisions/sections.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
 - 3. Color Selections: Because the Architect must prepare comprehensive color selections for Owner approval, the Contractor must submit all color samples, charts, etc., at the same time and in one package. Color selections cannot be made independently of one another. Once the Contractor submits the color package, the Architect will prepare comprehensive color selections for Owner approval. Upon approval by Owner, the Architect will issue a color schedule.
- C. Submittals Schedule: Comply with requirements in Division 01, Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.
- D. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal.
 - 1. Initial Review: Allow 20 days for initial review of each submittal. Allow additional time if processing must be delayed in order to permit coordination with subsequent submittals. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 - 2. If intermediate submittal is necessary, process it in same manner as initial submittal.
 - 3. Allow 15 days for processing each resubmittal.
 - 4. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing.
- E. Identification: Place a permanent label or title block on each submittal for identification.
 - 1. Indicate name of firm or entity that prepared each submittal on label or title block.
 - 2. Provide a space approximately 4 by 5 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
 - 3. Include the following information on label for processing and recording action taken:
 - a. Project name.
 - b. Date.

- c. Name of Architect.
 - d. Name of Contractor.
 - e. Name of subcontractor.
 - f. Name of supplier.
 - g. Name of manufacturer.
 - h. Unique identifier, including revision number.
 - i. Number and title of appropriate Specification Section.
 - j. Drawing number and detail references, as appropriate.
 - k. Other necessary identification.
- F. Deviations: Highlight, encircle, or otherwise identify deviations from the Contract Documents on submittals.
- G. Transmittal: Package each submittal individually and by specification section into one electronic document and upload using the Architect's Project Management Application. **Architect will reject submittals not uploaded separately and as one combined document as well as submittals received from sources other than Contractor.**
- 1. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements of the Contract Documents, including minor variations and limitations. Include the same label information as the related submittal.
 - 2. Include Contractor's certification stating that information submitted complies with requirements of the Contract Documents.
 - 3. Transmittal Form: Provide locations on form for the following information:
 - a. Project name.
 - b. Date.
 - c. Destination (To:).
 - d. Source (From:).
 - e. Names of subcontractor, manufacturer, and supplier.
 - f. Category and type of submittal.
 - g. Submittal purpose and description.
 - h. Indicate original submittal or resubmittal.
 - i. Submittal and transmittal distribution record.
 - j. Remarks.
 - k. Signature of transmitter.
 - 4. Provide separate transmittal form for each product group, equipment type, or assembly.
- H. Distribution: Furnish electronic 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: Use only final submittals with mark indicating action taken by Architect or Engineer in connection with construction.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

- A. General: Prepare and submit Action Submittals required by individual Specification Sections.
- B. Product Data: Collect information into a single submittal for each specification section listed in the Project Manual and upload as one electronic document into Architect's Project Management Application
 - 1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
 - 2. Mark each submittal to show which products and options are applicable.
 - 3. Include the following information, as applicable:
 - a. Manufacturer's written recommendations.
 - b. Manufacturer's product specifications.
 - c. Manufacturer's installation instructions.
 - d. Standard color charts.
 - e. Manufacturer's catalog cuts.
 - f. Wiring diagrams showing factory-installed wiring.
 - g. Printed performance curves.

- h. Operational range diagrams.
 - i. Mill reports.
 - j. Standard product operating and maintenance manuals.
 - k. Compliance with recognized trade association standards.
 - l. Compliance with recognized testing agency standards.
 - m. Application of testing agency labels and seals.
 - n. Notation of coordination requirements.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
- 1. Preparation: Include the following information, as applicable:
 - a. Dimensions.
 - b. Identification of products.
 - c. Identification of finishes.
 - d. Identification of fasteners.
 - e. Fabrication and installation drawings.
 - f. Roughing-in and setting diagrams.
 - g. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
 - h. Shopwork manufacturing instructions.
 - i. Templates and patterns.
 - j. Schedules.
 - k. Design calculations.
 - l. Compliance with specified standards.
 - m. Notation of coordination requirements.
 - n. Notation of dimensions established by field measurement.
 - 2. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
 - 3. Submit each submittal in electronic format as one combined document uploaded into Architect's Construction Management Application.
- D. Samples: Prepare physical units of materials or products, including the following:
- 1. Comply with requirements in Division 01, Section "Quality Requirements" for mockups.
 - 2. Samples for Initial Selection: If colors, textures, and patterns are not pre-selected, submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - 3. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from the same material to be used for the Work, cured and finished in manner specified, and physically identical with the 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. Physical color samples are to be submitted in two (2) complete packages: one for interior colors and one for exterior colors. Color selections will not be made until contractors' submittal is complete.
 - 4. Preparation: Mount, display, or package Samples in manner specified to facilitate review of qualities indicated. Prepare Samples to match Architect's sample where so indicated. Attach label on unexposed side that includes the following:
 - a. Generic description of Sample.
 - b. Product name or name of manufacturer.
 - c. Sample source.
 - 5. Submit Samples for review of kind, color, pattern, and texture for a final check of these characteristics with other elements and for a comparison of these characteristics between final submittal and actual component as delivered and installed.
 - a. If variation in color, pattern, texture, or other characteristic is inherent in the product represented by a Sample, submit at least three sets of paired units that show approximate limits of the variations.
 - b. Refer to individual Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation, and similar construction characteristics.
 - 6. Number of Samples for Initial Selection: Submit two full sets of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

7. Number of Samples for Verification: Submit two sets of Samples. Architect will retain one Sample set; remainder will be returned. Mark up and retain one returned Sample set as a Project Record Sample.
 - a. Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 8. For each Product Sample submitted, upload to the Architect's Construction Management Application an electronic copy of the submittal, which includes all color, texture and material sample options as a pdf document and a copy of the transmittal that accompanied the physical submittal.
 9. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
- E. Product Schedule or List: Prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product.
 2. Manufacture and supplier.
 3. Number and name of room or space, where applicable.
 4. Location within room or space, where applicable.
- F. Delegated-Design Submittal: Comply with requirements in Division 01, Section "Quality Requirements."
- G. Contractor's Construction Schedule: Comply with requirements in Division 01, Section "Construction Progress Documentation."
- H. Submittals Schedule: Comply with requirements in Division 01, Section "Construction Progress Documentation."
- I. Application for Payment: Comply with requirements in Division 01, Section "Payment Procedures."
- J. Schedule of Values: Comply with requirements in Division 01, Section "Payment Procedures."
- K. 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.

2.2 INFORMATIONAL SUBMITTALS

- A. General: Prepare and submit Informational Submittals required by other Specification Sections.
1. Certificates and Certifications: Provide a notarized statement that includes signature of Contractor, manufacturer, testing agency, or design professional responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of the company.
 2. Test and Inspection Reports: Comply with requirements in Division 01, Section "Quality Requirements."
- B. Contractor's Construction Schedule: Comply with requirements in Division 01, Section "Construction Progress Documentation."
- C. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- D. Product Certificates: Prepare written statements on manufacturer's original letterhead certifying that product complies with requirements.
- E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
- F. Installer Certificates: Prepare written statements on manufacturer's original letterhead certifying that Installer complies with requirements and, where required, is authorized for this specific Project.
- G. Manufacturer Certificates: Prepare written statements on manufacturer's original letterhead certifying that manufacturer complies with requirements. Include evidence of manufacturing experience where required.
- H. Material Certificates: Prepare written statements on manufacturer's original letterhead certifying that material complies with requirements.
- I. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.

- J. Pre-Construction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements.
- K. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- L. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements.
- M. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements. 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.
- N. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - 1. Name of evaluation organization.
 - a. International Building Code (IBC).
 - b. When reports are not available from above organization, Architect may consider reports of Building Official and Code Administrators International, Inc. (BOCA) or similar organization, subject to the approval of officials having jurisdiction.
 - 2. Date of evaluation.
 - 3. Time period when report is in effect.
 - 4. Product and manufacturers' names.
 - 5. Description of product.
 - 6. Test procedures and results.
 - 7. Limitations of use.
- O. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements in Division 01, Section "Operation and Maintenance Data."
- P. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.
- Q. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:
 - 1. Preparation of substrates.
 - 2. Required substrate tolerances.
 - 3. Sequence of installation or erection.
 - 4. Required installation tolerances.
 - 5. Required adjustments.
 - 6. Recommendations for cleaning and protection.
- R. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
 - 1. Name, address, and telephone number of factory-authorized service representative making report.
 - 2. Statement on condition of substrates and their acceptability for installation of product.
 - 3. Statement that products at Project site comply with requirements.
 - 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 - 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 - 6. Statement whether conditions, products, and installation will affect warranty.
 - 7. Other required items indicated in individual Specification Sections.
- S. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.

- T. Construction Photographs and Videotapes: Comply with requirements in Division 01, Section "Construction Progress Documentation."
- U. Material Safety Data Sheets: Submit information directly to Owner. If submitted to Architect, Architect will not review this information but will return it with no action taken.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Review each submittal and check for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Each submittal will be uploaded, as one combined document into the Architect's Project Management Application.
- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them as Rejected.
- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
 - 1. Architect Action:
 - a. Approved or No Exceptions: Contractor may proceed with the Work.
 - b. Approved As Noted: Contractor may proceed with the Work provided the indicated Exceptions are corrected.
 - c. Revise and Resubmit or Partial Resubmittal: Work may not proceed until the Contractor revises the submittal to reflect the requirements of the Contract Documents and Architect approves the revised submittal.
 - d. Rejected: Work may not proceed until the Contractor has submitted a product that reflects the requirements of the Contract Documents based on comments and information provided.
- C. Informational Submittals: Architect will review each submittal and will not return it or will reject and return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- D. Submittals not required by the Contract Documents will not be reviewed and may be discarded.

END OF SECTION 01 33 00

SECTION 01 40 00 – QUALITY REQUIREMENTS**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes administrative and procedural requirements for quality assurance, quality control, and IBC required special inspections.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- C. Related Sections include the following:
 - 1. Division 01, Section "Construction Progress Documentation" for developing a schedule of required tests and inspections.
 - 2. Division 01, Section "Cutting and Patching" for repair and restoration of construction disturbed by testing and inspecting activities.
 - 3. Divisions 02 through 49 Sections for specific test and inspection requirements.

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 ensure that proposed construction complies with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that completed construction complies with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Mockups: Full-size, physical example assemblies to illustrate finishes and materials. Mockups are used to verify selections made under Sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Mockups establish the standard by which the Work will be judged.
- D. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

1.3 DELEGATED DESIGN

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

1.4 SUBMITTALS

- A. All submittals are to be made in electronic format.
- B. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- C. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.
- D. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Description of test and inspection.
 - 3. Identification of applicable standards.

4. Identification of test and inspection methods.
 5. Number of tests and inspections required.
 6. Time schedule or time span for tests and inspections.
 7. Entity responsible for performing tests and inspections.
 8. Requirements for obtaining samples.
 9. Unique characteristics of each quality-control service.
- E. Reports: Prepare and submit certified written reports that include the following:
1. Date of issue.
 2. Project title and number.
 3. Name, address, and telephone number of testing agency.
 4. Dates and locations of samples and tests or inspections.
 5. Names of individuals making tests and inspections.
 6. Description of the Work and test and inspection method.
 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. Ambient conditions at time of sample taking and testing and inspecting.
 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and reinspecting.
- F. 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.

1.5 QUALITY ASSURANCE

- A. 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.
- B. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- C. 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.
- D. 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.
- 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 to those indicated for this Project in material, design, and extent.
- F. Testing Agency Qualifications: An agency with the experience and capability to conduct testing and inspecting indicated, as documented by ASTM E 548, and that specializes in types of tests and inspections to be performed.
- G. Pre-Construction Testing: Testing agency shall perform pre-construction testing for compliance with specified requirements for performance and test methods.
 1. Contractor responsibilities include the following:
 - a. Provide test specimens and assemblies representative of proposed materials and construction. Provide sizes and configurations of assemblies to adequately demonstrate capability of product to comply with performance requirements.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. Fabricate and install test assemblies using installers who will perform the same tasks for Project.
 - d. When testing is complete, remove assemblies; do not reuse materials on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- H. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
 2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 3. Demonstrate the proposed range of aesthetic effects and workmanship.
 4. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
 5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 6. Demolish and remove mockups when directed, unless otherwise indicated.

1.6 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will employ and pay for 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 the types of testing and inspecting they are engaged to perform.
 2. Costs for retesting and re-inspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Unless otherwise indicated, provide quality-control services specified and required by authorities having jurisdiction.
1. Quality Assurance and Control of Installation: Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
 - a. Comply fully with manufacturers' instructions.
 - b. Comply with specified standards as a minimum quality level for the Work, except when more stringent tolerances, code requirements, or other specified requirements indicate higher standards or more precise workmanship.
 - c. Tolerances: Monitor tolerance control of product installation to assure acceptable work. Do not permit tolerance margins to accumulate and result in non-conforming work.
 - 1) Comply with specified, referenced, and/or manufacturers' tolerances, whichever is most restrictive.
 - 2) Adjust products to appropriate dimensions and position before securing in place.
 2. Quality Control and Testing Services: Where testing services are indicated as Contractor's responsibility, engage and pay for a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ the same entity engaged by Owner, unless agreed to in writing by Owner.
 - b. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 - c. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 - d. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 - e. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Special Tests and Inspections: Owner will engage and pay for a testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner.
1. Testing agency will notify Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 2. Testing agency will submit a certified written report of each test, inspection, and similar quality-control service to Architect, with copy to Contractor and to authorities having jurisdiction.
 3. Testing agency will submit a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 4. Testing agency will interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 5. Testing agency will retest and re-inspect corrected work.
 6. See attachment to this section for IBC Code mandated special inspections.
- D. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.

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

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
 - 1. Comply with the Contract Document requirements for Division 01, Section "Cutting and Patching."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

3.2 TESTING SCHEDULE

- A. The Contractor shall coordinate the testing requirements are outlined in Division 03, 04, 05, 31, 32, and 33.

3.3 CONTRACTOR'S STATEMENT OF RESPONSIBILITY FOR SEISMIC-FORCED-RESISTING SYSTEM

- A. Attached to this section.

3.4 STATEMENT OF SPECIAL INSPECTIONS

- A. Attached to this section.

3.5 SCHEDULE OF SPECIAL INSPECTIONS

- A. Attached to this section.

SECTION CONTINUES

STATEMENT OF SPECIAL INSPECTIONS

Project:

Location:

Owner:

Owner's Address:

Architect of Record:

Structural Engineer of Record:

This *Statement of Special Inspections* is submitted as a condition for permit issuance in accordance with the Special Inspections requirements of the Building Code. It includes a Schedule of Special Inspection Services applicable to this project as well as the name of the Special Inspector and the identity of other approved agencies intended to be retained for conducting these inspections.

The Special Inspector shall keep records of all inspections and shall furnish inspection reports to the Building Official, Structural Engineer, and Architect of Record. 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 Building Official, Structural Engineer, and Architect of Record. The Special Inspection program does not relieve the Contractor of his or her responsibilities.

Interim reports shall be submitted to the Building Official, Owner, Structural Engineer, and Architect of Record.

A *Final Report of Special Inspections* documenting completion of all required Special Inspections and correction of any discrepancies noted in the inspections shall 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.

Interim Report Frequency:

or per attached schedule.

Prepared by:

(type or print name)



Signature Date

Owner's Authorization:

Building Official's Acceptance:

Signature Date

Signature Date

SCHEDULE OF SPECIAL INSPECTION SERVICES

Project: _____

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

- | | |
|---|---|
| <input type="checkbox"/> Soils and Foundations | <input type="checkbox"/> Applied Fireproofing |
| <input type="checkbox"/> Cast-in-Place Concrete | <input type="checkbox"/> Wood Construction |
| <input type="checkbox"/> Precast Architectural Concrete | <input type="checkbox"/> Polymer Modified Exterior Insulation and Finish System |
| <input type="checkbox"/> Unit Masonry | <input type="checkbox"/> Mechanical & Electrical Systems |
| <input type="checkbox"/> Structural Steel Framing | <input type="checkbox"/> Architectural Systems |
| <input type="checkbox"/> Cold-Formed Steel Framing | <input type="checkbox"/> Special Cases |

Inspection Agents	Firm	Address
1. Special Inspector		
2. Inspector		
3. Inspector		
4. Testing Laboratory		
5. Testing Laboratory		
6. Other		

Note: The inspection and testing agent shall be engaged by the Owner or 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 Building Official, prior to commencing work.

Seismic Performance Category

Basic Wind Speed

Wind Exposure Category

QUALIFICATIONS OF INSPECTORS AND TESTING TECHNICIANS

The qualifications of all personnel performing Special Inspection activities are subject to the approval of the Building Official. The credentials of all Inspectors and testing technicians shall be provided if requested.

It is recommended that the person administering the Special Inspections program be a Structural Engineer or a Professional Engineer experienced in the design of buildings.

Key for Minimum Qualification of Inspection Agents:

When the Structural Engineer of Record deems it appropriate that the individual performing a stipulated test or inspection have a specific certification or license as indicated below, such designation shall appear below the *Agent Number* on the *Schedule of Special Inspections*.

- SE** **Structural Engineer.** A licensed SE or PE specializing in the design of building structures. This may be required for the inspection of critical structural elements.
- GE** **Geotechnical Engineer.** A licensed PE specializing in soil mechanics and foundations. This may be required for the inspection of difficult soil conditions or deep foundations.
- EIT** **Engineer-in-Training.** A graduate engineer who has passed the Fundamentals of Engineering examination. This may be required for the inspection of elements that require some engineering training to properly evaluate.
- ACI** **American Concrete Institute – Level I Certified Concrete Field Testing Technician.** This certification is appropriate for individuals performing concrete sampling, slump tests, air-content tests, temperature tests, unit weight tests, and casting compression test cylinders.
- AWS** **American Welding Society – Certified Welding Inspector (CWI).** This certification is appropriate for individuals performing visual inspection of welds.
- ASNT** **American Society of Non-Destructive Testing – Level II or III.** This certification is appropriate for individuals performing ultra-sonic testing of welds.
- SMSI** **Structural Masonry Special Inspector.** Certification by ICBO.
- SWSI** **Structural Steel and Welding Special Inspector.** Certification by ICBO.
- SFSI** **Spray-Applied Fireproofing Special Inspector.** Certification by ICBO.
- PCSI** **Prestressed Concrete Special Inspector.** Certification jointly sponsored by ICBO, BOCA and SBCCI with participation form PCI and PTI.
- RCSI** **Reinforced Concrete Special Inspector.** Certification jointly sponsored by ACI, ICBO, BOCA and SBCCI.

Schedule of Special Inspection Services

SOILS AND FOUNDATIONS

Project: _____

Item	Agent No. (Qualif.)	Scope
1. Shallow Foundations		
2. Controlled Structural Fill		
3. Deep Foundations		
4. Other		

Schedule of Special Inspection Services

CAST-IN-PLACE CONCRETE

Project: _____

Item	Agent No. (Qualif.)	Scope
1. Mix Design		
2. Material Certification		
3. Reinforcement Installation		
4. Post-Tensioning Operations		
5. Batching Plant		
6. Formwork Geometry		
7. Concrete Placement		
8. Evaluation of Concrete Strength		
9. Curing and Protection		
10. Other		

Schedule of Special Inspection Services

PRECAST ARCHITECTURAL CONCRETE

Project: _____

Item	Agent No. (Qualif.)	Scope
1. Plant Certification / Quality Control Procedures		
2. Mix Design		
3. Material Certification		
4. Reinforcement Installation		
5. Prestress Operations		
6. Connections / Embedded Items		
7. Formwork Geometry		
8. Concrete Placement		
9. Evaluation of Concrete Strength		
10. Curing and Protection		
11. Erected Precast Elements		
12. Other		

Schedule of Special Inspection Services

UNIT MASONRY

Project: _____

Item	Agent No. (Qualif.)	Scope
1. Material Certification		
2. Mixing of Mortar and Grout		
3. Installation of Masonry		
4. Reinforcement Installation		
5. Grouting Operations		
6. Weather Protection		
7. Evaluation of Masonry Strength		
8. Anchors and Ties		
9. Other		

Schedule of Special Inspection Services

STRUCTURAL STEEL FRAMING

Project: _____

Item	Agent No. (Qualif.)	Scope
1. Fabricator Certification / Quality Control Procedures		
2. Material Certification		
3. Open Web Steel Joists		
4. Bolting		
5. Welding		
6. Shear Connectors		
7. Structural Details		
8. Metal Deck		
9. Other		

Schedule of Special Inspection Services

COLD-FORMED STEEL FRAMING

Project: _____

Item	Agent No. (Qualif.)	Scope
1. Member Sizes		
2. Material Thickness		
3. Material Properties		
4. Mechanical Connections		
5. Welding		
6. Framing Details		
7. Other		

Schedule of Special Inspection Services

APPLIED FIREPROOFING

Project: _____

Item	Agent No. (Qualif.)	Scope
1. Material Specifications		
2. Laboratory Tested Fire Resistance Design		
3. Schedule of Thickness		
4. Surface Preparation		
5. Application		
6. Curing and Ambient Condition		
7. Thickness		
8. Density		
9. Bond Strength		
10. Other		

Schedule of Special Inspection Services

WOOD CONSTRUCTION

Project: _____

Item	Agent No. (Qualif.)	Scope
1. Fabricator Certification / Quality Control Procedures		
2. Material Grading		
3. Connections		
4. Framing and Details		
5. Other		

Schedule of Special Inspection Services

POLYMER MODIFIED EXTERIOR INSULATION & FINISH SYSTEMS (EIFS)

Project: _____

Item	Agent No. (Qualif.)	Scope
1. Material Submittals		
2. Condition of Substrate		
3. Application of Foam Plastic Board		
4. Application of Coatings		
5. Application of Mesh		
6. Ambient Condition and Curing		
7. Flashing and Joint Details		
8. Sealants / Caulks		
9. Other		

Schedule of Special Inspection Services

MECHANICAL AND ELECTRICAL SYSTEMS

Project: _____

Item	Agent No. (Qualif.)	Scope
1. Smoke Control		
2. Mechanical, HVAC & Piping		
3. Electrical System		
4. Other		

Schedule of Special Inspection Services

ARCHITECTURAL SYSTEMS

Project: _____

Item	Agent No. (Qualif.)	Scope
1. Walls, Panels & Veneers		
2. Suspended Ceilings		
3. Access Floors		
4. Other		

Schedule of Special Inspection Services

SPECIAL CASES

Project: _____

Item	Agent No. (Qualif.)	Scope

END OF SECTION 01 40 00

SECTION 01 42 00 – REFERENCES**PART 1 - GENERAL****1.1 DEFINITIONS**

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": The term "approved," when used in conjunction with Architect's action on Contractor's submittals, applications, and requests, is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean directed by Architect, requested by Architect, and similar phrases.
- D. "Indicated": The term "indicated" refers to graphic representations, notes, or schedules on Drawings; or to other paragraphs or schedules in Specifications and similar requirements in the Contract Documents. Terms such as "shown," "noted," "scheduled," and "specified" are used to help the user locate the reference.
- E. "Regulations": The term "regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": The term "furnish" means to supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations, and pay all costs, including insurance, taxes, tariffs, licenses, and contributions, unless specifically exempted.
- G. "Install": The term "install" describes operations at Project site including unloading, temporary storage, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": The term "provide" means to furnish and install, complete and ready for the intended use.
- I. "Installer": An installer is Contractor or another entity engaged by Contractor, as an employee, subcontractor, or contractor of lower tier, to perform a particular construction operation, including installation, erection, application, and similar operations.
- J. The term "experienced," when used with the term "installer," means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with the special requirements indicated; and having complied with requirements of authorities having jurisdiction.
 - 1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.
- K. "Project site" is the space available for performing construction activities, either exclusively or in conjunction with others performing other work as part of Project. The extent of Project site is shown on the Drawings and may or may not be identical with the description of the land on which Project is to be built.
- L. "Required", "Requirements": Refers to the requirements of the Contract Documents, either explicitly stated or necessary to achieve indicated design or performance, unless another interpretation is clearly stated.
- M. Other Terms: Other technical terms not specifically defined within the Contract Documents shall have the meanings given in the Construction Specifications Institute "Uniform Drawings Standards Module 5: Terms and Abbreviations." Technical terms not defined above and used to describe items of the Work, and which so applied have a well-known technical or trade meaning, shall be deemed to have such recognized meaning.

1.2 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of the date of the Contract Documents, unless otherwise indicated.
- C. Conflicting Requirements: Where compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.
 - 1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of the requirements. Refer uncertainties to Architect for a decision before proceeding.
- D. Copies of Standards: Each entity engaged in construction on Project must be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from the publication source and make them available on request.

E. Abbreviations and Names: Abbreviations and acronyms are frequently used in the Specifications and other Contract Documents to represent the name of a trade association, standards-developing organization, authorities having jurisdiction, or other entity in the context of referencing a standard or publication. The following abbreviations and acronyms, as referenced in the Contract Documents, mean the associated names. Names and addresses are subject to change and are believed, but are not assured, to be accurate and up-to-date as of the date of the Contract Documents.

AA	Aluminum Association www.aluminum.org	202-862-5100
AABC	Associated Air Balance Council www.aabchq.com	202-737-0202
AAMA	American Architectural Manufacturers Association www.aamanet.org	847-303-5664
AAN	American Association of Nurserymen See ANLA)	
AASHTO	American Association of State Highway and Transportation Officials www.aashto.org	202-624-5800
AATCC	American Association of Textile Chemists and Colorists www.aatcc.org	919-549-8141
ABMA	American Bearing Manufacturers Association Formerly: Anti-Friction Bearing Manufacturers Association) www.abma-dc.org	202-429-5155
ABMA	American Boiler Manufacturers Association www.abma.com	703-522-7350
ACI	American Concrete Institute www.aci-int.org	248-848-3700
ACIL	ACIL: The Association of Independent Scientific, Engineering, and Testing Firms www.acil.org	202-887-5872
ACPA	American Concrete Pipe Association www.concrete-pipe.org	972-506-7216
ADC	Air Diffusion Council	312-201-0101
AEIC	Association of Edison Illuminating Companies www.aeic.org	205-250-2530
AFBMA	Anti-Friction Bearing Manufacturers Association See ABMA)	
AFPA	American Forest and Paper Association Formerly: National Forest Products Association) www.afandpa.org	800-878-8878 202-463-2700
AGA	American Gas Association www.aga.com	703-841-8400
AHA	American Hardboard Association	847-934-8800
AHAM	Association of Home Appliance Manufacturers www.aham.org	312-984-5800

AI	Asphalt Institute www.asphaltinstitute.org	606-288-4960
AIA	The American Institute of Architects www.aia.org	202-626-7300
AIA	American Insurance Association	202-828-7100
AIHA	American Industrial Hygiene Association www.aiha.org	703-849-8888
AISC	American Institute of Steel Construction www.aisc.web.com	800-644-2400
AISI	American Iron and Steel Institute www.steel.org	202-452-7100
AITC	American Institute of Timber Construction www.aitc-glulam.org	303-792-9559
ALA	American Laminators Association See LMA)	
ALCA	Associated Landscape Contractors of America www.alca.org	800-395-2522
ALI	Associated Laboratories, Inc. www.assoc-labs.com	214-565-0593
ALSC	American Lumber Standards Committee	301-972-1700
AMCA	Air Movement and Control Association International, Inc. www.amca.org	847-394-0150
ANLA	American Nursery and Landscape Association (Formerly: American Association of Nurserymen) www.anla.org	202-789-2900
ANSI	American National Standards Institute www.ansi.org	888-267-4783
AOAC	AOAC International www.aoac.org	301-924-7077
AOSA	Association of Official Seed Analysts www.zianet.com/AOSA	402-476-3852
APA	APA-The Engineered Wood Association Formerly: American Plywood Association) www.apawood.org	253-565-6600
APA	Architectural Precast Association www.archprecast.org	941-454-6989
API	American Petroleum Institute www.api.org	202-682-8000
ARI	Air-Conditioning and Refrigeration Institute www.ari.org	703-524-8800
ARMA	Asphalt Roofing Manufacturers Association Center Park www.asphaltroofing.org	301-348-2002

ASA	Acoustical Society of America //asa.aip.org	516-576-2360
ASC	Adhesive and Sealant Council www.ascouncil.org	202-452-1500
ASCA	Architectural Spray Coaters Association	609-848-6120
ASCE	American Society of Civil Engineers World Headquarters www.asce.org	800-548-2723 703-295-6000
ASHES	American Society for Healthcare Environmental Services Division of the American Hospital Association	312-422-3860
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers www.ashrae.org	800-527-4723
ASLA	American Society of Landscape Architects www.asla.org	202-898-2444
ASME	American Society of Mechanical Engineers www.asme.org	800-843-2763
ASPA	American Sod Producers Association (See TPI)	
ASPE	American Society of Plumbing Engineers	805-495-7120
ASQ	American Society for Quality www.asq.org	800-248-1946
ASSE	American Society of Sanitary Engineering www.asse-plumbing.org	440-835-3040
ASTM	American Society for Testing and Materials www.astm.org	610-832-9500
ATIS	Alliance for Telecommunications Industry Solutions (Formerly: Exchange Carriers Standards Association) www.atis.org	202-628-6380
AWCI	Association of the Wall and Ceiling Industries--International www.awci.org	703-534-8300
AWCMA	American Window Covering Manufacturers Association (See WCMA)	
AWI	Architectural Woodwork Institute www.awinet.org	800-449-8811
AWPA	American Wood-Preservers' Association www.awpa.com	817-326-6300
AWPB	American Wood Preservers' Bureau (This organization is now defunct.)	
AWS	American Welding Society www.amweld.org	800-443-9353
AWWA	American Water Works Association www.awwa.org	800-926-7337

BAC	Brick Association of the Carolinas Formerly: Brick Association of North Carolina) www.gobrick.com	800-622-7425 336-273-5566
BHMA	Builders Hardware Manufacturers Association	212-661-4261
BIA	Brick Industry Association www.bia.org	703-620-0010
BIFMA	The Business and Institutional Furniture Manufacturer's Association International www.bifma.com	616-285-3963
CAGI	Compressed Air and Gas Institute c/o Thomas Associates, Inc. www.taol.com/cagi	216-241-7333
CAUS	Color Association of the United States	212-582-6884
CBMA	Certified Ballast Manufacturers Association www.certbal.org	212-661-4261
CCC	Carpet Cushion Council	203-637-1312
CDA	Copper Development Association Inc. www.copper.org	800-232-3282
CFFA	Chemical Fabrics & Film Association, Inc. c/o Thomas Associates, Inc. www.taol.com/cffa	216-241-7333
CGA	Compressed Gas Association www.cganet.com	703-412-0900
CGSB	Canadian General Standards Board www.pwgsc.gc.ca/cgsb	819-956-3500 819-956-0425
CISCA	Ceilings and Interior Systems Construction Association www.cisca.org	630-584-1919
CISPI	Cast Iron Soil Pipe Institute www.cispi.org	423-892-0137
CLFMI	Chain Link Fence Manufacturers Institute www.baileadership.com	301-596-2584
CPA	Composite Panel Association (Formerly: National Particleboard Association) www.pbmdf.com	301-670-0604
CPPA	Corrugated Polyethylene Pipe Association www.cppa-info.org	800-510-2772
CRI	Carpet and Rug Institute www.carpet-rug.com	800-882-8846
CRSI	Concrete Reinforcing Steel Institute www.crsi.org	847-517-1200
CSSB	Cedar Shake and Shingle Bureau www.cedarbureau.org	206-453-1323
CTI	Ceramic Tile Institute of America	310-574-7800

CTI	Cooling Tower Institute www.cti.org	281-583-4087
DASMA	Door and Access Systems Manufacturers Association, International (Formerly: National Association of Garage Door Manufacturers) www.taol.com/dasma	216-241-7333
DHI	Door and Hardware Institute (Formerly: National Builders Hardware Association) www.dhi.org	703-222-2010
DIPRA	Ductile Iron Pipe Research Association www.dipra.org	205-402-8702
DLPA	Decorative Laminate Products Association Dissolved in 1995 - Now part of KCMA.)	
ECSA	Exchange Carriers Standards Association (See ATIS)	
EIA	Electronic Industries Association www.eia.org	703-907-7500
EIMA	EIFS Industry Members Association www.eifsfacts.com	800-294-3462
EJMA	Expansion Joint Manufacturers Association www.ejma.org	914-332-0040
ETL	ETL Testing Laboratories, Inc. (Now part of ITS)	
FCI	Fluid Controls Institute c/o Thomas Associates, Inc www.taol.com/fci	216-241-7333
FCICA	Floor Covering Installation Contractors Association	706-226-5488
FGMA	Flat Glass Marketing Association (See GANA)	
FM	Factory Mutual System www.factorymutual.com	781-762-4300
GA	Gypsum Association www.usg.com	202-289-5440
GANA	Glass Association of North America (Formerly: Flat Glass Marketing Association) www.glasswebsite.com/gana	913-266-7013
GRI	Geosynthetic Research Institute www.drexel.edu/gri	610-522-8440
HEI	Heat Exchange Institute c/o Thomas Associates, Inc. www.taol.com/hei	216-241-7333
HI	Hydraulic Institute	888-786-7744
HI	Hydronics Institute Division of Gas Appliance Manufacturers Association www.gamanet.org	908-464-8200

HMA	Hardwood Manufacturers Association (Formerly: Southern Hardwood Lumber Manufacturers Association) www.hardwood.org	412-829-0770
HPVA	Hardwood Plywood and Veneer Association www.hpva.org	703-435-2900
IAS	International Approval Services Division of Canadian Standards Association www.iasapprovals.org	216-524-4990
IBD	Institute of Business Designers (Now part of IIDA)	
ICC	International Code Council www.intlcode.org	703-931-4533
ICEA	Insulated Cable Engineers Association www.icea.net	508-394-4424
IEC	International Electrotechnical Commission (Available from ANSI) www.ansi.org	888-267-4783 212-642-4900
IEEE	Institute of Electrical and Electronics Engineers www.ieee.org	800-678-4333 212-705-7900
IESNA	Illuminating Engineering Society of North America www.iesna.org	212-248-5000
IGCC	Insulating Glass Certification Council	315-938-7444
IIDA	International Interior Design Association www.iida.com	800-888-4432 312-467-1950
ILI	Indiana Limestone Institute of America www.iliai.com	812-275-4426
IMSA	International Municipal Signal Association www.imsasafety.org	800-723-4672 315-331-2182
INCE	Institute of Noise Control Engineering www.ince.org	914-462-4006
IRI	HSB Industrial Risk Insurers www.industrialrisk.com	800-520-7300
ISA	ISA - International Society for Measurement and Control www.isa.org	919-549-8411
ISEA	Industrial Safety Equipment Association www.safetycentral.org/isea	703-525-1695
ISS	Iron and Steel Society www.issource.org	412-776-1535
ITS	Intertek Testing Services (Formerly: Inchcape Testing Services) www.itsglobal.com	800-345-3851 607-753-6711
KCMA	Kitchen Cabinet Manufacturers Association (Formerly: National Kitchen Cabinet Association) www.kema.org	703-264-1690

LGSI	Light Gage Structural Institute	972-625-4560
LIA	Lead Industries Association, Inc. www.leadinfo.com	800-422-5323 212-578-4750
LMA	Laminating Materials Association (Formerly: American Laminators Association) www.lma.org	201-664-2700
LPI	Lightning Protection Institute www.lightning.org	800-488-6864 847-577-7200
MBMA	Metal Building Manufacturers Association c/o Thomas Associates, Inc. www.taol.com/mbma	216-241-7333
MCAA	Mechanical Contractors Association of America www.mcaa.org	301-869-5800
MFMA	Maple Flooring Manufacturers Association (Formerly: Wood and Synthetic Flooring Institute) www.maplefloor.com	847-480-9138
MFMA	Metal Framing Manufacturers Association	312-644-6610
MHIA	Material Handling Industry Association www.mhia.org	800-345-1815
MIA	Marble Institute of America www.marble-institute.com	614-228-6194
MIA	Masonry Institute of America www.masonryinstitute.org	213-388-0472
ML/SFA	Metal Lath/Steel Framing Association	312-456-5590
MRCA	Midwest Roofing Contractors Association www.mrca.org	913-843-4888
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry www.mss-hq.com	703-281-6613
NAA	National Arborist Association www.natlarb.com	800-733-2622
NAAMM	National Association of Architectural Metal Manufacturers www.gss.net/naamm	312-322-0405
NAAMM	North American Association of Mirror Manufacturers (See GANA) www.glasswebsite.com/naamm	913-266-7013
NACE	NACE International (Formerly: National Association of Corrosion Engineers)	281-492-0535 281-492-8254
NAGDM	National Association of Garage Door Manufacturers (See DASMA)	
NAIMA	North American Insulation Manufacturers Association (Formerly: Thermal Insulation Manufacturers Association) www.naima.org	703-684-0084

NAMI	National Accreditation & Management Institute, Inc. Berkeley Springs, WV 25411	304-258-5100
NAPA	National Asphalt Pavement Association www.hotmix.org	888-468-6499 301-731-4748
NBHA	National Builders Hardware Association (See DHI)	
NBGQA	National Building Granite Quarries Association, Inc.	800-557-2848
NCAC	National Council of Acoustical Consultants www.ncac.com	973-564-5859
NCCA	National Coil Coaters Association www.coilcoaters.org	312-321-6894
NCMA	National Concrete Masonry Association www.ncma.org	703-713-1900
NCPI	National Clay Pipe Institute www.ncpi.org	414-248-9094
NCRPM	National Council on Radiation Protection and Measurements www.ncrp.com	800-229-2652 301-657-2652
NCSPA	National Corrugated Steel Pipe Association www.ncspa.org	202-452-1700
NEBB	Natural Environmental Balancing Bureau www.mcaa.org/nebb.htm www.nebb.org	301-977-3698
NECA	National Electrical Contractors Association www.necanet.org	301-657-3110
NEI	National Elevator Industry	201-944-3211
NELMA	Northeastern Lumber Manufacturers Association www.nelma.org	207-829-6901
NEMA	National Electrical Manufacturers Association www.nema.org	703-841-3200
NETA	InterNational Electrical Testing Association www.electricnet.com/neta	303-697-8441
NFPA	National Fire Protection Association www.nfpa.org	800-344-3555
NFPA	National Forest Products Association (See AFPA)	
NFRC	National Fenestration Rating Council Incorporated www.nfrc.org	301-589-6372
NGA	National Glass Association	703-442-4890
NHLA	National Hardwood Lumber Association www.natlhardwood.org	901-377-1818
NIA	National Insulation Association (Formerly: National Insulation and Abatement Contractors Association) www.insulation.org	703-683-6422

NIAC	National Insulation and Abatement Contractors Association (See NIA)	
NKCA	National Kitchen Cabinet Association (See KCMA)	
NLGA	National Lumber Grades Authority CANADA	604-524-2393
NOFMA	National Oak Flooring Manufacturers Association www.nofma.org	901-526-5016
NPA	National Parking Association	202-296-4336 800-647-7275
NPCA	National Paint and Coatings Association www.paint.org	202-462-6272
NRCA	National Roofing Contractors Association O'Hare International Center www.roofonline.org	800-323-9545 847-299-9070
NRMCA	National Ready Mixed Concrete Association www.nrmca.org	301-587-1400
NSA	National Stone Association www.aggregates.org	800-342-1415 202-342-1100
NSF	NSF International (Formerly: National Sanitation Foundation) www.nsf.org	734-769-8010
NSSEA	National School Supply and Equipment Association www.nssea.org	800-395-5550 301-495-0240
NTMA	National Terrazzo and Mosaic Association www.ntma.com	800-323-9736 703-779-1022
NUSIG	National Uniform Seismic Installation Guidelines	925-555-6331
NWMA	National Woodwork Manufacturers Association (See NWWDA)	
NWWDA	National Wood Window and Door Association Formerly: National Woodwork Manufacturers Association) www.nwwda.org	800-223-2301 847-299-5200
PATMI	Powder Actuated Tool Manufacturers' Institute	314-947-6610
PCA	Portland Cement Association www.portcement.org	847-966-6200
PCI	Precast/Prestressed Concrete Institute www.pci.org	312-786-0300
PDCA	Painting and Decorating Contractors of America www.pdca.com	800-332-7322 703-359-0826
PDI	Plumbing and Drainage Institute //pdi-online.org	800-589-8956 508-230-3516
PEI	Porcelain Enamel Institute www.porcelainenamel.com	615-385-5357

PGI	PVC Geomembrane Institute/Technology Program University of Illinois-Urbana Champaign //pgi-tp.ce.vivc.edu	217-333-3929
PIMA	Photographic and Imaging Manufacturers Association www.pima.net	914-698-7603
PPFA	Plastic Pipe and Fittings Association	888-314-6774 630-858-6540
PPI	Plastics Pipe Institute (The Society of the Plastics Industry, Inc.) www.plasticpipe.org	202-974-5306
RCMA	Roof Coatings Manufacturers Association Center Park www.roofcoatings.org	301-348-2003
RCSC	Research Council on Structural Connections Sargent & Lundy	312-269-2424
RFCI	Resilient Floor Covering Institute	301-340-8580
RMA	Rubber Manufacturers Association www.rma.org	800-220-7620 202-682-4800
SAE	SAE International For publications: Call 724-776-4970 www.sae.org	724-776-4841
SDI	Steel Deck Institute www.sdi.org	847-462-1930
SDI	Steel Door Institute www.steeldoor.org	440-899-0010
SEFA	Scientific Equipment and Furniture Association www.sefabfurn.com	843-689-6878
SEGD	Society for Environmental Graphic Design	202-638-5555
SGCC	Safety Glazing Certification Council	315-938-7444
SHLMA	Southern Hardwood Lumber Manufacturers Association (See HMA)	
SIGMA	Sealed Insulating Glass Manufacturers Association www.sigmaonline.org/sigma	312-644-6610 x3279
SJI	Steel Joist Institute	803-626-1995
SMA	Screen Manufacturers Association	561-533-0991
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association www.smacna.org	703-803-2980
SPI	The Society of the Plastics Industry, Inc. Spray Polyurethane Division www.socplas.org	800-951-2002 202-974-5200
SPIB	Southern Pine Inspection Bureau www.spib.org	850-434-2611

SPRI	SPRI (Formerly: Single Ply Roofing Institute) www.spri.org	781-444-0242
SSINA	Specialty Steel Industry of North America c/o Collier, Shannon Rill & Scott www.ssina.com	800-982-0355 202-342-8630
SSPC	SSPC: The Society for Protective Coatings www.sspc.org	800-837-8303
SSPMA	Sump and Sewage Pump Manufacturers Association	847-559-9233
STI	Steel Tank Institute www.steeltank.com	847-438-8265
SWI	Steel Window Institute c/o Thomas Associates, Inc. www.taol.com/swi	216-241-7333
SWPA	Submersible Wastewater Pump Association	847-729-7972
SWRI	Sealant, Waterproofing and Restoration Institute www.swrionline.org	816-472-7974
TCA	Tile Council of America www.tileusa.com	864-646-8453
TIMA	Thermal Insulation Manufacturers Association (See NAIMA)	
TPI	Truss Plate Institute	608-833-5900
TPI	Turfgrass Producers International (Formerly: American Sod Producers Association) www.turfgrassod.org	800-405-8873 847-705-9898
UFAC	Upholstered Furniture Action Council	910-885-6085
UL	Underwriters Laboratories Inc. www.ul.com	800-704-4050 847-272-8800
UNI	Uni-Bell PVC Pipe Association members.aol.com/unibell	972-243-3902
USITT	USITT: The American Association of Design and Production Professionals in the Performing Arts www.culturenet.ca/usitt	800-938-7488 315-463-6463
USP	U.S. Pharmacopeia (Formerly: U.S. Pharmacopoeial Convention) www.usp.org	800-227-8772 301-881-0666
WA	Wallcoverings Association	312-644-6610
WASTEC	Waste Equipment Technology Association	202-244-4700
WCLIB	West Coast Lumber Inspection Bureau	800-283-1486 503-639-0651
WCMA	Window Covering Manufacturers Association (Formerly: American Window Covering Manufacturers Association)	212-661-4261

WEF	Water Environment Federation Formerly: Water Pollution Control Federation) www.wef.org	800-666-0206 703-684-2400
WIC	Woodwork Institute of California www.wicnet.org	916-372-9943
WMMPA	Wood Moulding & Millwork Producers Association www.wmmpa.com	800-550-7889 530-661-9591
WPCF	Water Pollution Control Federation (See WEF)	
WRI	Wire Reinforcement Institute www.bright.net/~rreiter	419-425-9473
WSC	Water Systems Council Glen Ellyn, IL 60137	630-545-1762
WSFI	Wood and Synthetic Flooring Institute (See MFMA)	
WWPA	Western Wood Products Association www.wwpa.org	503-224-3930

- F. Federal Government Agencies: Names and titles of Federal Government standards- or specification-developing agencies are often abbreviated. The following abbreviations and acronyms referenced in the Contract Documents indicate names of standards- or specification-developing agencies of the Federal Government. Names and addresses are subject to change and are believed, but are not assured, to be accurate and up-to-date as of the date of the Contract Documents.

CE	Corps of Engineers U.S. Department of the Army) www.usace.army.mil CRD standards are available from: U.S. Army Corps of Engineers Waterways Experiment Station Technical Report Distribution Section Services Branch, TIC 3909 Halls Ferry Rd. Vicksburg, MS 39180-6199	202-761-0660 601-634-2696
CFR	Code of Federal Regulations (Available from the Government Printing Office) Washington, DC 20401 Material is usually published first in the "Federal Register." www.access.gpo.gov	202-512-1800
CPSC	Consumer Product Safety Commission www.cpsc.gov	800-638-2772 301-504-0990
CS	Commercial Standard (U.S. Department of Commerce) Government Printing Office Washington, DC 20402 For commercial standards, contact: Ms. Brenda Umberger, CS & PS Specialist c/o NIST Gaithersburg, MD 20899 www.nist.gov	202-512-1800 301-975-4036
DOC	Department of Commerce www.doc.gov	202-482-2000

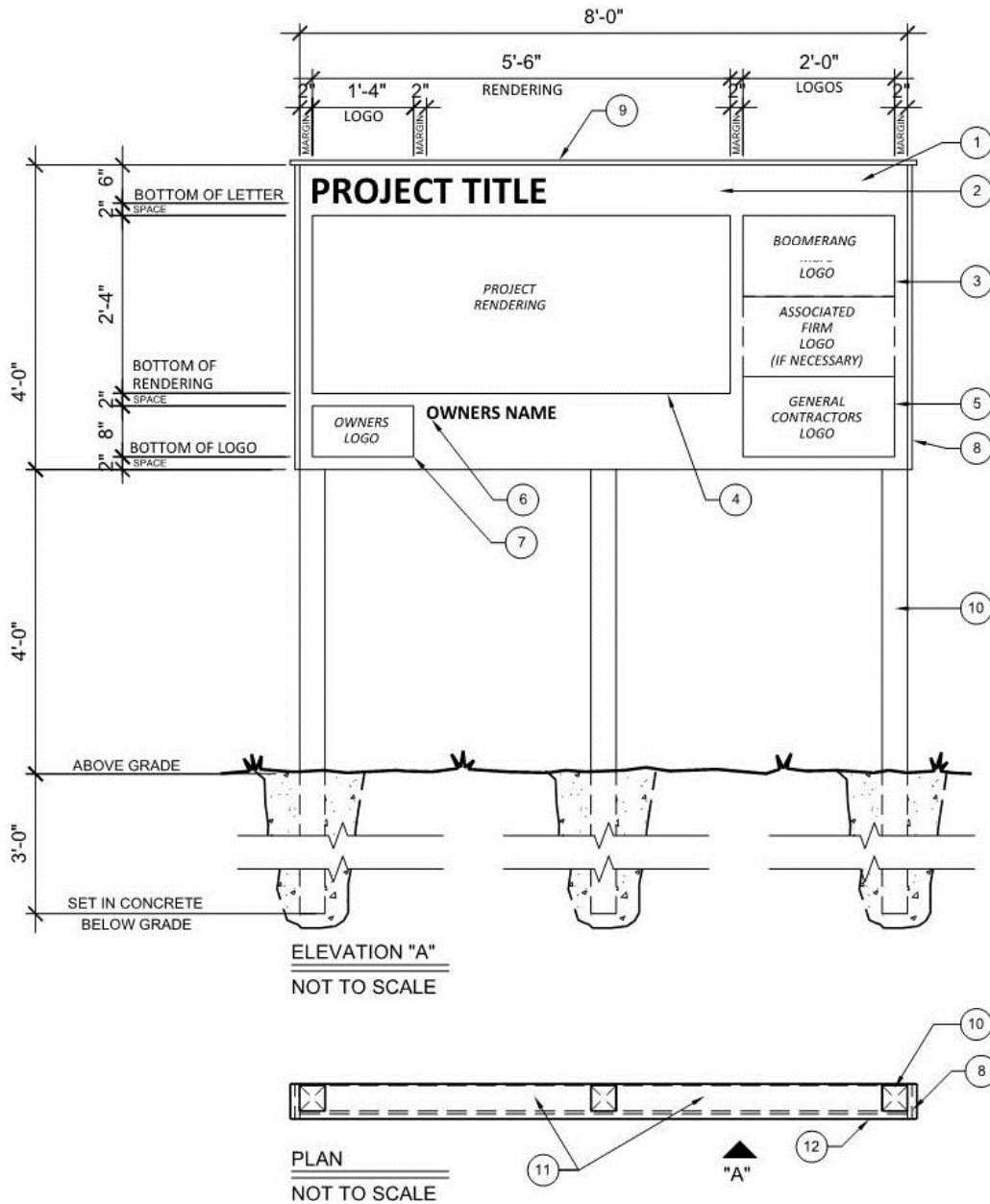
DOT	Department of Transportation www.dot.gov	202-366-4000
EPA	Environmental Protection Agency www.epa.gov	202-260-2090
FAA	Federal Aviation Administration U.S. Department of Transportation) www.faa.gov	202-366-4000
FCC	Federal Communications Commission www.fcc.gov	202-418-0126
FDA	Food and Drug Administration www.fda.gov	301-443-1544
FHA	Federal Housing Administration U.S. Department of Housing and Urban Development) www.hud.gov	202-401-0388
FS	Federal Specification Unit (Available from GSA) www.gsa.gov	202-619-8925
GSA	General Services Administration www.gsa.gov	202-708-5082
MIL	Military Standardization Documents (U.S. Department of Defense) Defense Automated Printing Service www.dodssp.daps.mil	215-697-2179
NIST	National Institute of Standards and Technology (U.S. Department of Commerce) www.nist.gov	301-975-2000
OSHA	Occupational Safety and Health Administration (U.S. Department of Labor) www.osha.gov	202-219-8148
PS	Product Standard of NBS (U.S. Department of Commerce) Government Printing Office Washington, DC 20402 For product standards, contact: Ms. Brenda Umberger, CS & PS Specialist c/o NIST Gaithersburg, MD 20899 www.nist.gov	202-512-1800 301-975-4036
RUS	Rural Utilities Service (Formerly: Rural Electrification Administration) (U.S. Department of Agriculture)	202-692-0187
TRB	Transportation Research Board, National Research Council www.nas.edu/trb	202-334-2934
USDA	U.S. Department of Agriculture www.usda.gov	202-720-8732
USPS	U.S. Postal Service www.usps.gov	202-268-2000

PART 2 - PRODUCTS Not Used)

PART 3 - EXECUTION Not Used)

END OF SECTION 01 42 00

SECTION 01 58 00 – JOBSITE SIGN



LEGEND

- 1) Background color to be PMS 445 Gray
- 2) Project name to be 4" high, solid white letters, left justified. Lettering font to be Calibri.
- 3) Architect's logo (eps image file to be provided by Architect)
- 4) Architect's Rendering (eps image file to be provided by Architect)
- 5) General Contractor's logo
- 6) Owner's name to be 2" high solid white letters, left justified. Lettering font to be Calibri.
- 7) Owner's Logo (eps image file to be provided by Architect)
- 8) Attach 1" x 6" x 8'-0" to both sides of sign. Color to be white.
- 9) Cap top of sign with 1" x 6" x 8'-3" centered. Color to be white.
- 10) 4" x 4" x 11'-8" PT posts (3), exposed areas to be painted white.
- 11) Reinforce top, middle and bottom of sign horizontally with PT 2" X 4" purlins.
- 12) Face of sign to be 4' x 8' sheet of "DURAPLY." Mounted horizontally

END OF SECTION 01 58 00

SECTION 01 60 00 – PRODUCT REQUIREMENTS**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following administrative and procedural requirements:
 1. Selection of Products for Use In Project.
 2. Product Delivery, Storage, And Handling.
 3. Manufacturers' Standard Warranties on Products.
 4. Special Warranties.
 5. Product Substitutions and Comparable Products.
- B. Related Sections include the following:
 1. Division 01, Section "Allowances" for products selected under an allowance.
 2. Division 01, Section "Alternates" for products selected under an alternate.
 3. Division 01, Section "References" for applicable industry standards for products specified.
 4. Division 01, Section "Closeout Procedures" for submitting warranties for contract closeout.
 5. Divisions 02 through 49 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.2 DEFINITIONS

- A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation, shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
 2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, subject to specifications, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
 3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
- C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.
- D. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
- E. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

1.3 SUBMITTALS

- A. Product List: Submit in electronic format a list, in tabular form, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.
 1. Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.
 2. Form: Tabulate information for each product under the following column headings:
 - a. Specification Section number and title.
 - b. Generic name used in the Contract Documents.
 - c. Proprietary name, model number, and similar designations.
 - d. Manufacturer's name and phone number.
 - e. Supplier's name and phone number.
 - f. Installer's name and phone number.
 - g. Projected delivery date or time span of delivery period.
 - h. Identification of items that require early submittal approval for scheduled delivery date.
 3. Completed List: Within 30 days after date of commencement of the Work, submit an electronic copy of completed product list. Include a written explanation for omissions of data and for variations from Contract requirements.

4. Architect's Action: Architect's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Architect's response, or lack of response, does not constitute a waiver of requirement that products comply with the Contract Documents.
- B. Substitution Requests: Substitutions after bidding shall be limited as described in Part 2. Submit an electronic 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 the form provided at the end of the Section.
 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified material or product cannot be provided.
 - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 - g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
 - i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
 - j. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
 - k. 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. Architect will notify Contractor in writing of acceptance or rejection of proposed substitution.
 - a. Form of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instruction.
 - b. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated.
- C. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01, Section "Submittal Procedures." Show compliance with all specified requirements and published product characteristics.
 1. For products listed as Basis of Design, the design reflects the parameters for the Basis of Design product; should another product be specified the contractor will be responsible for any required additional cost deviations of their project. Thus, if the product requires additional work, cost, schedule impact, the contractor shall bear the burden.

1.4 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.
 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
 5. Store products to allow for inspection and measurement of quantity or counting of units.
 6. Store materials in a manner that will not endanger Project structure.

7. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
8. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
9. Protect stored products from damage.

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.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft in electronic format for approval before final execution.
 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 - a. Where project-specific modifications are required, submit in electronic format evidence of acceptance of special warranty modifications by manufacturer with initial submittal.
 2. Refer to Divisions 02 through 49 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Division 01, Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT OPTIONS

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged, and unless otherwise indicated, that are new at time of installation.
 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected," Architect will make selection.
 5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
 6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
- B. Product Selection Procedures: Procedures for product selection include the following:
 1. Product: Where Specification paragraphs or subparagraphs titled "Product" name a single product and manufacturer, provide the product named.
 - a. Substitutions may be considered prior to bidding.
 2. Manufacturer/Source: Where Specification paragraphs or subparagraphs titled "Manufacturer" or "Source" name single manufacturers or sources, provide a product by the manufacturer or from the source named that complies with requirements.
 - a. Substitutions may be considered prior to bidding.
 3. Products: Where Specification paragraphs or subparagraphs titled "Products" introduce a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
 - a. Substitutions may be considered prior to bidding.
 4. Manufacturers: Where Specification paragraphs or subparagraphs titled "Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
 - a. Substitutions may be considered prior to bidding.
 5. Available Products: Where Specification paragraphs or subparagraphs titled "Available Products" introduce a list of names of both products and manufacturers, provide one of the products listed or another product that complies with requirements. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
 6. Available Manufacturers: Where Specification paragraphs or subparagraphs titled "Available Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed or another manufacturer that complies with requirements. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
 7. Product Options: Where Specification paragraphs titled "Product Options" indicate that size, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide either the specific product or system indicated or a comparable product or system by another manufacturer. Comply with provisions in "Product Substitutions" Article.

8. Basis-of-Design Products: Where Specification paragraphs or subparagraphs titled "Basis-of-Design Products" are included and also introduce or refer to a list of manufacturers' names, provide either the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
 - a. Substitutions may be considered prior to bidding.
9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product (and manufacturer) that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches satisfactorily.
 - a. If no product available within specified category matches satisfactorily and complies with other specified requirements, comply with provisions of the Contract Documents on "substitutions" for selection of a matching product.
10. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product (and manufacturer) that complies with other specified requirements.
 - a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that does not include premium items.
 - b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that includes both standard and premium items.
11. Allowances: Refer to individual Specification Sections and "Allowance" provisions in Division 01 for allowances that control product selection and for procedures required for processing such selections.

2.2 PRODUCT SUBSTITUTIONS FOLLOWING AWARD OF CONTRACT

- A. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 2. Requested substitution does not require extensive revisions to the Contract Documents.
 3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 4. Substitution request is fully documented and properly submitted.
 5. Specified product procurement will adversely affect Contractor's Construction Schedule; requested substitution will not adversely affect Contractor's Construction Schedule.
 6. Specified product cannot receive approvals of authorities having jurisdiction; requested substitution has received necessary approvals of authorities having jurisdiction.
 7. Specified product is not compatible with other portions of the Work; requested substitution is compatible with other portions of the Work.
 8. Specified product cannot be coordinated with other portions of the Work; requested substitution has been coordinated with other portions of the Work.
 9. Specified product does not provide the specified warranty; requested substitution provides specified warranty.
 10. Specified product cannot be coordinated with Work of other Contracts; requested substitution has been coordinated with other portions of the Project, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

2.3 COMPARABLE PRODUCTS

- A. Where products or manufacturers are specified by name, submit the following, in addition to other required submittals, to obtain approval of an unnamed product:
 1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.

5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

SECTION CONTINUES

REQUEST FOR SUBSTITUTION FORM – For submission during construction

Project Name: Cooper Academy Addition & Renovations BD Project No.: 2307

To: Boomerang Design
Attention: Duane Hutchins
E-mail: dhutchins@thinkboomerang.com
Requested by:
Contract for:
Bid Date:
Substitution Request No.:
Section Name:
Section Number & Paragraph:
Related Drawings:

Reason for Substitution Request: (See 2.2, subparagraphs 1 through 10):

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 Substitute: Attached:
Point by Point Comparative Product Data
Tests
Reports
Fabrication Drawings
Samples (Where Applicable)
List of Related Changes/Modifications:

Differences between proposed substitution and specified product:

Proposed product/fabrication method affects other parts of Work: No Yes; explain:

SECTION 01 60 00 – PRODUCT REQUIREMENTS

Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product, 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, if specified.
- 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.

Submitted by: _____

Signed: _____

Firm: _____

Address: _____

Telephone: _____

E-mail: _____

BOOMERANG DESIGN REVIEW AND ACTION *(For internal use only)*

Substitution Approved

Substitution Rejected

Signed By: _____ Project Architect Date: _____

Signed By: _____ Specifications Manager Date: _____

ADDITIONAL COMMENTS:

END OF SECTION 01 60 00

SECTION 01 73 00 – EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. General installation of products.
 - 4. Coordination of Owner-installed products.
 - 5. Progress cleaning.
 - 6. Starting and adjusting.
 - 7. Protection of installed construction.
 - 8. Correction of the Work.
- B. Related Sections include the following:
 - 1. Division 01, Section "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
 - 2. Division 01, Section "Submittal Procedures" for submitting surveys.
 - 3. Division 01, Section "Cutting and Patching" for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.
 - 4. Division 01, Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.2 SUBMITTALS

- A. All submittals shall be made in electronic format.
- B. Qualification Data: For land surveyor 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.
- C. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.
- D. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.
- E. Certified Surveys: Submit copy signed by land surveyor.
- F. Final Property Survey: Submit copy showing the Work performed and record survey data.

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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.
 - 1. Before construction, verify the location and points of connection of utility services.
- B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning site work, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - a. Description of the Work.
 - b. List of detrimental conditions, including substrates.
 - c. List of unacceptable installation tolerances.
 - d. Recommended corrections.
2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 1. Notify Architect and Owner not less than three days in advance of proposed utility interruptions.
 2. Do not proceed with utility interruptions without Architect's or Owner's written permission.
- C. 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.
- D. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- E. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents. Submit requests on Document 00 63 13 "Request for Interpretation."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. General: Engage a land surveyor 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 dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 3. Inform installers of lines and levels to which they must comply.
 4. Check the location, level and plumb, of every major element as the Work progresses.
 5. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

- A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- 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.

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 8 feet (2.4 m) in spaces without a suspended ceiling.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 2. Allow for building movement, including thermal expansion and contraction.
- G. 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.
- H. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
1. Remove liquid spills promptly.
 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

- G. Cutting and Patching: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.
 - 1. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.
- H. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
- I. 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.
- J. 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.
- K. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.7 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 01, Section "Quality Requirements."

3.8 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.9 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 01, Section "Cutting and Patching."
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01 73 00

SECTION 01 73 29 – CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.
- B. Related Sections include the following:
 - 1. Division 02, Section "Selective Demolition" for demolition of selected portions of the building for alterations.
 - 2. Division 07, Section "Firestopping" for patching fire-rated construction.
 - 3. Divisions 02 through 49 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1.2 DEFINITIONS

- A. Cutting: Removal of existing construction necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.3 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
- B. Operational Elements: Do not cut and patch 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.
- C. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections of these Specifications.
- B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
 - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to minimize interruption of services to occupied areas.

3.3 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete 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.
- C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 4. Ceilings: Patch, repair, or re-hang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

END OF SECTION 01 73 29

SECTION 01 77 00 – CLOSEOUT PROCEDURES**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 1. Inspection procedures.
 2. Warranties.
 3. Instruction of Owner's personnel.
 4. Final cleaning.
- B. Related Sections include the following:
 1. Division 01, Section "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
 2. Division 01, Section "Construction Progress Documentation" for submitting Final Completion construction photographs and negatives.
 3. Division 01, Section "Execution Requirements" for progress cleaning of Project site.
 4. Division 01, Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 5. Division 01, Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
 6. Divisions 02 through 49 Sections for specific closeout and special cleaning requirements for products of those Sections.

1.2 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
 2. Advise Owner of pending insurance changeover requirements through Architect.
 3. Submit an electronic copy of specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 5. Prepare and submit an electronic copy of Project Record Documents, operation and maintenance manuals, Final Completion construction photographs, damage or settlement surveys, and similar final record information.
 6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
 7. Make final changeover of permanent locks, if required, and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 8. Complete startup testing of systems.
 9. Submit an electronic copy of test/adjust/balance records.
 10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 11. Advise Owner of changeover in heat and other utilities.
 12. Submit in electronic format changeover information related to Owner's occupancy, use, operation, and maintenance.
 13. Complete final cleaning requirements, including touchup painting.
 14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- B. Inspection: Submit in electronic format a written request for inspection for Substantial Completion. On receipt of request, 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. Re-inspection: Send written request for re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.
 - a. Contractor shall execute Change Order reducing the Contract Sum in the amount of the Owner's costs for the second reinspection of items which fail the first reinspection.
 2. Results of completed inspection will form the basis of requirements for Final Completion.

- C. If request for inspection for substantial completion and/or final completion proves to be premature, then the Architect's/Engineer's re-inspections shall be compensated by the Contractor.

1.3 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:
 - 1. Submit a final Application for Payment in electronic format according to Division 01, Section "Payment Procedures."
 - 2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect in electronic format. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 - 3. Submit in electronic format evidence of final, continuing insurance coverage complying with insurance requirements.
 - 4. Submit in electronic format pest-control final inspection report and warranty.
 - 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training videotapes.
- B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect 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. Re-inspection: Send written request in electronic format for re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.
 - a. Contractor shall execute Change Order reducing the Contract Sum in the amount of the Owner's costs for reinspection of items that fail the first Final Inspection.
- C. If request for inspection for substantial completion and/or final completion proves to be premature, then the Architect's/Engineer's re-inspections shall be compensated by the Contractor.

1.4 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Preparation: Submit an electronic copy 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. Use CSI Form 14.1A.
 - 1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
 - 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
 - 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.

1.5 WARRANTIES

- A. Submittal Time: Submit written warranties in electronic format on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
- B. Partial Occupancy: Submit in electronic format properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
 - 1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
- D. Provide additional copy of each warranty in operation and maintenance manuals.
- E. All warranties will begin on the date of Substantial Completion for the entire project. The Contractor is responsible for securing any required warranty extensions to meet this requirement.

1.6 TIMELINESS OF CLOSEOUT

- A. Time spent by Architect/Engineer 60 days beyond substantial completion date shall be reimbursed by the Contractor.

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 or leave residue.

PART 3 - EXECUTION

3.1 DEMONSTRATION AND TRAINING

- A. Instruction: Instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Provide instructors experienced in operation and maintenance procedures.
 - 2. Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at the start of each season.
 - 3. Schedule training with Owner, through Architect, with at least seven days' advance notice.
 - 4. Coordinate instructors, including providing notification of dates, times, length of instruction, and course content.
- B. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections. For each training module, develop a learning objective and teaching outline. Include instruction for the following:
 - 1. System design and operational philosophy.
 - 2. Review of documentation.
 - 3. Operations.
 - 4. Adjustments.
 - 5. Troubleshooting.
 - 6. Maintenance.
 - 7. Repair.

3.2 FINAL CLEANING

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - 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; shampoo 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. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - j. Remove labels that are not permanent.
 - k. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.

- l. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - m. Replace parts subject to unusual operating conditions.
 - n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - p. Clean ducts, blowers, and coils if units were operated without filters during construction.
 - q. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
 - r. Leave Project clean and ready for occupancy.
- C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid Project of rodents, insects, and other pests. Prepare a report.
- D. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

3.3 ELEVENTH MONTH CORRECTION PERIOD INSPECTION

- A. Contractor shall participate in comprehensive project walkthrough inspection prior to expiration of Contractor's twelve-month Period for Correction of the Work. Architect will coordinate scheduling of inspection to include Architect, Owner, and Contractor. Purpose of the walkthrough will be to assist the Owner in identifying elements of the Work that require repair or replacement due to defects in the Work.
- B. Contractor shall promptly repair defective Work and shall coordinate access to the site with the Owner. Contractor shall issue a final report to the Architect indicating that all defects have been corrected.

3.4 SCHEDULE OF WARRANTIES

- A. The Contractor shall prepare a schedule of required Warranties and submit the schedule electronically for review during the submittal process. The schedule shall include the section number, section name, length of warranty and type of coverage.

END OF SECTION 01 77 00

SECTION 01 78 23 – OPERATION AND MAINTENANCE DATA**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes administrative and procedural requirements for operation and maintenance manuals, including the following:
 1. Preparing and submitting operation and maintenance manuals for building operating systems and equipment.
 2. Preparing and submitting instruction manuals covering the care, preservation, and maintenance of architectural products and finishes.
 3. Instruction of the Owner's operating personnel in the operation and maintenance of building systems and equipment.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 1. Division 01, Section "Submittals" specifies preparation of Shop Drawings and Product Data.
 2. Division 01, Section "Contract Closeout" specifies general closeout requirements.
 3. Division 01, Section "Project Record Documents" specifies general requirements for submitting project record documents.
 4. Appropriate Sections of Divisions 02 through 49 specify special operation and maintenance data requirements for specific pieces of equipment or building operating systems.

1.2 QUALITY ASSURANCE

- A. Maintenance Manual Preparation: In preparation of maintenance manuals, use personnel thoroughly trained and experienced in operation and maintenance of equipment or system involved.
- B. Instructions for the Owner's Personnel: Use experienced instructors thoroughly trained and experienced in operation and maintenance of equipment or system involved to instruct the Owner's operation and maintenance personnel.

1.3 SUBMITTALS

- A. Submittal Schedule: Comply with the following schedule for submitting operation and maintenance manuals:
 1. Before Substantial Completion, when each installation that requires operation and maintenance manuals is nominally complete, electronically submit a draft copy of each manual to the Architect for review. Include a complete index or table of contents of each manual.
 2. Electronically submit the data in final form at least 15 days before final inspection.
 3. After final inspection, make corrections or modifications to comply with the Architect's comments. Submit each approved manual to the Architect within 15 days of receipt of the Architect's comments.
- B. Form of Submittal: Prepare operation and maintenance manuals in the form of an instructional manual for use by the Owner's operating personnel. Organize O&M documents into an orderly sequence based on the Table of Contents of the Project Manual.
 1. Text Material: Where maintenance manuals require written material, use the manufacturer's standard printed material. If manufacturer's standard printed material is not available, provide specially prepared data, neatly scanned.
 2. Electronic submittal: For scanned documents, provide color/grayscale scans at minimum 300 dpi.

New Text
shw

1.4 MANUAL CONTENT

- A. In each manual include information specified in the individual Specification Section and the following information for each major component of building equipment and its controls:
 1. General system or equipment description.
 2. Design factors and assumptions.
 3. Copies of applicable Shop Drawings and Product Data.
 4. System or equipment identification, including:
 - a. Name of manufacturer.
 - b. Model number.
 - c. Serial number of each component.
 5. Operating instructions.
 6. Emergency instructions.
 7. Wiring diagrams.
 8. Inspection and test procedures.
 9. Maintenance procedures and schedules.

10. Precautions against improper use and maintenance.
 11. Copies of warranties.
 12. Repair instructions including spare parts listing.
 13. Sources of required maintenance materials and related services.
 14. Manual index.
- B. Organize each manual into separate Sections for each piece of related equipment. As a minimum, each manual shall contain a title page; a table of contents; copies of Product Data, supplemented by Drawings and written text; and copies of each warranty, bond, and service contract issued.
1. Title Page: Provide a title page in a transparent, plastic envelope as the first sheet of each manual. Provide the following information:
 - a. Subject matter covered by the manual.
 - b. Name and address of the Project.
 - c. Date of submittal.
 - d. Name, address, and telephone number of the Contractor.
 - e. Names and contact information of Owner's personnel trained in related systems operation.
 - f. Name and address of the Architect.
 - g. Cross-reference to related systems in other operation and maintenance manuals.
 2. Table of Contents: After title page, include a typewritten table of contents for each volume, arranged systematically according to the Project Manual format. Include a list of each product included, identified by product name or other appropriate identifying symbol and indexed to the content of the volume.
 - a. Where a system requires more than one volume to accommodate data, provide a comprehensive table of contents for all volumes in each volume of the set.
 3. General Information: Provide a general information Section immediately following table of contents, listing each product included in the manual, identified by product name. Under each product, list the name, address, and telephone number of the subcontractor or Installer and the maintenance contractor. Clearly delineate the extent of responsibility of each of these entities. Include a local source for replacement parts and equipment.
 4. Product Data: Where the manuals include manufacturer's standard printed data, include only sheets that are pertinent to the part or product installed. Mark each sheet to identify each part or product included in the installation. Where the Project includes more than one item in a tabular format, identify each item, using appropriate references from the Contract Documents. Identify data that is applicable to the installation, and delete references to information that is not applicable.
 5. Written Text: Prepare written text to provide necessary information where manufacturer's standard printed data is not available, and the information is necessary for proper operation and maintenance of equipment or systems. Prepare written text where it is necessary to provide additional information or to supplement data included in the manual. Organize text in a consistent format under separate headings for different procedures. Where necessary, provide a logical sequence of instruction for each operation or maintenance procedure.
 6. Drawings: Provide specially prepared drawings where necessary to supplement manufacturer's printed data to illustrate the relationship of component parts of equipment or systems or to provide control or flow diagrams. Coordinate these drawings with information contained in project record drawings to assure correct illustration of the completed installation.
 - a. Do not use original project record documents as part of operation and maintenance manuals.
 7. Warranties, Bonds, and Service Contracts: Provide a copy of each warranty, bond, or service contract in the appropriate manual for the information of the Owner's operating personnel. Provide written data outlining procedures to follow in the event of product failure. List circumstances and conditions that would affect validity of warranty or bond.

1.5 MATERIAL AND FINISHES MAINTENANCE MANUAL

- A. Submit one copy of each manual and one digital copy in PDF format, in final form, on material and finishes to the Architect for distribution. Provide one section for architectural products, including applied materials and finishes. Provide a second section for products designed for moisture protection and products exposed to the weather.
1. Refer to individual Specification Sections for additional requirements on care and maintenance of materials and finishes.
- B. Architectural Products: Provide manufacturer's data and instructions on care and maintenance of architectural products, including applied materials and finishes.
1. Manufacturer's Data: Provide complete information on architectural products, including the following, as applicable:
 - a. Manufacturer's catalog number.
 - b. Size.
 - c. Material composition.

- d. Color.
 - e. Texture.
 - f. Reordering information for specially manufactured products.
2. Care and Maintenance Instructions: Provide information on care and maintenance, including manufacturer's recommendations for types of cleaning agents to be used and methods of cleaning. Provide information on cleaning agents and methods that could prove detrimental to the product. Include manufacturer's recommended schedule for cleaning and maintenance.
- C. Moisture Protection and Products Exposed to the Weather: Provide complete manufacturer's data with instructions on inspection, maintenance, and repair of products exposed to the weather or designed for moisture-protection purposes.
- 1. Manufacturer's Data: Provide manufacturer's data giving detailed information, including the following, as applicable:
 - a. Applicable standards.
 - b. Chemical composition.
 - c. Installation details.
 - d. Inspection procedures.
 - e. Maintenance information.
 - f. Repair procedures.

1.6 EQUIPMENT AND SYSTEMS MAINTENANCE MANUAL

- A. Submit one copy of each manual and one digital copy in PDF format, in final form, on equipment and systems to the Architect for distribution. Provide separate manuals for each unit of equipment, each operating system, and each electric and electronic system.
- 1. Refer to individual Specification Sections for additional requirements on operation and maintenance of the various pieces of equipment and operating systems.
- B. Equipment and Systems: Provide the following information for each piece of equipment, each building operating system, and each electric or electronic system.
- 1. Description: Provide a complete description of each unit and related component parts, including the following:
 - a. Equipment or system function.
 - b. Operating characteristics.
 - c. Limiting conditions.
 - d. Performance curves.
 - e. Engineering data and tests.
 - f. Complete nomenclature and number of replacement parts.
 - 2. Manufacturer's Information: For each manufacturer of a component part or piece of equipment, provide the following:
 - a. Printed operation and maintenance instructions.
 - b. Assembly drawings and diagrams required for maintenance.
 - c. List of items recommended to be stocked as spare parts.
 - 3. Maintenance Procedures: Provide information detailing essential maintenance procedures, including the following:
 - a. Routine operations.
 - b. Troubleshooting guide.
 - c. Disassembly, repair, and reassembly.
 - d. Alignment, adjusting, and checking.
 - 4. Operating Procedures: Provide information on equipment and system operating procedures, including the following:
 - a. Startup procedures.
 - b. Equipment or system break-in.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Instructions on stopping.
 - f. Shutdown and emergency instructions.
 - g. Summer and winter operating instructions.
 - h. Required sequences for electric or electronic systems.
 - i. Special operating instructions.
 - 5. Servicing Schedule: Provide a schedule of routine servicing and lubrication requirements, including a list of required lubricants for equipment with moving parts.

6. Controls: Provide a description of the sequence of operation and as-installed control diagrams by the control manufacturer for systems requiring controls.
7. Coordination Drawings: Provide each Contractor's Coordination Drawings.
 - a. Provide as-installed, color-coded, piping diagrams, where required for identification.
8. Valve Tags: Provide charts of valve-tag numbers, with the location and function of each valve.
9. Circuit Directories: For electric and electronic systems, provide complete circuit directories of panelboards, including the following:
 - a. Electric service.
 - b. Controls.
 - c. Communication.

1.7 INSTRUCTIONS FOR THE OWNER'S PERSONNEL

- A. Prior to final inspection, instruct the Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Provide instruction at mutually agreed upon times.
 1. For equipment that requires seasonal operation, provide similar instruction during other seasons.
 2. Use operation and maintenance manuals for each piece of equipment or system as the basis of instruction. Review contents in detail to explain all aspects of operation and maintenance.
- B. Provide complete videotape record of instructional sessions for Owner's personnel.
 1. Retain services of experienced audio/visual recording technicians to record and produce videotape.
 2. Edit recording to eliminate extraneous footage. Provide index to recording content. Provide label on DVD and protective case identifying content.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 78 23

SECTION 01 78 39 – PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
- B. Related Sections include the following:
 - 1. Division 01, Section "Closeout Procedures" for general closeout procedures.
 - 2. Division 01, Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 3. Divisions 02 through 49 Sections for specific requirements for Project Record Documents of products in those Sections.

1.2 SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one hard copy set of marked-up Record Prints.
- B. Record Specifications: Submit one hard copy of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit one copy of each Product Data submittal in electronic format.
 - 1. Where Record Product Data is required as part of operation and maintenance manuals, submit marked-up Product Data as an insert in the manual instead of submittal as Record Product Data.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.
 - 1. Preparation: Mark Record Prints and Transparencies to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an understandable drawing technique.
 - c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
 - 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations below first floor.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 - 3. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
 - 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
 - 5. Mark important additional information that was either shown schematically or omitted from original Drawings.

6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
 1. Record Prints: Organize Record Prints and newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Record Transparencies: The Owner will provide one set of transparencies near the end of the project for the Contractor to transfer all as-built recorded information from the record drawings to the transparencies. Organize into unbound sets matching Record Prints. Place transparencies in durable tube-type drawing containers with end caps. Mark end cap of each container with identification. If container does not include a complete set, identify Drawings included.
 3. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 3. Record the name of the manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
 5. Note related Change Orders, Record Drawings, and Product Data where applicable.

2.3 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.
- B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

END OF SECTION 01 78 39

SECTION 01 79 00 – DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
- B. Related Sections include the following:
 - 1. Division 01, Section "Project Management and Coordination" for requirements for pre-instruction conferences.

1.2 SUBMITTALS

- A. Instruction Program: Submit two copies of outline of instructional program for demonstration and training in electronic format, including schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. At completion of training, submit two complete training manuals for Owner's use.
- B. 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.

1.3 QUALITY ASSURANCE

- A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01, Section "Quality Requirements," experienced in operation and maintenance procedures and training.

1.4 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections, and as follows:
 - 1. Fire-protection systems, including: fire alarm, fire pumps and fire-extinguishing systems.
 - 2. Intrusion detection systems.
 - 3. Conveying systems, including: elevators and wheelchair lifts.
 - 4. Heat generation, including boilers, feedwater equipment, pumps, and water distribution piping.
 - 5. Refrigeration systems, including chillers, pumps, and distribution piping.
 - 6. Plumbing systems, including manual and automatic flush valves.
 - 7. HVAC systems, including air-handling equipment, air distribution system, and terminal equipment and devices.
 - 8. HVAC instrumentation and controls.
 - 9. Electrical service and distribution, including transformers, switchboards, panelboards, and motor controls.
 - 10. Packaged engine generators, including transfer switches.
 - 11. Lighting equipment and controls.
 - 12. Communication systems, including intercommunication surveillance, clocks and programming, voice and data equipment.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include 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. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project Record Documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. 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. Shutdown instructions for each type of emergency.
 - c. Operating instructions for conditions outside of normal operating limits.
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.
5. 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.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual.
- B. Set up instructional equipment at instruction location.

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. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a written or a demonstration performance-based test.

END OF SECTION 01 79 00

**DIVISION 02
EXISTING CONDITIONS**

SECTION 02 41 19 – SELECTIVE DEMOLITION**PART 1 - GENERAL****1.1 Summary**

- A. This Section includes the following:
 - 1. Demolition and removal of selected portions of a building.
 - 2. Demolition and removal of selected site elements.
 - 3. Patching and repairs.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 01, Section "Summary" for use of the building and phasing requirements.
 - 2. Division 01, Section "Cutting and Patching" for cutting and patching procedures for selective demolition operations.
 - 3. Division 01, Section "Construction Progress Documentation" for selective demolition schedule requirements.
 - 4. Division 01, Section "Closeout Procedures" for record document requirements.
 - 5. Division 02, Section "Building Demolition" for demolition of buildings, structures, and site improvements.
 - 6. Division 31, Section "Site Clearing" for site clearing and removing above- and below-grade improvements.
 - 7. Division 31, Section "Earthwork" for soil materials, excavating, backfilling, and site grading.

1.2 Definitions

- A. Remove: Remove and legally dispose of items except those indicated to be reinstalled, salvaged, or to remain the Owner's property.
- B. Remove and Salvage: Items indicated to be removed and salvaged remain the Owner's property. Remove, clean, and pack or crate items to protect against damage. Identify contents of containers and deliver to Owner's designated storage area.
- C. Remove and Reinstall: Remove items indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage. Reinstall items in the same locations or in locations indicated.
- D. Existing to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by the Architect, items may be removed to a suitable, protected storage location during selective demolition and then cleaned and reinstalled in their original locations.

1.3 Materials Ownership

- A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain the Owner's property, demolished materials shall become the Contractor's property and shall be removed from the site with further disposition at the Contractor's option.
 - 1. Verify with Owner whether Owner wishes to retain any materials indicated to be removed. Turn over requested items to Owner.

1.4 Submittals

- A. Proposed dust-control measures.
- B. Proposed noise-control measures.
- C. Inventory of items to be removed and salvaged.
- D. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by selective demolition operations.
- E. Record drawings at Project closeout according to Division 01, Section "Closeout Procedures."
 - 1. Identify and accurately locate capped utilities and other subsurface structural, electrical, or mechanical conditions.
- F. Landfill records indicating receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.5 Quality Assurance

- A. Demolition Firm Qualifications: Engage an experienced firm that has successfully completed selective demolition Work similar to that indicated for this Project.
- B. Regulatory Requirements: Comply with governing EPA notification regulations before starting selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

1.6 Project Conditions

- A. Owner will occupy portions of the building immediately adjacent to selective demolition area. Conduct selective demolition so that Owner's operations will not be disrupted. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.
- B. Owner assumes no responsibility for actual condition of buildings to be selectively demolished.

- C. Asbestos: It is not expected that asbestos will be encountered in the Work. If any materials suspected of containing asbestos are encountered, do not disturb the materials. Immediately notify the Architect and the Owner.
- D. Storage or sale of removed items or materials on-site will not be permitted.

1.7 Scheduling

- A. Arrange selective demolition schedule so as not to interfere with Owner's on-site operations.

PART 2 - PRODUCTS

2.1 Repair Materials

- A. Use repair materials identical to existing materials.
 - 1. Where identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
 - 2. Use materials whose installed performance equals or surpasses that of existing materials.

PART 3 - EXECUTION

3.1 Examination

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with the intended function or design are encountered, investigate and measure the nature and extent of the conflict. Promptly submit a written report to the Architect.

3.2 Utility Services

- A. Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Do not interrupt existing utilities serving occupied or operating facilities, except when authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to governing authorities.
 - a. Provide not less than 72 hours' notice to Owner if shutdown of service is required during changeover.
- B. Utility Requirements: Refer to Division 22 and 26 Sections for shutting off, disconnecting, removing, and sealing or capping utility services. Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.3 Preparation

- A. Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with selective demolition operations.
- B. Employ a certified, licensed exterminator to treat building and to control rodents and vermin before and during selective demolition operations.
- C. Conduct demolition operations and remove debris to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
- D. Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of building to be selectively demolished.
 - 1. Strengthen or add new supports when required during progress of selective demolition.

3.4 Pollution Controls

- A. Use water mist, temporary enclosures, and other suitable methods to limit the spread of dust and dirt. Comply with governing environmental protection regulations.
 - 1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
- B. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 1. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level.
- C. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before start of selective demolition.

3.5 Selective Demolition

- A. Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete Work within limitations of governing regulations and as follows:
 - 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition work above each floor or tier before disturbing supporting members on lower levels.
 - 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. To minimize disturbance of adjacent surfaces, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 - 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 - 5. Maintain adequate ventilation when using cutting torches.
 - 6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 - 7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 - 8. Locate selective demolition equipment throughout the structure and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 - 9. Dispose of demolished items and materials promptly. On-site storage or sale of removed items is prohibited.
 - 10. Return elements of construction and surfaces to remain to condition existing before start of selective demolition operations.

3.6 Patching and Repairs

- A. Promptly patch and repair holes and damaged surfaces caused to adjacent construction by selective demolition operations.
- B. Patching is specified in Division 01, Section "Cutting and Patching."
- C. Restore exposed finishes of patched areas and extend finish restoration into adjoining construction to remain in a manner that eliminates evidence of patching and refinishing.
- D. Patch and repair floor and wall surfaces in the new space where demolished walls or partitions extend one finished area into another. Provide a flush and even surface of uniform color and appearance.
- E. Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.7 Disposal of Demolished Materials

- A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
- B. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.8 Cleaning

- A. Sweep the building broom clean on completion of selective demolition operation.
- B. Change filters on air-handling equipment on completion of selective demolition operations.

END OF SECTION 02 41 19

**DIVISION 03
CONCRETE**

SECTION 03 10 00 - CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Form-facing material for cast-in-place concrete.
 - 2. Shoring, bracing, and anchoring.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each of the following:
 - 1. Exposed surface form-facing material.
 - 2. Concealed surface form-facing material.
 - 3. Form ties.
 - 4. Waterstops.
 - 5. Form-release agent.
- B. Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.
 - 1. For exposed vertical concrete walls, indicate dimensions and form tie locations.
 - 2. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301.
 - a. Location of construction joints is subject to approval of the Architect.
 - 3. Indicate location of water stops.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Minutes of preinstallation conference.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.
 - 1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
 - 2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.

2.2 FORM-FACING MATERIALS

- A. As-Cast Surface Form-Facing Material:
 - 1. Provide continuous, true, and smooth concrete surfaces.
 - 2. Furnish in largest practicable sizes to minimize number of joints.
 - 3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete, and as follows:
 - a. Plywood, metal, or other approved panel materials.
 - b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

- 1) APA HDO (high-density overlay).
- B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.
 1. Provide lumber dressed on at least two edges and one side for tight fit.

2.3 WATERSTOPS

- A. Flexible Rubber Waterstops: U.S. Army Corps of Engineers CRD-C 513, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints, with factory fabricate corners, intersections, and directional changes.
 1. Profile: Flat dumbbell with center bulb, Flat dumbbell without center bulb, Ribbed with center bulb, Ribbed without center bulb.
- B. Flexible PVC Waterstops: U.S. Army Corps of Engineers CRD-C 572, [with factory-installed metal eyelets,] for embedding in concrete to prevent passage of fluids through joints, with factory fabricate corners, intersections, and directional changes.
 1. Profile: Flat dumbbell with center bulb, Flat dumbbell without center bulb, Ribbed with center bulb, Ribbed without center bulb.
- C. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.
- D. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer-modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch.

2.4 RELATED MATERIALS

- A. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.
- B. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
 2. Form release agent for form liners shall be acceptable to form liner manufacturer.
- C. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

- A. Comply with ACI 301.
- B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes.
- C. Limit concrete surface irregularities as follows:
- D. Construct forms tight enough to prevent loss of concrete mortar.
 1. Minimize joints.
 2. Exposed Concrete: Symmetrically align joints in forms.
- E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.
 1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
 2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 3. Install keyways, reglets, recesses, and other accessories, for easy removal.
- F. Do not use rust-stained, steel, form-facing material.
- G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.

1. Provide and secure units to support screed strips.
 2. Use strike-off templates or compacting-type screeds.
- H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.
1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
 2. Locate temporary openings in forms at inconspicuous locations.
- I. Chamfer exterior corners and edges of permanently exposed concrete.
- J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.
- K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
1. Determine sizes and locations from trades providing such items.
 2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.
- L. Construction and Movement Joints:
1. Construct joints true to line with faces perpendicular to surface plane of concrete.
 2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 3. Place joints perpendicular to main reinforcement.
 4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.
 - a. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 6. Space vertical joints in walls at 15 ft on center or as specified in the contract documents.
- M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
 2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 INSTALLATION OF 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.
1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
 3. Install dovetail anchor slots in concrete structures, as indicated on Drawings.
 4. Clean embedded items immediately prior to concrete placement.

3.3 INSTALLATION OF WATERSTOPS

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm.

1. Install in longest lengths practicable.
 2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
 3. Allow clearance between waterstop and reinforcing steel of not less than 2 times the largest concrete aggregate size specified in Section 033000 "Cast-In-Place Concrete."
 4. Secure waterstops in correct position at 12 inches on center.
 5. Field fabricate joints in accordance with manufacturer's instructions using heat welding.
 - a. Miter corners, intersections, and directional changes in waterstops.
 - b. Align center bulbs.
 6. Clean waterstops immediately prior to placement of concrete.
 7. Support and protect exposed waterstops during progress of the Work.
- B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, according to manufacturer's written instructions, by adhesive bonding, mechanically fastening, and firmly pressing into place.
1. Install in longest lengths practicable.
 2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
 3. Protect exposed waterstops during progress of the Work.

3.4 FIELD QUALITY CONTROL.

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

END OF SECTION 031000

SECTION 03 20 00 - CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Steel reinforcement bars.
 - 2. Welded-wire reinforcement.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction contraction and isolation joints.
 - c. Steel-reinforcement installation.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Each type of steel reinforcement.
 - 2. Bar supports.
 - 3. Mechanical splice couplers.
- B. Shop Drawings: Comply with ACI SP-066:
 - 1. Include placing drawings that detail fabrication, bending, and placement.
 - 2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.
- C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.
 - 1. Location of construction joints is subject to approval of Architect.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Statements: For testing and inspection agency.
- B. Delegated Design Engineer Qualifications: Include the following:
 - 1. Experience providing delegated design engineering services of the type indicated.
- C. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Epoxy-Coated Reinforcement: CRSI's "Epoxy Coating Plant Certification."
 - 2. Dual-Coated Reinforcement: CRSI's "Epoxy Coating Plant Certification."
- D. Material Test Reports: For the following, from a qualified testing agency:
 - 1. Steel Reinforcement:
 - a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.
 - 2. Mechanical splice couplers.
- E. Field quality-control reports.
- F. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency **acceptable to authorities having jurisdiction**, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
 - 1. Store reinforcement to avoid contact with earth.
 - 2. Do not allow epoxy-coated reinforcement to be stored outdoors for more than 60 days without being stored under an opaque covering.
 - 3. Do not allow dual-coated reinforcement to be stored outdoors for more than 60 days without being stored under an opaque covering.
 - 4. Do not allow stainless steel reinforcement to come into contact with uncoated reinforcement.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENT

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60 (Grade 420), deformed.
- B. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.
- C. Galvanized-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from galvanized-steel wire into flat sheets.

2.3 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A615/A615M, Grade 60 (Grade 420), plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.
 - 1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
- C. Mechanical Splice Couplers: ACI 318 (ACI 318M) Type 2, same material of reinforcing bar being spliced; tension-compression type with dowel-bar type or mechanical-lap type.
- D. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A775/A775M.

2.4 FABRICATING REINFORCEMENT

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

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protection of In-Place Conditions:
 - 1. Do not cut or puncture vapor retarder.
 - 2. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

- A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
- B. Accurately position, support, and secure reinforcement against displacement.

1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
2. Do not tack weld crossing reinforcing bars.
- C. Preserve clearance between bars of not less than 1 inch (25 mm), not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- D. Provide concrete coverage in accordance with ACI 318 (ACI 318M).
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Splices: Lap splices as indicated on Drawings.
 1. Bars indicated to be continuous, and all vertical bars to be lapped not less than 36 bar diameters at splices, or 24 inches (610 mm), whichever is greater.
 2. Stagger splices in accordance with ACI 318 (ACI 318M).
 3. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.
 4. Weld reinforcing bars in accordance with AWS D1.4/D 1.4M, where indicated on Drawings.
- G. Install Deformed Bar Anchors with electric arch stud welding.
 1. Where Deformed Bar Anchor lengths are greater than can be welded by the electric arch stud welding process, lap splice shorter Deformed Bar Anchors with standard deformed Reinforcing Bars.
 2. At contractor's option, Deformed Bar Anchors may be substituted with Weldable Reinforcing, ASTM A706, and welded to structure with welds capable of developing the strength of the bar in accordance with AWS D1.4.
- H. Install welded-wire reinforcement in longest practicable lengths.
 1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."
 - a. For reinforcement less than W4.0 or D4.0, continuous support spacing to not exceed 12 inches (305 mm).
 2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches (50 mm) for plain wire and 8 inches (200 mm) for deformed wire.
 3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
 4. Lace overlaps with wire.

3.3 JOINTS

- A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 1. Reference construction drawings for construction joints at
 2. Place joints perpendicular to main reinforcement.
 3. Continue reinforcement across construction joints unless otherwise indicated.
 4. Do not continue reinforcement through sides of strip placements of floors and slabs.
- B. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length, to prevent concrete bonding to one side of joint.

3.4 INSTALLATION TOLERANCES

- A. Comply with ACI 117 (ACI 117M).

3.5 SPECIAL INSPECTIONS

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports. Special Inspections shall be in accordance with Section 1705.3 of the Building Code, refer to Schedule of Special Inspections for detailed requirements.
- B. Inspections:
 1. Steel-reinforcement placement.
 2. Steel-reinforcement welding.

END OF SECTION 032000

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.
- B. Related Requirements:
 - 1. Section 031000 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. 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 the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction joints, control joints, isolation joints, and joint-filler strips.
 - c. Vapor-retarder installation.
 - d. Anchor rod and anchorage device installation tolerances.
 - e. Cold and hot weather concreting procedures.
 - f. Concrete finishes and finishing.
 - g. Curing procedures.
 - h. Floor and slab flatness and levelness measurements.
 - i. Concrete repair procedures.
 - j. Concrete protection.
 - k. Initial curing and field curing of field test cylinders (ASTM C31/C31M.)
 - l. Protection of field cured field test cylinders.

1.5 ACTION SUBMITTALS

- A. Product Data: For each of the following.
 - 1. Portland cement.
 - 2. Fly ash.
 - 3. Silica fume.
 - 4. Aggregates.

5. Admixtures:
 - a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
 6. Vapor retarders.
 7. Floor and slab treatments.
 8. Liquid floor treatments.
 9. Curing materials.
 10. Joint fillers.
 11. Repair materials.
- B. Design Mixtures: For each concrete mixture, include the following:
1. Mixture identification.
 2. Minimum 28-day compressive strength.
 3. Durability exposure class.
 4. Maximum w/cm.
 5. Calculated equilibrium unit weight, for lightweight concrete.
 6. Slump limit.
 7. Air content.
 8. Nominal maximum aggregate size.
 9. Steel-fiber reinforcement content.
 10. Synthetic micro-fiber content.
 11. Include manufacturer's certification that permeability-reducing admixture is compatible with mix design.
 12. Include certification that dosage rate for permeability-reducing admixture matches dosage rate used in performance compliance test.
 13. Intended placement method.
 14. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Shop Drawings:
1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - a. Location of construction joints is subject to approval of the Architect.
- D. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:
1. Concrete Class designation.
 2. Location within Project.
 3. Exposure Class designation.
 4. Formed Surface Finish designation and final finish.
 5. Final finish for floors.
 6. Curing process.
 7. Floor treatment if any.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For the following:
1. Installer: Include copies of applicable ACI certificates.
 2. Ready-mixed concrete manufacturer.
 3. Testing agency: Include copies of applicable ACI certificates.
- B. Material Certificates: For each of the following, signed by manufacturers:
1. Cementitious materials.

2. Admixtures.
 3. Curing compounds.
 4. Floor and slab treatments.
 5. Bonding agents.
 6. Adhesives.
 7. Vapor retarders.
 8. Semirigid joint filler.
 9. Joint-filler strips.
 10. Repair materials.
- C. Material Test Reports: For the following, from a qualified testing agency:
1. Portland cement.
 2. Fly ash.
 3. Silica fume.
 4. Aggregates.
 5. Admixtures:
- D. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.
- E. Research Reports:
1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
 2. For sheet vapor retarder/termite barrier, showing compliance with ICC AC380.
- F. Preconstruction Test Reports: For each mix design.
- G. Field quality-control reports.
- H. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician with experience installing and finishing concrete, incorporating permeability-reducing admixtures.
1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.
- B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.
1. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.
- D. Field Quality Control Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
1. Personnel conducting field tests shall be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with ACI CPP 610.1 or an equivalent certification program.
- E. Mockups: Cast concrete slab-on-ground and formed-surface panels to demonstrate typical joints, rustications, surface finish, texture, tolerances, floor treatments, and standard of workmanship.
1. Slab-On-Ground: Build panel approximately 15 feet by 15 feet in the location indicated or, if not indicated, as directed by Architect.

- a. Divide panel into four equal panels to demonstrate saw joint cutting.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.
 1. Include the following information in each test report:
 - a. Admixture dosage rates.
 - b. Slump.
 - c. Air content.
 - d. Water-Cement ratio.
 - e. Seven-day compressive strength.
 - f. 28-day compressive strength.
 - g. Standard deviation.
 - h. ACI required compressive strength
 - i. Unit weight.
 - j. Water-soluble chloride ion content determined in accordance with ASTM C1218 at age between 28 and 42 days.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C94/C94M and ACI 301.

1.10 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.
 1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 2. When average high and low temperature is expected to fall below 40 deg F, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 3. Do not use frozen materials or materials containing ice or snow.
 4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
 5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:
 1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.
 - a. Maintain forms, steel reinforcement, embedded items, and subgrade temperature less than 115 deg F.

1.11 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement sheet vapor retarder/termite barrier material and accessories for sheet vapor retarder/ termite barrier and accessories that do not comply with requirements or that fail to resist penetration by termites within specified warranty period.
 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

- A. Source Limitations:
 1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.

2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
 3. Obtain aggregate from single source.
 4. Obtain each type of admixture from single source from single manufacturer.
- B. Cementitious Materials:
1. Portland Cement: ASTM C150/C150M, Type I/II, gray.
 2. Fly Ash: ASTM C618, Class C or F.
 3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
 4. Silica Fume: ASTM C1240 amorphous silica.
- C. Normal-Weight Aggregates: ASTM C33/C33M, coarse aggregate or better, graded. Provide aggregates from a single source.
1. Alkali-Silica Reaction: Comply with one of the following:
 - a. Expansion Result of Aggregate: Not more than 0.04 percent at one-year when tested in accordance with ASTM C1293.
 - b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567.
 - c. Alkali Content in Concrete: Not more than 4 lb./cu. yd. for moderately reactive aggregate or 3 lb./cu. yd. for highly reactive aggregate, when tested in accordance with ASTM C1293 and categorized in accordance with ASTM C1778, based on alkali content being calculated in accordance with ACI 301.
 2. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
 3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Lightweight Aggregate: ASTM C330/C330M, 3/4-inch nominal maximum aggregate size.
- E. Air-Entraining Admixture: ASTM C260/C260M.
- F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride in steel-reinforced concrete.
1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
 2. Retarding Admixture: ASTM C494/C494M, Type B.
 3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
 5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
 7. 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 C494/C494M, Type C.
 8. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.
- G. Water and Water Used to Make Ice: ASTM C94/C94M, potable or complying with ASTM C1602/C1602M, including all limits listed in Table 2 and the requirements of paragraph 5.4

2.3 VAPOR RETARDERS

- A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.4 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

- B. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
- C. Water: Potable or complying with ASTM C1602/C1602M.
- D. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.
 - 1.

2.5 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, 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 in accordance with ASTM D2240.
- C. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- D. Floor Slab Protective Covering: Eight-foot-wide cellulose fabric.

2.6 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, in accordance with ACI 301.
 - 1. Use a qualified 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 or Other Pozzolans: 25 percent by mass.
 - 2. Slag Cement: 50 percent by mass.
 - 3. Silica Fume: 10 percent by mass.
 - 4. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
 - 5. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
- C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
 - 1. Use 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, and concrete with a w/cm below 0.50.
 - 4. Use permeability-reducing admixture in concrete mixtures where indicated.

2.7 CONCRETE MIXTURES

- A. Class **A** - Normal-weight concrete used for **footings**.
 - 1. Exposure Class: ACI 318 F0 S0 W0 C0.
 - 2. Minimum Compressive Strength: 3000 psi at 28 days.
 - 3. Maximum w/cm: 0.50.
 - 4. Slump Limit: 8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture at Project site.
 - 5. Air Content: N/A.
- B. Class **B**: Normal-weight concrete used for **foundation walls and concrete piers**.
 - 1. Exposure Class: ACI 318 F0 S0 W0 C0.
 - 2. Minimum Compressive Strength: 4000 psi at 28 days.
 - 3. Maximum w/cm: 0.55.
 - 4. Slump Limit: 8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture at Project site.
 - 5. Slump Flow Limit: 30 inches, plus or minus 2.5 inches.
 - 6. Air Content:

- a. Exposure Class F1: 5.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch nominal maximum aggregate size.
7. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.
- C. Class C: Normal-weight concrete used for **interior** slabs-on-ground.
 1. Exposure Class: ACI 318 F0 S0 W0 C0.
 2. Minimum Compressive Strength: 3500 psi at 28 days.
 3. Maximum w/cm: 0.50.
 4. Slump Flow Limit: 30 inches, plus or minus 2.5 inches.
 5. Air Content:
 - a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
 6. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.
- D. Class D: Normal-weight concrete used for **interior supported floor slabs**.
 1. Exposure Class: ACI 318 F0 S0 W0.
 2. Minimum Compressive Strength: 4000 psi at 28 days.
 3. Maximum w/cm: 0.50 Insert number.
 4. Slump Limit: 8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture at Project site.
 5. Slump Flow Limit: 30 inches, plus or minus 2.5 inches.
 6. Air Content:
 - a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
 7. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.
- E. Class I: Normal-weight concrete used for **interior metal pan stairs and landings**:
 1. Exposure Class: ACI 318 F0 S0 W0 C0.
 2. Minimum Compressive Strength: 3000 psi at 28 days.
 3. Maximum w/cm: 0.55.
 4. Minimum Cementitious Materials Content: 470 lb/cu. yd..
 5. Maximum Size Aggregate: 1/2 inch.
 6. Slump Limit: 3 inches, plus 1 inch or minus 2 inches.
 7. Air Content: [0] Insert number percent, plus or minus 0.5 percent at point of delivery.
 8. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.
 9. Retarding Admixture: Not allowed.
 10. Accelerating Admixture: Not allowed.

2.8 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M and ASTM C1116/C1116M, and furnish batch ticket information.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete in accordance with ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.
 1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
 2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:

1. Daily access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 INSTALLATION OF 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.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3.4 INSTALLATION OF VAPOR RETARDER

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.

1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
2. Face laps away from exposed direction of concrete pour.
3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
4. Lap joints 6 inches and seal with manufacturer's recommended tape.
5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
7. Protect vapor retarder during placement of reinforcement and concrete.
 - a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.

B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder in accordance with manufacturer's written instructions.

3.5 JOINTS

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

B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.

1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
2. Place joints perpendicular to main reinforcement.
 - a. Continue reinforcement across construction joints unless otherwise indicated.
 - b. Do not continue reinforcement through sides of strip placements of floors and slabs.

3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 6. Space vertical joints in walls at 15 feet on center max. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
 7. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 8. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.
- D. Isolation Joints in Slabs-on-Ground: 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 on Drawings.
 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, embedded items, and vapor retarder is complete and that required inspections are completed.
1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
 2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of **ACI 301**, but not to exceed the amount indicated on the concrete delivery ticket.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
1. If a section cannot be placed continuously, provide construction joints as indicated.
 2. Deposit concrete to avoid segregation.
 3. Limit concrete freefall distance to the minimum of the following:

- a. Smallest width of formwork in horizontal dimension less than, or equal to, twenty-four inches: Ten-foot maximum freefall.
 - b. Smallest width of formwork in horizontal dimension greater than twenty-four inches, but less than thirty-six inches: Fifteen-foot maximum freefall.
 - c. Within formwork that has cross ties, spacers, rods, reinforcing, or other embedded items: Ten-foot maximum freefall.
 - d. All other conditions: Twenty-foot maximum freefall.
4. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 5. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
 - a. Do not use vibrators to transport concrete inside forms.
 - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
 - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
 - d. 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.
- F. 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. Do not place concrete floors and slabs in a checkerboard sequence.
 2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 3. Maintain reinforcement in position on chairs during concrete placement.
 4. Screed slab surfaces with a straightedge and strike off to correct elevations.
 5. Level concrete, cut high areas, and fill low areas.
 6. Slope surfaces uniformly to drains where required.
 7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
 8. Do not further disturb slab surfaces before starting finishing operations.

3.7 FINISHING FORMED SURFACES

- A. As-Cast Surface Finishes:
1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
 - a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
 - b. Remove projections larger than 1 inch.
 - c. Tie holes do not require patching.
 - d. Surface Tolerance: ACI 117 Class D.
 - e. Apply to concrete surfaces not exposed to public view.

3.8 FINISHING FLOORS AND SLABS

- A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Trowel Finish:
1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
 2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
 3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 4. Do not add water to concrete surface.

5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
6. 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, where the total air content of concrete is less than 3 percent.
7. Finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor surface:
 - a. Slabs on Ground:
 - 1) Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.
 - 2) 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.
 - 3) Specified overall values of flatness, F_F 35; and of levelness, F_L 25; with minimum local values of flatness, F_F 24; and of levelness, F_L 17.
 - 4) Specified overall values of flatness, F_F 45; and of levelness, F_L 35; with minimum local values of flatness, F_F 30; and of levelness, F_L 24.
 - 5) Specified Overall Value (SOV): F_F 50 and F_L 25 with minimum local value (MLV): F_F 40 and F_L 17.
 - 6) Specified Overall Value (SOV): F_F 25 and F_L 20 with minimum local value (MLV): F_F 17 and F_L 15.
 - b. Suspended Slabs:
 - 1) Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.
 - 2) 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.
 - 3) Specified overall values of flatness, F_F 35; and of levelness, F_L 20; with minimum local values of flatness, F_F 24; and of levelness, F_L 15.
 - 4) Specified overall values of flatness, F_F 45; and of levelness, F_L 35; with minimum local values of flatness, F_F 30; and of levelness, F_L 24.

3.9 CONCRETE CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
 1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
 2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
 3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h before and during finishing operations.
- B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:
 1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
 - a. Curing Period: 7 days, or until concrete reaches 70% of its design strength.
 2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
 3. If forms remain during curing period, moist cure after loosening forms.
 4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:
 - a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
 - b. Continuous Sprinkling: Maintain concrete surface continuously wet.
 - c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
 - d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
 - e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.

- 1) Recoat areas subject to heavy rainfall within three hours after initial application.
 - 2) Maintain continuity of coating and repair damage during curing period.
- C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:
1. Begin curing immediately after finishing concrete.
 - a. Curing Period: 10 days or until concrete reaches 70% of its design strength, typical. 28 days for surfaces to receive a polished concrete finish
 2. Interior Concrete Floors:
 - a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12-inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 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.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.
 - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.
 - b. Floors to Receive Polished Finish: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12 inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.

3.10 TOLERANCES

- A. Conform to ACI 117.

3.11 JOINT FILLING

- A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
1. Defer joint filling until concrete has aged at least [**one**] [**six**] month(s).
 2. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.

D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.12 CONCRETE SURFACE REPAIRS

A. Defective Concrete:

1. Do not repair and patch defective areas until such repair and patch is approved by Architect.
 - a. Architect will require engineered concrete repair products and details, other than those listed in this specification, where defective area affects the structural integrity of the concrete in question as determined by Structural Engineer.
2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 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.
 - a. Limit cut depth to 3/4 inch.
 - b. Make edges of cuts perpendicular to concrete surface.
 - c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
 - d. Fill and compact with patching mortar before bonding agent has dried.
 - e. 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 matches surrounding color.
 - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
 - b. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces:

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
 - a. Correct low and high areas.
 - b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
2. Repair finished surfaces containing surface defects, including 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.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.
 - a. Finish repaired areas to blend into adjacent concrete.
5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
 - a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - b. Feather edges to match adjacent floor elevations.

6. Correct other low areas scheduled to remain exposed with repair topping.
 - a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
 - b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.
 - a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
 - b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
 - c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
 - d. Place, compact, and finish to blend with adjacent finished concrete.
 - e. Cure in same manner as adjacent concrete.
8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.
 - a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
 - b. Dampen cleaned concrete surfaces and apply bonding agent.
 - c. Place patching mortar before bonding agent has dried.
 - d. Compact patching mortar and finish to match adjacent concrete.
 - e. 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 SPECIAL INSPECTIONS & FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports. Special Inspections shall be in accordance with Section 1705.3 of the Building Code, refer to Schedule of Special Inspections for detailed requirements.
- B. Field Quality Control: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
 1. Special Inspector Testing agency shall be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
 2. Special Inspector Testing agency shall immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
 3. Special Inspector Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
 - a. Test reports shall include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
 - 1) Project name.
 - 2) Name of testing agency.
 - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
 - 4) Name of concrete manufacturer.
 - 5) Date and time of inspection, sampling, and field testing.
 - 6) Date and time of concrete placement.
 - 7) Location in Work of concrete represented by samples.
 - 8) Date and time sample was obtained.
 - 9) Truck and batch ticket numbers.

- 10) Design compressive strength at 28 days.
 - 11) Concrete mixture designation, proportions, and materials.
 - 12) Field test results.
 - 13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
 - 14) Type of fracture and compressive break strengths at seven days and 28 days.
- C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.
- D. Inspections:
1. Headed bolts and studs.
 2. Verification of use of required design mixture.
 3. Concrete placement, including conveying and depositing.
 4. Curing procedures and maintenance of curing temperature.
 5. Verification of concrete strength before removal of shores and forms from beams and slabs.
 6. Batch Plant Inspections: On a random basis, as determined by Architect.
 7. Post-installed anchors in hardened concrete.
- E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M shall be performed in accordance with the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 150 cu. yd. or fraction thereof.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C143/C143M:
 - a. 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.
 - b. Perform additional tests when concrete consistency appears to change.
 3. Slump Flow: ASTM C1611/C1611M:
 - a. 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.
 - b. Perform additional tests when concrete consistency appears to change.
 4. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete;:
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 5. Concrete Temperature: ASTM C1064/C1064M:
 - a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
 6. Unit Weight: ASTM C567/C567M fresh unit weight of structural lightweight concrete.
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 7. Compression Test Specimens: ASTM C31/C31M:

- a. Cast and laboratory cure six 6-inch by 12-inch or 4-inch by 8-inch standard cylinder specimens for each composite sample.
 - b. Cast, initial cure, and field cure six standard cylinder specimens for each composite sample.
8. Compressive-Strength Tests: ASTM C39/C39M.
- a. Test one set of two laboratory-cured specimens at seven days and one set of three specimens at 28 days. Maintain remainder of specimens in reserve for later testing if required.
 - b. Test one set of two field-cured specimens at seven days and one set of two specimens at 28 days.
 - c. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
10. 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 if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
11. 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.
12. Additional Tests:
- a. 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.
 - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
- 1) Acceptance criteria for concrete strength shall be in accordance with ACI 301 section 1.6.6.3.
13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- F. Measure floor and slab flatness and levelness in accordance with ASTM E1155 within 72 hours of completion of floor finishing and promptly report test results to Architect.

3.14 PROTECTION

- A. Protect concrete surfaces as follows:
1. Protect from petroleum stains.
 2. Diaper hydraulic equipment used over concrete surfaces.
 3. Prohibit vehicles from interior concrete slabs.
 4. Prohibit use of pipe-cutting machinery over concrete surfaces.
 5. Prohibit placement of steel items on concrete surfaces.
 6. Prohibit use of acids or acidic detergents over concrete surfaces.
 7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
 8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

END OF SECTION 033000

**DIVISION 04
MASONRY**

SECTION 04 05 14 – MASONRY MORTAR AND GROUT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes:
 - 1. Premixed masonry cement.
 - 2. Cement grout for concrete masonry assemblies.
- B. Related Sections include the following:
 - 1. Division 04, Section "Unit Masonry" for cavity and composite wall construction.

1.2 SUBMITTALS

- A. Product Data: For each different mortar and grout type.
- B. Material Test Reports: From a qualified testing agency indicating and interpreting test results of the following for compliance with requirements indicated:
 - 1. Mortar complying with property requirements of ASTM C 270.
 - 2. Grout mixes complying with compressive strength requirements of ASTM C 476. Include description of type and proportions of grout ingredients.
 - 3. Each cement product required for mortar and grout, including name of manufacturer, brand, type, and weight slips at time of delivery.
- C. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

1.3 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1093 to conduct the testing indicated, as documented according to ASTM E 548.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality from one manufacturer for each cementitious component and from one source or producer for each aggregate.
- C. Mockups: Before installing unit masonry, build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Comply with requirements of related masonry assembly section(s).

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- B. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- C. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.5 PROJECT CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.
- B. Hot-Weather Requirements: Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required. Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS602.
 - 1. When ambient temperature exceeds 100 deg F, or 90 deg F with a wind velocity greater than 8 mph, do not spread mortar beds more than 48 inches ahead of masonry. Set masonry units within one minute of spreading mortar.

PART 2 - PRODUCTS

2.1 MORTAR AND GROUT MATERIALS

- A. Masonry Cement: ASTM C 91.
- B. Aggregate for Mortar: ASTM C 144; except for joints less than ¼-inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
 - 1. Mortar Aggregates: Natural-colored sand.
- C. Portland Cement for grout: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction.
- D. Aggregate for Grout: ASTM C 404.

- E. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494, Type C, and recommended by the manufacturer for use in masonry mortar of composition indicated.
- F. Water: Potable.
- G. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Masonry Cement:
 - a. Argis US (FYI purchased LaFarge in 2011).
 - b. Brixment; Essroc, Italcementi Group.
 - c. Mortamix Masonry Cement; Holcim (US) Inc.
 - d. Giant Mix; Giant Mix Cement Holding, Inc.
 - e. Lehigh Masonry Cement; Lehigh Hanson.
 - 2. Cold-Weather Admixture:
 - a. Accelguard 80; Euclid Chemical Co.
 - b. Morset; W. R. Grace & Co., Construction Products Division.
 - c. Trimix-NCA; BASF.

2.2 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.
 - 2. Add cold-weather admixture (if used) at the same rate for all mortar, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in the 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. Limit cementitious materials in mortar to portland cement, mortar cement, and lime.
 - 2. For masonry below grade, in contact with earth, and where indicated, use Type S.
 - 3. For reinforced masonry and where indicated, use Type S.
 - 4. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type S.
- D. Grout for Unit Masonry: Comply with ASTM C 476.
 - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 of ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
 - 2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation and other conditions affecting performance.

3.2 MIXING

- A. Mix mortar and grout using gas powered equipment of adequate size, in good working order.

3.3 INSTALLATION, GENERAL

- A. Refer to installation requirements of corresponding **[Division 04 masonry assembly]** section(s).

END OF SECTION 04 05 14

SECTION 04 20 00 – UNIT MASONRY**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes unit masonry assemblies consisting of the following:
 - 1. Concrete masonry units.
 - 2. Concrete brick.
 - 3. Face brick.
 - 4. Reinforcing steel.
 - 5. Masonry joint reinforcement.
 - 6. Ties and anchors.
 - 7. Embedded flashing.
 - 8. Miscellaneous masonry accessories.
 - 9. Cavity-wall insulation.
- B. Related Sections include the following:
 - 1. Division 04, Section "Masonry Mortar and Grout" for masonry mortar and grout used in assembly specified in this section.
 - 2. Division 05, Section "Expansion Control" for metal expansion joint covers.
 - 3. Division 07, Section "Bituminous Dampproofing" for dampproofing applied to cavity face of backup wythes of cavity walls.
 - 4. Division 07, Section "Sheet Metal Flashing and Trim" for exposed sheet metal flashing.
 - 5. Division 07, Section "Firestopping" for firestopping at tops of masonry walls and at penetrations in masonry walls.
 - 6. Division 07, Section "Joint Protection" for preformed expansion joint gaskets and joint sealants.
 - 7. Division 08, Section "Louvers and Vents" for wall vents.
- C. Products furnished, but not installed, under this Section include the following:
 - 1. Dovetail slots for masonry anchors, installed under Division 03, Section "Cast-in-Place Concrete."
- D. Products installed, but not furnished, under this Section include the following:
 - 1. Steel lintels for unit masonry, furnished under Division 05, Section "Metal Fabrications."
 - 2. Manufactured reglets in masonry joints for metal flashing, furnished under Division 07, Section "Sheet Metal Flashing and Trim."
 - 3. Hollow-metal frames in unit masonry openings, furnished under Division 08, Section "Hollow Metal Doors and Frames."

1.2 SUBMITTALS

- A. Product Data: For the following:
 - 1. Weep holes/vents in color to match mortar color.
 - 2. Each type and size of joint reinforcement.
 - 3. Each type and size of anchor, tie, and metal accessory.
- B. Samples: Submit samples of concrete masonry units showing the full range of anticipated colors and textures.
 - 1. Architect must approve texture of units prior to ordering.
- C. Qualification Data: For parties listed in Quality Assurance article.
 - 1. Submit Installing Subcontractor's qualifications with submittal of Subcontractor List.
 - 2. Submit installing masonry foreman's qualifications prior to commencing masonry work.
- D. Certificates:
 - 1. For fire-resistance rated concrete masonry units, submit ASTM C90 (latest edition) and ACI fire rating calculations certificates.
- E. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements. Submit upon request of Architect.
- F. Brick and mortar manufacturer's written acceptance of proposed proprietary masonry cleaning product.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Experienced masons with 3 years minimum experience performing similar work, under the direction of a full-time on-site masonry foreman with minimum 5 years of experience performing similar work.
- B. Installer Qualifications: An experienced masonry subcontracting firm with 5 years of experience specializing in similar work, under the direction of a full-time on-site masonry foreman with 5 years of experience performing similar work, utilizing only full-time, experienced employees.

- C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1093 to conduct the testing indicated, as documented according to ASTM E 548.
- D. 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, through one source from a single manufacturer for each product required.
- E. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by another means, as acceptable to authorities having jurisdiction.
- F. Mockups: Before installing unit masonry, build mockups to verify selections and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Locate mockups on site, to present the elements specified in each section in proper relationship to each other.
 - 2. Build mockups for the following types of masonry in sizes approximately 48 inches long by 48 inches high by full thickness, including face and backup wythes and accessories. Include a full-height control joint in each mockup.
 - a. Each type of exposed unit masonry construction.
 - b. Typical exterior wall with lower corner of window opening. Make opening approximately 12 inches wide by 16 inches high.
 - c. Typical exterior wall with through-wall flashing installed for a 24-inch length in corner of 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). Include ties, anchors, and cavity drainage material.
 - d. Typical interior unit masonry wall.
 - 3. Clean exposed faces of mockups with masonry cleaner as specified.
 - 4. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 - 5. Protect accepted mockups from the elements with weather-resistant membrane.
 - 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 7. 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.
 - 8. Demolish and remove mockups when directed.

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

1.5 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and from mortar splatter by coverings spread on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.
- E. Hot-Weather Requirements: Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required.
 - 1. When ambient temperature exceeds 100 deg F, or 90 deg F with a wind velocity greater than 8 mph, do not spread mortar beds more than 48 inches ahead of masonry. Set masonry units within one minute of spreading mortar.

PART 2 - PRODUCTS**2.1 CONCRETE MASONRY UNITS**

- A. General: Provide shapes indicated and as follows:
1. Provide special shapes for lintels, corners, jambs, sash, control joints, headers, bonding, and other special conditions.
 2. Provide 1" bullnose units for outside corners, unless otherwise indicated.
- B. Concrete Masonry Units: ASTM C 90 and as follows:
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2000 psi.
 2. Weight Classification: Light weight conforming to ASTM C 331 and ASTM C330 with 6% to 10% absorption when tested in accordance with ASTM C128
 3. All units shall be free of organic impurities that will cause rusting, staining, or pop outs and shall contain no combustible matter. Use of coal cinder aggregate/bottom ash or similar waste products will not be allowed.
 4. Size (Width): Manufactured to the following dimensions:
 - a. 4 inches nominal; 3-5/8 inches actual.
 - b. 6 inches nominal; 5-5/8 inches actual.
 - c. 8 inches nominal; 7-5/8 inches actual.
 - d. 12 inches nominal; 11-5/8 inches actual.
 5. Exposed Faces: Manufacturer's standard color.
 - a. Where units are to be left exposed, provide manufacturer's full range of colors and textures for approval by Architect.
 - b. Edges: Provide units with crisp edges matching approved sample.
 6. Products: Subject to full compliance with the requirements, provide units from one of the following manufacturers:
 - a. Oldcastle APG - Adams.
 - b. Johnson Concrete Products.
 - c. Chandler Concrete Products.
 - d. Or approved equal.
- C. Concrete Masonry Units: Fire Resistance Certified Units: ASTM C 90 and as follows:
1. Provide 1" bullnose units for outside corners, unless otherwise indicated.
 2. Provide units certified under UL263 and UL618.
 3. Size (Width): Manufactured to the following dimensions:
 - a. 4 inches nominal; 3-5/8 inches actual.
 - b. 6 inches nominal; 5-5/8 inches actual.
 - c. 8 inches nominal; 7-5/8 inches actual.
 - d. 12 inches nominal; 11-5/8 inches actual.
 4. Products: Subject to full compliance with the requirements, provide units from one of the following manufacturers:
 - a. Oldcastle APG - Adams.
 - b. Johnson Concrete Products.
 - c. Chandler Concrete Products.
 - d. Or approved equal.

2.2 BRICK

- A. General: Provide shapes indicated and as follows for each form of brick required:
1. Provide units without cores or frogs and with exposed surfaces finished for ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces.
- B. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
1. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
 2. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- C. Face Brick: ASTM C 216, Grade SW, Type FBS, and as follows:
1. Initial Rate of Absorption: Per ASTM C 216.
 2. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
 3. Size: Manufactured to the following actual dimensions:
 - a. Modular: 3-1/2 to 3-5/8 inches wide by 2-1/4 inches high by 7-1/2 to 7-5/8 inches long.
 - b. Closure Modular: 3-1/2 to 3-5/8 inches wide by 3-1/2 to 3-5/8 inches high by 7-1/2 to 7-5/8 inches long.
 - c. Utility: 3-1/2 to 3-5/8 inches wide by 3-1/2 to 3-5/8 inches high by 11-1/2 to 11-5/8 inches long.
 4. Products: Subject to compliance with requirements, provide brick from one of the following manufacturers which is judged an acceptable match by the Architect for the basis of design product indicated:
 - a. Basis of Design:

- 1) FB-1: Palmetto Brick-Medium Red Wirecut
- 2) FB-2: Palmetto Brick- .75 Greystone
- b. General Shale Brick & Building Materials.
- c. Triangle Brick Co.
- d. Adams Product Co.
- e. Pine Hall Brick Co.
- f. Statesville Brick Co.
- g. Taylor Clay Products Co.

2.3 REINFORCING STEEL

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M; ASTM A 616/A 616M, including Supplement 1; or ASTM A 617/A 617M, Grade 60.

2.4 MASONRY JOINT REINFORCEMENT

- A. General: ASTM A 951 and as follows:
 1. Hot-dip galvanized, carbon-steel wire for both interior and exterior walls.
 2. Wire Size for Side Rods: W1.7 or 0.148-inch diameter
 3. Wire Size for Cross Rods: W1.7 or 0.148-inch diameter.
 4. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units where indicated.
- B. For multi-wythe masonry, provide types as follows:
 1. Adjustable (2-piece) type with single pair of side rods and cross ties spaced not more than 16 inches o.c. and with separate adjustable veneer ties engaging the cross ties. Cross ties are either U-shaped with eyes or rectangular. Space side rods for embedment within each face shell of backup wythe and size adjustable ties to extend at least halfway through outer wythe but with at least 5/8-inch cover on outside face.
 - a. Provide ladder-type joint reinforcement with straight or adjustable veneer tie as required, engaging cavity insulation with pintles.

2.5 TIES AND ANCHORS, GENERAL

- A. General: Provide ties and anchors, specified in subsequent articles, made from materials that comply with this Article, unless otherwise indicated.
- B. Hot-Dip Galvanized Carbon-Steel Wire: ASTM A 82; with ASTM A 153, Class B-2 coating.
- C. Steel Sheet, galvanized after fabrication: ASTM A 366/A 366M cold-rolled, carbon-steel sheet hot-dip galvanized after fabrication to comply with ASTM A 153.
- D. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

2.6 BENT WIRE TIES

- A. General: Rectangular units with closed ends and not less than 4 inches wide. Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches long may be used for masonry constructed from solid units or hollow units laid with cells horizontal.
 1. Where coursing between wythes does not align, use adjustable ties composed of 2 parts; 1 with pintles, the other with eyes; with maximum misalignment of 1-1/4 inches.
- B. Wire: Fabricate from 1/4-inch- diameter, hot-dip galvanized steel wire.
- C. Steel Drill Screws for Steel Studs: ASTM C 954 except manufactured with hex washer head and neoprene washer, No. 10 diameter by length required to penetrate steel stud flange by not less than 3 exposed threads, and with the following corrosion protective coating:
 1. Organic polymer coating with salt-spray resistance to red rust of more than 800 hours per ASTM B 117.
- D. Steel Tapping Screws for Concrete Masonry: Self-tapping screws with specially designed threads for tapping and wedging into masonry, with hex washer head and neoprene washer, 3/16-inch diameter by 1-1/2-inch length, and with the following corrosion-protective coating:
 1. Organic polymer coating with salt-spray resistance to red rust of more than 500 hours per ASTM B 117.
- E. Products: Subject to compliance with requirements, provide one of the following:
 1. Screw-Attached, Masonry-Veneer Anchors:
 - a. 315-D with 316; Heckman Building Products, Inc.
 - b. DW-10HS; Hohmann & Barnard, Inc.
 - c. Type III Screw-On Veneer Anchor; Wire-Bond.
 2. Screw Attached Masonry Veneer System for use with ties mounted through the face of rigid insulation in concrete masonry unit (CMU) wall assemblies.
 - a. Standard Ties:
 - 1) Hohmann & Barnard, Inc.: Thermal 2-seal Wing Nut Anchor.
 - 2) Heckmann – Pos-I-tie
 3. Organic-Polymer-Coated, Steel Drill Screws:
 - a. Dril-Flex; Elco Industries, Inc.

- b. Traxx; ITW-Buildex.

2.7 MISCELLANEOUS ANCHORS

- A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron inserts of type and size indicated.
- B. Dovetail Slots: Furnish dovetail slots with filler strips, of slot size indicated, fabricated from 0.0336-inch, galvanized steel sheet.
- C. Anchor Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153, Class C; of diameter and length indicated and in the following configurations:
 - 1. Headed bolts.
 - 2. Non-headed bolts, bent in manner indicated.

2.8 CONCEALED FLASHING:

- A. Copper-Core Flexible Flashing: Manufacturer's standard laminated flashing consisting of 060 temper sheet copper in accordance with ASTM B 370-98 bonded with non-asphalt adhesive between two layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.
- B. Adhesives, Primers, Prefabricated Corner Units, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by the flashing manufacturer for bonding flashing sheets to each other and to substrates.
- C. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Copper-Core Flexible Flashing:
 - a. Wall Guardian Copper TWF, STS Coatings.
 - b. Copper-Tuff; Hohmann & Barnard, Inc.
 - c. Multi-Flash 500, York Flashings.

2.9 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Pre-molded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane or PVC.
- B. Preformed Control-Joint Gaskets: Material as indicated below, designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
 - 1. Styrene-Butadiene-Rubber Compound: ASTM D 2000, Designation M2AA-805.
 - 2. PVC: ASTM D 2287, Type PVC-65406.
- C. Plastic Weep Hole/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, designed to fill head joint with outside face held back 1/8 inch from exterior face of masonry, in color selected from manufacturer's standard.
- D. Cavity Drainage Material: 3/4-inch thick, min. 10-inches high, free-draining mesh; made from polyethylene strands and shaped to avoid being clogged by mortar droppings.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cav Clear: Masonry Mat.
 - b. Sandell Mfg: Mortar Web.
 - c. Advanced Building Products: Mortar Break.
 - d. Mortar Net USA: Mortar Net.

2.10 MASONRY CLEANERS

- A. Use cleaning methods and materials specifically recommended by brick and mortar manufacturers. Select from the following:
 - 1. Job-Mixed Detergent Solution: Solution of 1/2-cup dry measure tetrasodium polyphosphate and 1/2-cup dry measure laundry detergent dissolved in 1 gal. of water.
 - 2. 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.
 - a. Submit brick and mortar manufacturer's written acceptance of proposed cleaner.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance.
 - 2. Verify that foundations are within tolerances specified.
 - 3. Verify that reinforcing dowels are properly placed.
 - 4. Proceed with installation only after unsatisfactory conditions have been corrected.

- B. Before installation, examine rough-in and built-in construction to verify actual locations of piping connections.

3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to the full thickness shown. Build single-wythe walls to the actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this Section and in other Sections of the Specifications.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to the opening.
- D. Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide a continuous pattern and to fit adjoining construction. Where possible, use full-size units without cutting. Allow units cut with water-cooled saws to dry before placing, unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
 - 1. Mix units from several pallets or cubes as they are placed.
- F. Wetting of Brick: Wet brick before laying if the initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at the time of laying.

3.3 CONSTRUCTION TOLERANCES

- A. Comply with tolerances in ACI 530.1/ASCE 6/TMS 602 and the following:
 - 1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/4 inch in 20 feet, nor 1/2 inch maximum.
 - 2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, nor 1/2 inch maximum.
 - 3. For conspicuous horizontal lines, such as exposed lintels, sills, parapets, and reveals, do not vary from level by more than 1/4 inch in 20 feet, nor 1/2 inch maximum.
 - 4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch. Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
 - 5. 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.

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: Lay exposed masonry in the following bond pattern; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
 - 1. One-half running bond with vertical joint in each course centered on units in courses above and below.
- C. Bullnose Corners: Provide bullnose units at all exposed interior outside corners. Select bullnose units whose texture matches the texture of adjoining units.
- D. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- E. Stopping and Resuming Work: In each course, rack back one-half-unit length for one-half running bond or one-third-unit length for one-third running bond; do not tooth. Clean exposed surfaces of set masonry, wet clay masonry units lightly if required, and remove loose masonry units and mortar before laying fresh masonry.
- F. Built-in Work: As construction progresses, build in items specified under this and other Sections of the Specifications. Fill in solidly with masonry around built-in items.
- G. Fill space between hollow-metal frames and masonry solidly with mortar, unless otherwise indicated.
- H. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.
- I. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.
- J. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.
 - 1. Install compressible filler in joint between top of partition and underside of structure above.
 - 2. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.

3.5 BONDING OF MULTI-WYTHE MASONRY

- A. Use masonry joint reinforcement installed in horizontal mortar joints to bond wythes together.
- B. Corners: Provide interlocking masonry unit bond in each wythe and course at corners, unless otherwise indicated.

1. Provide continuity with masonry joint reinforcement at corners by using prefabricated "L" units as well as masonry bonding.
- C. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, bond walls together as follows:
 1. Provide rigid metal anchors not more than 24 inches o.c. If used with hollow masonry units, embed ends in mortar-filled cores.

3.6 MORTAR BEDDING AND JOINTING

- A. Lay hollow masonry units as follows:
 1. With full mortar coverage on horizontal and vertical face shells.
 2. Bed webs in mortar in starting course on footings and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout.
 3. For starting course on footings where cells are not grouted, spread out full mortar bed, including areas under cells.
- B. Lay solid brick-size 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.
 1. At cavity walls, bevel beds away from cavity, to minimize mortar protrusions into cavity. As work progresses, trowel mortar fins protruding into cavity flat against the cavity face of the brick.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than the joint thickness, unless otherwise indicated.
- D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint), unless otherwise indicated.

3.7 CAVITIES

- A. Keep cavities clean of mortar droppings and other materials during construction. Strike joints facing cavities flush.
 1. Use wood strips temporarily placed in cavity to collect mortar droppings. As work progresses, remove strips, clean off mortar droppings, and replace in cavity.

3.8 MASONRY JOINT REINFORCEMENT

- A. General: Provide continuous masonry joint reinforcement as indicated. Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
 1. Space reinforcement not more than 16 inches o.c.
 2. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.
 - a. Reinforcement above is in addition to continuous reinforcement.
- B. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
- C. Provide continuity at corners and wall intersections by using prefabricated "L" and "T" sections. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.9 ANCHORING MASONRY TO STRUCTURAL MEMBERS

- A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:
 1. Provide an open space not less than 1 inch in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar or other rigid materials.
 2. Anchor masonry to structural members with flexible 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.

3.10 ANCHORING MASONRY VENEERS

- A. Anchor masonry veneers to wall framing with seismic masonry-veneer anchors to comply with the following requirements:
 1. Fasten each anchor section through sheathing to wall framing with two metal fasteners of type indicated.
 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 18 inches o.c. vertically and 24 inches o.c. horizontally, with not less than 1 anchor for each 2 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around the perimeter.

3.11 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joints in unit masonry where indicated or, if not indicated, at intervals not greater than 30 feet. Build-in related items as masonry progresses. Do not form a continuous span through movement joints unless provisions are made to prevent in-plane restraint of wall or partition movement.

- B. Form control joints (**CJ**) in concrete masonry as follows:
 - 1. Fit bond-breaker strips into hollow contour in ends of concrete masonry units on one side of control joint. Fill resultant core with grout and rake joints in exposed faces, or install preformed control-joint gaskets designed to fit standard sash block.
 - 2. Install temporary foam-plastic filler in head joints on exposed sides of construction for installation of sealant and backer rod specified in Division 07, Section "Joint Protection." Keep joint free and clear of mortar, and remove filler when unit masonry is complete.
- C. Form building expansion joints (BEJ) in concrete masonry and brick made from clay or shale as follows:
 - 1. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete.
- D. Form expansion joints (EJ) in brick made from clay or shale as follows:
 - 1. Build in joint fillers of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Division 07, Section "Joint Protection." Keep joint free and clear of mortar.

3.12 LINTELS

- A. Install steel lintels where indicated.
- B. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

3.13 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. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Unless otherwise indicated, 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.
- C. Install flashing as follows:
 - 1. At multi-wythe masonry walls, including cavity walls, extend flashing from exterior face of outer wythe of masonry, through outer wythe, turned up a minimum of 8 inches, and through inner wythe to within 1/2 inch of the interior face of the wall in exposed masonry. Where interior surface of inner wythe is concealed by furring, carry flashing completely through inner wythe and turn flashing up approximately 2 inches, unless otherwise indicated.
 - 2. At lintels and shelf angles, extend flashing a minimum of 4 inches into masonry at each end. At heads and sills, extend flashing a minimum of 4 inches at ends and turn flashing up not less than 2 inches to form a pan.
 - 3. Cut flashing off flush with face of wall after masonry wall construction is completed.
- D. Install weep holes in the head joints in exterior wythes of the first course of masonry immediately above embedded flashing and as follows:
 - 1. Use plastic weep hole/vents or vinyl weep hole/vents to form weep holes.
 - 2. Space weep holes 24 inches o.c.
- E. Cavity Drainage Material: Place cavity drainage material immediately above flashing in cavities.
- F. Install vents in vertical head joints at the top of each continuous cavity at spacing indicated. Use plastic weep hole/vents or vinyl weep hole/vents to form vents.
 - 1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.
- G. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

3.14 FIELD QUALITY CONTROL

- A. Owner will engage a qualified independent testing agency to perform field quality-control testing indicated below.
 - 1. Payment for these services will be made by Owner.
 - 2. Retesting of materials failing to meet specified requirements shall be done at Contractor's expense.
- B. Mortar properties will be tested per ASTM C 780.
- C. Grout will be sampled and tested for compressive strength per ASTM C 1019.

3.15 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application.
- 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. Clean brick by the bucket-and-brush hand-cleaning method described in BIA Technical Notes No. 20, using job-mixed detergent solution.
4. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2 applicable to type of stain on exposed surfaces.

3.16 MASONRY WASTE DISPOSAL

- A. Recycling: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Disposal as Fill Material: Dispose of clean masonry waste, including broken masonry units, waste mortar, and excess or soil-contaminated sand, by crushing and mixing with fill material as fill is placed.
 1. Crush masonry waste to less than 4 inches in each dimension.
 2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Division 31, Section "Earthwork."
 3. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- C. Excess Masonry Waste: Remove excess, clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04 20 00

SECTION 04 72 00 – CAST STONE**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
 1. Cast stone wall caps.
- B. Related Sections include the following:
 1. Division 04, Section "Unit Masonry" for installing cast stone units in unit masonry.

1.2 DEFINITIONS

- A. Cast Stone: Architectural precast concrete building units intended to simulate natural cut stone.

1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for cast stone units.
- B. Shop Drawings: Show fabrication and installation details for cast stone units. Include dimensions; details of reinforcement and anchorages, if any; and indication of finished faces.
 1. Include building elevations showing layout of units and locations of joints and anchors.
- C. Samples: For each color and texture of cast stone required, 10 inches (250 mm) square in size.
- D. Samples for Verification: For each mortar color required, showing the full range expected in the finished construction. Make samples using the same sand and mortar ingredients to be used on Project. Label samples to indicate type and amount of colorant used.
- E. Samples: For each type of cast stone unit required. Make available for Architect's review at Project site before installing cast stone.
- F. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of cast stone with requirements indicated.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing cast stone units similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to manufacture required units.
- B. Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.
- C. Source Limitations for Cast Stone: Obtain cast stone units through one source from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Pack, handle, and ship cast stone units in suitable packs or pallets.
 1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move cast stone units, if required, using dollies with wood supports.
 2. Store cast stone units on wood skids or pallets with nonstaining, waterproof covers. Arrange to distribute weight evenly and to prevent damage to units. Ventilate under covers to prevent condensation.
- B. Store installation materials on elevated platforms, under cover, and in a dry location.

1.6 COORDINATION

- A. Coordinate production and delivery of cast stone with unit masonry work to minimize the need for on-site storage and to avoid delaying the Work.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Lucas Concrete Products.
 2. Continental Cast Stone Manufacturing, Inc.
 3. Dura Art Stone.
 4. Pineapple Grove Designs.
 5. Rock Cast.
 6. Thunderstone.

2.2 CAST STONE MATERIALS

- A. General: Comply with ASTM C 1364 and the following:
- B. Portland Cement: ASTM C 150, Type I, containing not more than 0.60 percent total alkali when tested according to ASTM C 114.

- C. Coarse Aggregates: Granite, quartz, or limestone complying with ASTM C 33; gradation as needed to produce required textures.
- D. Fine Aggregates: Manufactured or natural sands complying with ASTM C 33, gradation as needed to produce required textures.
- E. Air-Entraining Admixture: ASTM C 260, certified by the manufacturer to be compatible with other admixtures used.
 - 1. Add to mixes for units exposed to the exterior at manufacturer's prescribed rate to result in an air content of 5 to 7 percent.
- F. Reinforcement: Deformed steel bars complying with ASTM A 615/A 615M.
- G. Embedded Anchors and Other Inserts: Fabricated from steel complying with ASTM A 36/A 36M, and hot-dip galvanized to comply with ASTM A 123.

2.3 CAST STONE UNITS

- A. Cast Stone ASTM C 1364:
 - 1. Casting Method: Vibrant dry tamp.
 - 2. Compressive Strength: 6500 psi at 28 days.
 - 3. Absorption: ASTM C 642 or C 1195. 6% maximum at 28 days.
- B. Surface Texture:
 - 1. Fine grained texture.
 - 2. No bug holes, air voids, or other surface blemishes allowed.
- C. Color and Finish:
 - 1. Selected by Architect from manufacturer's full range.
 - 2. To match existing building cast stone.
- D. Color Variation:
 - 1. Viewing Conditions: Compare in direct sunlight at 10'-0" between components of similar age.
 - 2. Maximum Variation: ASTM D 2244.
 - a. Hue: Two units.
 - b. Lightness, Chroma and Hue Combined: Six units.
- E. Tolerances: Fabricate cast stone components within tolerances in accordance with the Cast Stone Institute Technical Manual.
 - 1. Dimensions: Plus or minus 1/8".
 - 2. Maximum Bow, Camber, and Twist: Length/360.
 - 3. Joint Width: DO not vary joint widths more than 1/8".

2.4 ACCESSORIES

- A. Anchors: Type and size indicated, fabricated from steel complying with ASTM A 36, and hot-dip galvanized to comply with ASTM A 123.
- B. Dowels: Round steel bars complying with ASTM A 36 or ASTM A 615, 1/2-inch diameter, and hot-dip galvanized to comply with ASTM A 123.
- C. Job-Mixed Detergent Solution: Solution of 1/2 cup of dry-measure tetrasodium polyphosphate and 1/2 cup of dry-measure laundry detergent dissolved in 1 gal. of water.
- D. Proprietary Acidic Cleaner: Manufacturer's standard-strength, general-purpose cleaner designed for removing mortar/grout stains, efflorescence, and other construction stains from new masonry surfaces without discoloring or damaging masonry surfaces; expressly approved for intended use by cast stone manufacturer and expressly approved by cleaner manufacturer for use on cast stone and adjacent masonry materials.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. 202 New Masonry Detergent; Diedrich Technologies, Inc.
 - b. 202V Vana-Stop; Diedrich Technologies, Inc.
 - c. Sure Klean No. 600 Detergent; ProSoCo, Inc.
 - d. Sure Klean Vana Trol; ProSoCo, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of cast stone.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Set cast stone as indicated on Drawings. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place. Set units accurately in locations indicated with edges and faces aligned according to established relationships and indicated tolerances.
- B. Drench units with clear water just before setting.
- C. Set units in full bed of mortar with full head joints, unless otherwise indicated. Build anchors and ties into mortar joints as units are set.
 - 1. Fill dowel holes and anchor slots with mortar.
 - 2. Fill collar joint solid as units are set.
 - 3. Build concealed flashing into mortar joints as units are set.
 - 4. Leave head joints open in coping and other units with exposed horizontal surfaces. Keep joints clear of mortar, and rake out to receive sealant.
- D. Rake out joints for pointing with mortar to depths of not less than 3/4 inch. Rake joints to uniform depths with square bottoms and clean sides. Scrub faces of units to remove excess mortar as joints are raked.
- E. Point mortar joints by placing and compacting mortar in layers not greater than 3/8 inch. Compact each layer thoroughly and allow to become thumbprint hard before applying next layer.
- F. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.
- G. Provide expansion, control, and pressure-relieving joints of widths and at locations required by manufacturer.
 - 1. Sealing joints is specified in Division 07, Section "Joint Protection."
 - 2. Keep joints free of mortar and other rigid materials.
- H. Repair:
 - 1. Do not install units that do not comply with tolerances noted and/or referenced.
 - 2. For minor chipping, repair chipping and other minor surface damage that is noticeable when viewed in direct sunlight from a distance of 10'-0".
 - 3. For major chipping and surface damage, remove and replace the damaged units.

END OF SECTION 04 72 00

**DIVISION 05
METALS**

SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural-steel materials.
2. Shrinkage-resistant grout.
3. Prefabricated building columns.
4. Shear stud connectors.

B. Related Requirements:

1. Section 053100 "Steel Decking" for field installation of shear stud connectors through deck.
2. Section 055000 "Metal Fabrications" for **steel lintels and shelf angles not attached to structural-steel frame miscellaneous steel fabrications** and other steel items not defined as structural steel.
3. **Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" and Section 099600 "High-Performance Coatings"** for painting requirements.

1.2 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

B. Heavy Sections: Rolled and built-up sections as follows:

1. Shapes included in ASTM A6/A6M with flanges thicker than 1-1/2 inches.
2. Welded built-up members with plates thicker than 2 inches.
3. Column base plates thicker than 2 inches.

C. Demand-Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the seismic-load-resisting system and which are indicated as "demand critical" or "seismic critical" on Drawings.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data:

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Shear stud connectors.
4. Anchor rods.
5. Shop primer.
6. Galvanized-steel primer.
7. Galvanized repair paint.
8. Shrinkage-resistant grout.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.

2. Include embedment Drawings.
 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
 5. Identify members not to be shop primed.
- C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide in accordance with AWS D1.1/D1.1M for each welded joint whether prequalified or qualified by testing, including the following:
1. Power source (constant current or constant voltage).
 2. Electrode manufacturer and trade name, for demand-critical welds.
- D. Delegated Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation. In addition, the professional engineer responsible for connection design shall review the shop drawings prior to submittal to verify that the connections detailed comply with the calculations provided as well as the design requirements. A review letter, signed and sealed by the professional engineer responsible for connection design, shall be provided with the shop drawings and calculations submittal stating that this review and verification has been completed.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Mill test reports for structural-steel materials, including chemical and physical properties.
- E. Product Test Reports: For the following:
 1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
 2. High-strength, bolt-nut-washer assemblies.
 3. Shear stud connectors.
- F. Source quality-control reports.
- G. Field quality-control reports.

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).
- B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- C. Shop-Painting Applicator Qualifications: Qualified in accordance with AISC's Sophisticated Paint Endorsement P1 or to SSPC-QP 3.
- D. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.

2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the following specifications and documents:
 1. ANSI/AISC 303.
 2. ANSI/AISC 360.
 3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- B. Connection Design Information:
 1. Option 3 and 3A: Design connections in accordance with ANSI/AISC 303 by fabricator's qualified professional engineer. Member reinforcement at connections is indicated on Drawings.
 - a. Use Load and Resistance Factor Design; data are given at factored-load level.
- C. Construction: Braced frame.

2.2 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A992/A992M, Grade 50.
- B. Channels and Angles: ASTM A36/A36M Grade 36.
- C. Plate and Bar: ASTM A36/A36M Grade 36.
- D. Cold-Formed Hollow Structural Sections: **ASTM A500/A500M, Grade C** structural tubing.
- E. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.
 1. Weight Class: Standard or Extra strong as indicated.
 2. Finish: Black except where indicated to be galvanized.
- F. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

- A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325. (Grade A325M), Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
- B. High-Strength A490 Bolts, Nuts, and Washers: Grade A490 (Grade A490M), Type 1, heavy-hex steel structural bolts or Grade F2280 tension-control, bolt-nut-washer assemblies with splined ends; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
- C. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
 1. Finish: **Hot-dip or mechanically deposited zinc coating.**
- D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, heavy-hex round head assemblies, consisting of steel structural bolts with splined ends; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
 1. Finish: Plain.
- E. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

2.4 RODS

- A. Headed Anchor Rods: **ASTM F1554, Grade 36**

1. Nuts: ASTM A563 **heavy**-hex carbon steel.
 2. Plate Washers: ASTM A36/A36M carbon steel.
 3. Washers: ASTM F436, Type 1, hardened carbon steel.
 4. Finish: Plain.
- B. Threaded Rods: ASTM A36/A36M.
1. Nuts: ASTM A63 (ASTM A563M) hex carbon steel.
 2. Washers: ASTM F436 (ASTM F436M), Type 1, hardened carbon steel.
 3. Finish: Plain.

2.5 PRIMER

- A. Steel Primer:
1. Comply with. Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."
 2. SSPC-Paint 23, latex primer.
 3. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
- B. Galvanized-Steel Primer: MPI#26.
1. Etching Cleaner: MPI#25, for galvanized steel.
 2. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20 ASTM A780/A780M.

2.6 SHRINKAGE-RESISTANT GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.7 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
1. Camber structural-steel members where indicated.
 2. Fabricate beams with rolling camber up.
 3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
 4. Mark and match-mark materials for field assembly.
 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with **SSPC-SP 3**.
- F. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.
- G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
1. Cut, drill, or punch holes perpendicular to steel surfaces
 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.8 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
- C. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.
 - 1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
 - 2. Galvanize lintels, shelf angles and welded door frames attached to structural-steel frame and located in exterior walls.

2.9 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 - 2. Surfaces to be field welded.
 - 3. Surfaces of high-strength bolted.
 - 4. Galvanized surfaces unless indicated to be painted.
- B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:
 - 1. SSPC-SP 3.
 - 2. SSPC-SP 8.
- C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner or in accordance with SSPC-SP 16.
- D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 - 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.10 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform shop tests and inspections.
 - 1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
 - 2. Bolted Connections: Inspect and test shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 - 3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E165/E165M.
 - b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - c. Ultrasonic Inspection: ASTM E164.
 - d. Radiographic Inspection: ASTM E94/E94M..

4. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear stud connector.
 - b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear stud connectors if weld fracture occurs on shear stud connectors already tested.
5. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.
 1. Do not remove temporary shoring supporting composite deck construction and structural-steel framing until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.
- B. Baseplates, Bearing Plates, and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 2. Weld plate washers to top of baseplate.
 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for grouting.
- C. Maintain erection tolerances of structural steel within ANSI/AISC 303.
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.
 - 1. Joint Type: Snug tightened and Slip critical at collector axial connections.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.
- C. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

3.5 REPAIR

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.
- B. Touchup Painting:
 - 1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
- C. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

3.6 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:
 - 1. Verify structural-steel materials and inspect steel frame joint details.
 - 2. Verify weld materials and inspect welds.
 - 3. Verify connection materials and inspect high-strength bolted connections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
 - 1. Bolted Connections: Inspect and test bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 - 2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.
 - a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - 1) Liquid Penetrant Inspection: ASTM E165/E165M.
 - 2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - 3) Ultrasonic Inspection: ASTM E164.
 - 4) Radiographic Inspection: ASTM E94/E94M.
 - 3. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.

- b. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

END OF SECTION 051200

SECTION 05 21 00 - STEEL JOIST FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. K-series steel joists.
 - 2. LH- series long-span steel joists.

1.2 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."

1.3 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.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Welding certificates.
- C. Manufacturer certificates.
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- E. Mill Certificates: For each type of bolt.
- ~~F.~~ Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."
 - 1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.
- B. Welding Qualifications (If field welding is required): Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 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:
 - 1. Use LRFD; data are given at factored-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.

2.2 STEEL JOISTS

- A. K-Series Steel Joist: Manufactured steel joists of type indicated according to "Standard Specification 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.
 - 2. K-Series 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.
 - 3. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated on Drawings, complying with SJI's "Specifications."
 - 4. Do not camber joists.
 - 5. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

- B. Long-Span Steel Joist: Manufactured steel joists according to "Standard Specification for Longspan Steel Joists, LH-Series in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as indicated on Drawings.
 - 1. Joist Type: LH-series long-span steel joists.
 - 2. End Arrangement: Underslung.
 - 3. Provide holes in chord members for connecting and securing other construction to joists.
 - 4. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches (1:48).

C.

2.3 PRIMERS

- A. Primer:
 - 1. Provide shop primer that complies with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

2.4 STEEL JOIST ACCESSORIES

- A. Bridging:
 - 1. Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
- B. Fabricate steel bearing plates from ASTM A36/A36M steel with integral anchorages of sizes and thicknesses indicated on Drawings. Shop prime paint.
- C. Furnish ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction.
 - 1. Extend ends to within 1/2 inch of finished wall surface unless otherwise indicated on Drawings.
- D. Welding Electrodes: Comply with AWS standards.
- E. 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 (0.025 mm) thick.
- C. Shop priming of joists and joist accessories is specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

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 of the Work.
- 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 SJ's "Specifications," joist manufacturer's written instructions, and requirements in this Section.
 - 1. Space, adjust, and align joists accurately in location before permanently fastening.
 - 2. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
 - 3. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads are applied.
- C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
- D. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for high-strength structural bolt installation and tightening requirements.
- E. 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 REPAIRS

- A. Touchup Painting:
 - 1. Immediately after installation, clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.
 - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 - b. Apply a compatible primer of same type as primer used on adjacent surfaces.
 - 2. Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Visually inspect field welds according to AWS D1.1/D1.1M.
- C. Visually inspect bolted connections.
- D. Prepare test and inspection reports.

END OF SECTION 052100

SECTION 05 31 00 – STRUCTURAL DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof deck.
2. Composite floor deck.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
2. Section 035216 "Lightweight Insulating Concrete" for lightweight insulating concrete fill over steel deck.
3. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
4. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.2 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.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Test and Evaluation Reports:

1. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
 - a. Power-actuated mechanical fasteners.
2. Research Reports: For steel deck, from ICC-ES showing compliance with the building code.

D. Field Quality-Control Submittals:

1. Field quality-control reports.

E. Qualification Statements: For welding personnel and testing agency.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with SDI QA/QC and the following welding codes:

1. AWS D1.3/D1.3M.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Store products in accordance with SDI MOC3. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

1.6 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."

PART 2 - PRODUCTS

2.1 ROOF DECK

- A. Fabrication of Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with SDI RD and with the following:
 - 1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), **Grade 33**, zinc coating.
 - 2. Deck Profile: As indicated.
 - 3. Cellular Deck Profile: As indicated, with bottom plate.
 - 4. Profile Depth: As indicated.
 - 5. Span Condition: Triple span or more.
 - 6. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.2 COMPOSITE FLOOR DECK

- A. Fabrication of Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with SDI C, with the minimum section properties indicated, and with the following:
 - 1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33, zinc coating.
 - 2. Profile Depth: As indicated.
 - 3. Span Condition: Triple span or more.

2.3 ACCESSORIES

- A. 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 (4.8-mm) 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 (230 MPa), not less than 0.0359-inch (0.91-mm) 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 recommended by SDI standards for overhang and slab depth.
- 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. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- J. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

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 of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories in accordance with SDI C, SDI NC, and SDI RD, as applicable; 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 in accordance with deck manufacturer's written instructions.
- J. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

3.3 INSTALLATION OF ROOF DECK

- 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 (38 mm) long, and as follows:
 - 1. Weld Diameter: 5/8 inch, nominal.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-third of the span or **12 inches** , and as follows:
 - 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
 - 2. Mechanically clinch or button punch.
 - 3. Fasten with a minimum of 1-1/2-inch long welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Lapped 2 inches minimum.
- D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld flanges to top of deck. Space welds not more than 12 inches apart with at least one weld at each corner.
 - 1. Install reinforcing channels or zees in ribs to span between supports and weld.
- E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels in accordance with deck manufacturer's written instructions. Weld 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 in accordance with manufacturer's written instructions to ensure complete closure.

3.4 INSTALLATION OF FLOOR DECK

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
 - 1. Weld Diameter: 5/8 inch nominal.
 - 2. Weld Spacing:
 - a. Weld edge ribs of panels at each support.
 - b. Space and locate welds as indicated.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-third of the span or 12 inches, and as follows:
 - 1. Mechanically clinch or button punch.

2. Fasten with a minimum of 1-1/2-inch-long welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 1. End Joints: Lapped.
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure in accordance with SDI recommendations unless otherwise indicated.
- E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, in accordance with SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.
- F. Install piercing hanger tabs at 14 inches apart in both directions, within 9 inches of walls at ends, and not more than 12 inches from walls at sides unless otherwise indicated.

3.5 SPECIAL INSPECTIONS

- A. Special Inspections and tests shall be performed by the Special Inspector or Special Inspection Agency.
- B. Verification and inspection of metal deck construction shall be in accordance with Table 1705.2.2 of Virginia Construction Code 2018 - IBC 2018, and as follows:
 1. Welding: Welding inspection shall be in compliance with AWS D1.3.
 2. Details: Perform an inspection of the steel decking to verify compliance with the details shown on the approved construction documents, such as layout, bearing and laps, quantity and spacing of welds and screws.
- C. Shear Studs: Test and inspect welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
 1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.
- D. Remove and replace work that does not comply with specified requirements.
- E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
 1. Special inspections and qualification of welding special inspectors for cold-formed steel floor and roof deck in accordance with quality-assurance inspection requirements of SDI QA/QC.
 - a. Field welds will be subject to inspection.
 2. Steel decking will be considered defective if it does not pass tests and inspections.
 3. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded shear connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors that are already tested.
- C. Prepare test and inspection reports.

END OF SECTION 053100

SECTION 05 40 00 – COLD-FORMED-METAL-FRAMING**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. This Section includes the following:
1. Exterior non-load-bearing wall framing.
 2. Exterior ceiling joist, soffit and fascia framing.
 3. Interior suspended overhead framing including ceilings, ceiling clouds, bulkheads and soffits.
 4. All framing designated as "CFMF" on drawings.
 5. Overbuilt joist and stud framing.
- B. Related Sections include the following:
1. Division 1 Section "Special Inspection Services" for administrative and procedural requirements for special inspection services.

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:
 - a. Dead Loads: Weights of materials and construction.
 - b. Wind Loads: As indicated.
 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/600 of the wall height.
 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 1 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 SUBMITTALS

- A. Product Data: For each type of cold-formed metal framing product and accessory indicated.

- B. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
 - 1. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 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. 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 - Header Design."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
 - 1. Grade: As required by structural performance.
 - 2. Coating: G60.
- B. Steel Sheet for Vertical Deflection Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
 - 1. Grade: 50, Class 1 or 2.
 - 2. Coating: G90.

2.2 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: 1-5/8 inches.
- 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: 0.0428 inch.
 - 2. Flange Width: 1-1/4 inches.

- C. Vertical Deflection Clips: Manufacturer's standard bypass clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

2.3 EXTERIOR CEILING JOIST, SOFFIT AND FASCIA FRAMING

- A. Members: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0329 inch.
 2. Flange Width: 1-5/8 inches, minimum.

2.4 INTERIOR SUSPENDED OVERHEAD FRAMING

- A. Members: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0329 inch.
 2. Flange Width: 1-5/8 inches, minimum.

2.5 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. Stud kickers, knee braces, and girts.
 8. Hole reinforcing plates.
 9. Backer plates.

2.6 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. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
- C. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.
- D. 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.

2.7 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A 780.

2.8 FABRICATION

- A. Fabricate cold-formed metal 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 metal framing members by screw fastening. Wire tying of framing members is not permitted.
 - a. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.
 4. Fasten other materials to cold-formed metal framing by 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 metal 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.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" 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 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 metal 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 metal framing members by screw fastening. Wire tying of framing members is not permitted.

- a. 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 and control joints with cold-formed metal framing. Independently frame both sides of joints.
- H. Install insulation, specified in Division 07 Section "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 standard punched openings.
- J. Erection Tolerances: Install cold-formed metal 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 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 bottom track, unless otherwise indicated. Space studs as follows:
 - 1. Stud Spacing: 16 inches, maximum.
- 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. Connect vertical deflection clips to bypassing studs and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced 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.
 - 2. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system.

3.4 EXTERIOR CEILING JOIST, SOFFIT AND FASCIA INSTALLATION

- A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.
- B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
 - 1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches.
 - 2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated on Shop Drawings.
- C. Space joists not more than 2 inches from abutting walls, and as follows:

1. Joist Spacing: 24 inches, maximum.
- D. Frame openings with built-up joist headers consisting of joist and joist track, nesting joists, or another combination of connected joists if indicated.
- E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated on Shop Drawings.
- F. Install bridging at intervals indicated on Shop Drawings. Fasten bridging at each joist intersection as follows:
 1. Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
- G. Secure joists to load-bearing walls or supporting framing to prevent lateral movement of bottom flange.
- H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.5 INTERIOR SUSPENDED OVERHEAD FRAMING INSTALLATION

- A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.
- B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
 1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches.
 2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated on Shop Drawings.
- C. Space joists not more than 2 inches from abutting walls, and as follows:
 1. Joist Spacing: 24 inches, maximum.
- D. Frame openings with built-up joist headers consisting of joist and joist track, nesting joists, or another combination of connected joists if indicated.
- E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated on Shop Drawings.
- F. Install bridging at intervals indicated on Shop Drawings. Fasten bridging at each joist intersection as follows:
 1. Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
- G. Secure joists to load-bearing walls or supporting framing to prevent lateral movement of bottom flange.
- H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.6 SPECIAL INSPECTIONS

- A. Special Inspections and tests shall be performed by the Special Inspector or Special Inspection Agency.
- B. Verification and inspection of steel construction shall be in accordance with Table 1704.3 of 2012 North Carolina Building Code, and as follows:
 1. Details: Perform periodic inspections of the installed cold-formed metal framing to verify compliance with the details shown on the construction documents and approved shop drawings such as member size, gage, location and spacing, connection details and miscellaneous framing.
- C. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

- D. Additional testing performed to determine compliance of corrected work with specified requirements shall be at Contractor's expense.

3.7 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal 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 metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 05 50 00 – METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Steel ladders.
 - 2. Loose bearing and leveling plates.
 - 3. Loose steel lintels.
 - 4. Shelf angles.
 - 5. Support angles for elevator door sills.
 - 6. Elevator machine beams.
 - 7. Steel framing and support for applications where framing and supports are not specified in other Sections.
 - 8. Miscellaneous metal trim.
 - 9. Pipe bollards.
- B. Related Sections include the following:
 - 1. Division 05, Section "Metal Stairs" for metal-framed stairs with metal pan, metal plate, or grating treads.
 - 2. Division 05, Section "Pipe and Tube Railings" for metal pipe and tube handrails and railings.
 - 3. Division 06, Section "Miscellaneous Carpentry" for metal framing anchors and other rough hardware.

1.2 SUBMITTALS

- A. Shop Drawings: Detail fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
 - 1. Provide templates for anchors and bolts specified for installation under other Sections.
- B. Samples for Verification: For each type and finish of extruded nosing and tread.

1.3 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing metal fabrications 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.
- B. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.2, "Structural Welding Code--Aluminum."
 - 3. AWS D1.3, "Structural Welding Code--Sheet Steel."
 - 4. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.4 PROJECT CONDITIONS

- A. Field Measurements: Where metal fabrications are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.5 COORDINATION

- A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

- A. Metal Surfaces, General: For metal fabrications exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

2.2 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500.

- C. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.
- D. Slotted Channel Framing: Cold-formed metal channels with flange edges returned toward web and with 9/16-inch-wide slotted holes in webs at 2 inches o.c.
 - 1. Width of Channels: 1-5/8 inches.
 - 2. Depth of Channels: As indicated.
 - 3. Metal and Thickness: Uncoated steel complying with ASTM A 570, Grade 33; 0.0677-inch minimum thickness.
 - 4. Finish: Rust-inhibitive, baked-on, acrylic enamel.
- E. Cast-in-Place Anchors in Concrete: Anchors of type indicated below, fabricated from corrosion-resistant materials capable of sustaining, without failure, the load imposed within a safety factor of 4, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47 malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.
- F. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

2.3 PAINT

- A. Shop Primer for Ferrous Metal: Organic zinc-rich primer, complying with SSPC-Paint 20 and compatible with topcoat.
- B. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
- C. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.

2.4 FASTENERS

- A. General: Provide Type 304 or 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, where built into exterior walls. Select fasteners for type, grade, and class required.
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F 1554, Grade 36.
- D. Machine Screws: ASME B18.6.3.
- E. Lag Bolts: ASME B18.2.1.
- F. Wood Screws: Flat head, carbon steel, ASME B18.6.1.
- G. Plain Washers: Round, carbon steel, ASME B18.22.1.
- H. Lock Washers: Helical, spring type, carbon steel, ASME B18.21.1.
- I. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Material: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.
 - 2. Material: Alloy Group 1 or 2 stainless-steel bolts complying with ASTM F 593 and nuts complying with ASTM F 594.
- J. Toggle Bolts: FS FF-B-588, tumble-wing type, class and style as needed.

2.5 GROUT

- A. 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.

2.6 CONCRETE FILL

- A. Concrete Materials and Properties: Comply with requirements in Division 03, Section "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. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Shear and punch metals cleanly and accurately. Remove burrs.

- C. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. 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.
- E. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- F. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- G. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.
- H. Allow for thermal movement resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening up 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.
- I. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
- J. Remove sharp or rough areas on exposed traffic surfaces.
- K. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

2.8 [STEEL LADDERS

- A. General: Fabricate ladders for locations shown, with dimensions, spacings, details, and anchorages as indicated.
 - 1. Comply with ANSI A14.3, unless otherwise indicated.
 - 2. For elevator pit ladders, comply with ASME A17.1.
- B. Siderails: Continuous, 1/2-by-2-1/2-inch steel flat bars, with eased edges, spaced 18 inches apart.
- C. Bar Rungs: 3/4-inch- diameter steel bars, spaced 12 inches o.c.
- D. Fit rungs in centerline of side rails; plug-weld and grind smooth on outer rail faces.
- E. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets. Size brackets to support design loads specified in ANSI A14.3.
- F. Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung by a proprietary process.

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.

2.10 LOOSE STEEL LINTELS

- A. Fabricate loose structural-steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.
- B. Weld adjoining members together to form a single unit where indicated.
- C. Size loose lintels to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than 8 inches, unless otherwise indicated.
- D. Galvanize loose steel lintels located in exterior walls.

2.11 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.
- B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete. Align expansion joints in angles with indicated control and expansion joints in cavity-wall exterior wythe.

- C. Galvanize shelf angles to be installed in exterior walls.
- D. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.12 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports that are not a part of structural-steel framework as necessary to complete the Work.
- B. General: Provide steel framing and supports indicated and as necessary to complete the Work.
- C. Fabricate units from structural-steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.
 - 1. Fabricate units from slotted channel framing where indicated.
 - 2. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors 1-1/4 inches wide by 1/4-inch thick by 8 inches long at 24 inches o.c., unless otherwise indicated.
 - 3. Furnish inserts if units must be installed after concrete is placed.
- D. Galvanize miscellaneous framing and supports where indicated.

2.13 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from structural-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. Provide anchors, welded to trim, for embedding in concrete or masonry construction, spaced not more than 6 inches from each end, 6 inches from corners, and 24 inches o.c., unless otherwise indicated.
- C. Galvanize miscellaneous steel trim in the following locations:
 - 1. Exterior.

2.14 PIPE BOLLARDS

- A. Fabricate pipe bollards from Schedule 40 steel pipe.

2.15 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.

2.16 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
 - 1. ASTM A 123, for galvanizing steel and iron products.
 - 2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.
- B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed metal fabrications:
 - 1. Exteriors (SSPC Zone 1B): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."
- C. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

- D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- E. Field Welding: Comply with the following requirements:
 - 1. 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.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

3.2 SETTING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
 - 1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations, unless otherwise indicated.
 - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.3 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings, if any.
- B. Anchor supports for operable partitions securely to and rigidly brace from building structure.
- C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
 - 1. Where grout space under bearing plates is indicated at girders supported on concrete or masonry, install as specified above for setting and grouting bearing and leveling plates.
- D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified above for setting and grouting bearing and leveling plates.
 - 1. Do not grout baseplates of columns supporting steel girders until girders are installed and leveled.

3.4 INSTALLING PIPE BOLLARDS

- A. Anchor bollards in place with concrete footings. Support and brace bollards in position in footing excavations until concrete has been placed and cured.
- B. Fill bollards solidly with concrete, mounding top surface.
 - 1. Do not fill removable bollards with concrete.

3.5 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09, Section "Painting."
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 50 00

SECTION 05 51 00 – METAL STAIRS**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
 1. Preassembled steel stairs with concrete-filled treads.
- B. Related Sections include the following:
 1. Division 03, Section "Cast-in-Place Concrete" for concrete fill for stair treads and platforms.
 2. Division 05, Section "Pipe and Tube Railings" for pipe and tube handrails and railings.
 3. Division 09, Section "High-Performance Coatings" for painting of metal stairs.

1.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal stairs capable of withstanding the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections. Apply each load to produce the maximum stress in each component of metal stairs.
 1. Treads and Platforms of Metal Stairs: Capable of withstanding a uniform load of 100 lbf/sq. ft. or a concentrated load of 300 lbf on an area of 4 sq. in., whichever produces the greater stress.
 2. Stair Framing: Capable of withstanding stresses resulting from loads specified above in addition to stresses resulting from railing system loads.
 3. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch, whichever is less.

1.3 SUBMITTALS

- A. Product Data: For metal stairs and the following:
 1. Prefilled metal-pan stair treads.
 2. Cast nosings.
- B. Shop Drawings: Show fabrication and installation details for metal stairs. Include plans, elevations, sections, and details of metal stairs and their connections. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other Sections.
 1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Arrange for metal stairs specified in this Section to be fabricated and installed by the same firm.
- 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 metal stairs (including handrails and railing systems) that are similar to those indicated for this Project in material, design, and extent.
- C. Fabricator Qualifications: A firm experienced in producing metal stairs 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. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

1.5 COORDINATION

- A. Coordinate installation of anchorages for metal stairs. 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.

PART 2 - PRODUCTS**2.1 FERROUS METALS**

- A. Metal Surfaces, General: Provide metal free from pitting, seam marks, roller marks, and other imperfections where exposed to view on finished units. Do not use steel sheet with variations in flatness exceeding those permitted by referenced standards for stretcher-leveled sheet.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500.
- D. Uncoated, Cold-Rolled Steel Sheet: Commercial quality, complying with ASTM A 366/A 366M; or structural quality, complying with ASTM A 611, Grade A, unless another grade is required by design loads.
- E. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

2.2 FASTENERS

- A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 25 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Machine Screws: ASME B18.6.3.
- D. Lag Bolts: ASME B18.2.1.
- E. Plain Washers: Round, carbon steel, ASME B18.22.1.
- F. Lock Washers: Helical, spring type, carbon steel, ASME B18.21.1.
- G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Material: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.
 - 2. Material: Alloy Group 1 or 2 stainless-steel bolts complying with ASTM F 593 and nuts complying with ASTM F 594.

2.3 PAINT

- A. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664, selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.
- B. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers or cold-applied asphalt emulsion complying with ASTM D 1187.

2.4 CONCRETE FILL AND REINFORCING MATERIALS

- A. Concrete Materials and Properties: Comply with requirements in [Division 03, Section "Cast-in-Place Concrete"] for normal-weight, ready-mixed concrete with a minimum 28-day compressive strength of 3000 psi, unless higher strengths are indicated.
- B. Welded Wire Fabric: ASTM A 185, 6 by 6 inches--W1.4 by W1.4, unless otherwise indicated.

2.5 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, struts, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
 - 1. Join components by welding, unless otherwise indicated.
 - 2. Use connections that maintain structural value of joined pieces.
 - 3. Fabricate treads and platforms of exterior stairs so finished walking surfaces slope to drain.
- B. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.
 - 1. Commercial class.
- C. Shop Assembly: Preassemble stairs in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- D. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Shear and punch metals cleanly and accurately. Remove sharp or rough areas on exposed surfaces.
- E. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- F. Weld connections 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. Weld exposed corners and seams continuously, unless otherwise indicated.
 - 5. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.
- H. Fabricate joints that will be exposed to weather in a manner to exclude water or provide weep holes where water may accumulate.

2.6 STEEL-FRAMED STAIRS

- A. Stair Framing: Fabricate stringers of structural-steel channels, plates, or a combination of both, as indicated. Provide closures for exposed ends of stringers. Construct platforms of structural-steel channel headers and miscellaneous framing members as indicated. Bolt or weld headers to stringers; bolt or weld framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.
 - 1. Where stairs are enclosed by gypsum board shaft-wall assemblies, provide hanger rods to support landings from floor construction above. Locate hanger rods within stud space of shaft-wall construction.
 - 2. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.
- B. Metal Risers, Subtread Pans, and Subplatforms: Form to configurations shown from steel sheet of thickness necessary to support indicated loads, but not less than 0.0677 inch.
 - 1. Steel Sheet: Uncoated cold-rolled steel sheet, unless otherwise indicated.
 - 2. Directly weld metal pans to stringers; locate welds on side of subtreads to be concealed by concrete fill. Do not weld risers to stringers.
 - 3. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
 - 4. Shape metal pans to include nosing integral with riser.
 - 5. At Contractor's option, provide stair assemblies with metal-pan subtreads filled with reinforced concrete during fabrication.
 - 6. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.
 - a. Smooth Soffit Construction: Construct subplatforms with smooth soffits.

2.7 STAIR HANDRAILS AND RAILINGS

- A. General: Comply with applicable requirements in Division 05, Section "Pipe and Tube Railings" for handrails and railings, and as follows:
 - 1. Connect railing posts to stair framing by direct welding, unless otherwise indicated.

2.8 FINISHES

- A. Comply with NAAMM'S "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal stairs after assembly.
- C. 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 products:
 - 1. Interiors (SSPC Zone 1A): SSPC SP 3, "Power Tool Cleaning."
- D. Apply shop primer to prepared surfaces of metal stair components, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
 - 1. Do not apply primer to galvanized surfaces.
 - 2. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION**3.1 INSTALLATION, GENERAL**

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free from rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete, unless otherwise indicated.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. 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.
- F. 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.

3.2 INSTALLING STEEL TUBE RAILINGS AND HANDRAILS

- A. Adjust handrails and railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and railing ends to building construction as follows:

3.3 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09, Section "Painting."

END OF SECTION 05 51 00

SECTION 05 51 33.13 – VERTICAL METAL LADDERS**PART 1 - PRODUCTS****1.1 SUMMARY**

- A. This Section includes the following:
 1. Exterior aluminum ladders for roof access.

1.2 SUBMITTALS

- A. Shop Drawings: For ladder-mounting bracket, indicating mounting plates, fasteners, hardware, and method of attachment to structure and heights.
- B. Verify Owner's selected sizes prior to ordering.
- C. Ladders shall be submitted with all details for approval, prior to fabrication. Complete dimensions, mounting attachments, materials, construction, and finish must be shown and must comply with all required safety orders for the installation.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain ladders through one source from a single manufacturer.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Available Products: Subject to compliance with requirements, provide products by one of the following manufacturers comparable to the basis of design product indicated:
 1. Alaco Ladder Co.
 2. ACL Industries.
 3. O'Keefe's, Inc., Basis of Design (Model 503, Low Parapet Access Ladder with Platform and Return and Model 503A, Low Parapet Access Ladder with Platform, No Return)

2.2 ALUMINUM LADDERS

- A. Furnish and install ladder at locations shown on drawings.
- B. Fixed Wall Ladders:
 1. Shall be 6063-T6 aluminum. Rungs shall be 1-1/8 inch round serrated and have cast aluminum rung connectors secured to 2-7/8 inch channel side rails with four (4) solid aircraft rivets each for a combined shear strength of over 3600 pounds each rung.
 2. Walk-Through and Parapet Railing shall extend no less than 42 inches above the landing.
 3. Rest Platform shall be 5005-H34 alloy mill finish with Grip Strut® floor and toe boards .063 inch thick by 4 inches wide. Railings shall be 1-1/4 inches round serrated tube with cast aluminum railing fittings.
- C. Finish: Mill finish aluminum.

2.3 MISCELLANEOUS

- A. Technical Data:
 1. Applicable Standards: American National Standards Institute (ANSI) A14.3 - Ladders-Fixed-Safety Requirements.
- B. Approvals:
 1. U.S. Occupational Safety and Health Administration (OSHA) A14.3.
- C. Installation:
 1. Preparatory Work: Handle and store product according to manufacturer's recommendations.
- D. Building Codes:
 1. Building Code requirements and product compliance data shall be obtained from the manufacturer. Installation must comply with applicable local, state, and national code jurisdictions.
- E. Warranty:
 1. Ladder shall carry a limited warranty of five (5) years.
- F. Maintenance:
 1. Ladder shall be maintenance free, with no painting required.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. Install ladders where indicated. Secure to structure in strict accordance with manufacturer's instructions. Test load selected units as directed by Architect.

3.2 PROTECTING AND CLEANING

- A. Protect equipment after installation from damage during construction. If damage occurs despite such protection, remove and replace damaged components or entire unit as required to provide units in their original, undamaged condition.

END OF SECTION 05 51 33.13

SECTION 05 52 13 – PIPE AND TUBE RAILINGS**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
 1. Steel pipe and tube handrails and railings.

1.2 PERFORMANCE REQUIREMENTS

- A. General: In engineering handrails and railings to withstand structural loads indicated, determine allowable design working stresses of handrail and railing materials based on the following:
 1. Structural Steel: AISC S335, "Specification for Structural Steel Buildings Allowable Stress Design and Plastic Design with Commentary."
 2. Cold-Formed Structural Steel: AISI SG-673, Part I, "Specification for the Design of Cold-Formed Steel Structural Members."
- B. Structural Performance of Handrails and Railings: Provide handrails and railings capable of withstanding the following structural loads without exceeding allowable design working stresses of materials for handrails, railings, anchors, and connections:
 1. Top Rail of Guards: Capable of withstanding the following loads applied as indicated:
 - a. Concentrated load of 250 lbf applied at any point and in any direction.
 - b. Uniform load of 50 lbf/ft. applied horizontally and concurrently with uniform load of 100 lbf/ft. applied vertically downward.
 - c. Concentrated and uniform loads above need not be assumed to act concurrently.
 2. Handrails Not Serving as Top Rails: Capable of withstanding the following loads applied as indicated:
 - a. Concentrated load of 250 lbf applied at any point and in any direction.
 - b. Uniform load of 50 lbf/ft. applied in any direction.
 - c. Concentrated and uniform loads above need not be assumed to act concurrently.
 3. Infill Area of Guards: Capable of withstanding a horizontal concentrated load of 200 lbf applied to 1 sq. ft. at any point in system, including panels, intermediate rails, balusters, or other elements composing infill area.
 - a. Load above need not be assumed to act concurrently with loads on top rails in determining stress on guard.

1.3 SUBMITTALS

- A. Shop Drawings: Show fabrication and installation of handrails and railings. Include plans, elevations, sections, component details, and attachments to other Work.
 1. For installed handrails and railings indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 QUALITY ASSURANCE

- A. 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 handrails and railings that are similar to those indicated for this Project in material, design, and extent.
- B. Source Limitations: Obtain each type of handrail and railing through one source from a single manufacturer.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify handrail and railing dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.6 COORDINATION

- A. Coordinate installation of anchorages for handrails and 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.

1.7 SCHEDULING

- A. Schedule installation so handrails and railings are mounted only on completed walls. Do not support temporarily by any means that does not satisfy structural performance requirements.

PART 2 - PRODUCTS**2.1 METALS**

- A. General: Provide metal free from pitting, seam marks, roller marks, stains, discolorations, and other imperfections where exposed to view on finished units.
- B. Steel and Iron: Provide steel and iron in the form indicated, complying with the following requirements:
 1. Steel Pipe: ASTM A 53; finish, type, and weight class as follows:

- a. Black finish, unless otherwise indicated.
- b. Type F, or Type S, Grade A, standard weight (Schedule 40), unless another grade and weight are required by structural loads.
- 2. Steel Tubing: Cold-formed steel tubing, ASTM A 500, Grade A, unless another grade is required by structural loads.
- 3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- 4. Iron Castings: Malleable iron complying with ASTM A 47, Grade 32510.
- C. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.

2.2 WELDING MATERIALS, FASTENERS, AND ANCHORS

- A. Welding Electrodes and Filler Metal: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- B. Fasteners for Anchoring Handrails and Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring handrails and railings to other types of construction indicated and capable of withstanding design loads.
 - 1. For steel handrails, railings, and fittings, use plated fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating.
- C. Fasteners for Interconnecting Handrail and Railing Components: Use fasteners fabricated from same basic metal as fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.
 - 1. Provide concealed fasteners for interconnecting handrail and railing components and for attaching them to other work, unless otherwise indicated.
 - 2. Provide concealed fasteners for interconnecting handrail and railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for handrails and railings indicated.
 - 3. Provide Phillips flat-head machine screws for exposed fasteners, unless otherwise indicated.
- D. Cast-in-Place and Post-installed Anchors: Anchors of type indicated below, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
 - 1. Cast-in-place anchors.
 - 2. Chemical anchors.

2.3 PAINT

- A. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664; selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.

2.4 GROUT AND ANCHORING CEMENT

- A. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.5 FABRICATION

- A. General: Fabricate handrails and 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. Assemble handrails and railings in the 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. Use connections that maintain structural value of joined pieces.
- C. Form changes in direction of railing members as follows:
 - 1. As detailed.
- D. Welded Connections: Fabricate handrails and railings for connecting members by welding. Cope components at perpendicular and skew connections to provide close fit, or use fittings designed for this purpose. Weld connections 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 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.
 - 5. Fabricate splice joints for field connection using an epoxy structural adhesive where this is manufacturer's standard splicing method.

- E. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect handrail and railing members to other work, unless otherwise indicated.
- F. Provide inserts and other anchorage devices for connecting handrails and railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by handrails and railings. Coordinate anchorage devices with supporting structure.
- G. Shear and punch metals cleanly and accurately. Remove burrs from exposed cut edges.
- H. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.
- I. Cut, reinforce, drill, and tap components, as indicated, to receive finish hardware, screws, and similar items.
- J. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members that are exposed to exterior or to moisture from condensation or other sources.
- K. Fabricate joints that will be exposed to weather in a watertight manner.
- L. Close exposed ends of handrail and 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 railing and wall is 1/4 inch or less.
- N. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.6 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Provide exposed fasteners with finish matching appearance, including color and texture, of handrails and railings.

2.7 STEEL FINISHES

- A. For nongalvanized steel handrails and railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors to be embedded in exterior concrete or masonry.
- B. Preparation for Shop Priming: Thoroughly clean handrails and railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic-phosphate process.
- C. Apply shop primer to prepared surfaces of handrail and railing components, unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
 - 1. Stripe paint edges, corners, crevices, bolts, and welds.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been 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 to install handrails and railings. Set handrails and railings accurately in location, alignment, and elevation; measured from established lines and levels and free from rack.
 - 1. Do not weld, cut, or abrade surfaces of handrail and 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 from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- C. Adjust handrails and railings before anchoring to ensure matching alignment at abutting joints. Space posts at interval indicated, but not less than that required by structural loads.
- D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing handrails and railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

- A. 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.

3.4 ANCHORING POSTS

- A. 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 the following anchoring material, mixed and placed to comply with anchoring material manufacturer's written instructions:
 - 1. Nonshrink, nonmetallic grout.
- B. Cover anchorage joint with flange of same metal as post, attached to post as follows:
 - 1. Welded to post after placing anchoring material.
- C. Leave anchorage joint exposed; wipe off surplus anchoring material; and leave 1/8-inch build-up, sloped away from post.

3.5 ANCHORING RAILING ENDS

- A. Anchor railing ends into concrete and masonry with round flanges connected to railing ends and anchored into wall construction with post-installed anchors and bolts.
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces.
 - 1. Weld flanges to railing ends.

3.6 ATTACHING HANDRAILS TO WALLS

- A. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- B. Secure wall brackets 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.

3.7 CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material.

3.8 PROTECTION

- A. Protect finishes of handrails and railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at the time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

END OF SECTION 05 52 13

DIVISION 06
WOOD, PLASTICS, AND COMPOSITES

SECTION 06 10 53 – MISCELLANEOUS CARPENTRY**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
 1. Wood blocking, cants, and nailers.
 2. Plywood backing panels.
 3. Wood Preservative Treatment.
 4. Miscellaneous fasteners.

1.2 SUBMITTALS

- A. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:
 1. Preservative-treated wood.
 2. Fire-retardant-treated wood.
 3. Metal framing anchors.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber, plywood, and other panels; place spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS**2.1 WOOD PRODUCTS, GENERAL**

- A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.
 1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. For exposed lumber indicated to receive a stained or natural finish, provide certificates of grade compliance issued by grading agency.
 3. 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.
 4. Provide dressed lumber, S4S, unless otherwise indicated.
 5. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.
- B. Wood Structural Panels:
 1. Plywood: Either DOC PS 1 or DOC PS 2, unless otherwise indicated.
 2. Thickness: As needed to comply with requirements specified but not less than thickness indicated.
 3. Comply with "Code Plus" provisions in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial."
 4. Factory mark panels according to indicated standard.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWWA C2 (lumber) and AWWA C9 (plywood), except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWWA C31 with inorganic boron (SBX).
 1. 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.
 2. Preservation Chemicals: Provide acceptable products to authorities having jurisdiction:
 - a. Alkaline Copper Quat (ACQ).
 - b. Copper Azole (CBA).
 - c. Micronized Copper Azole (MCA).
- B. Kiln-dry material after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark each treated item with the treatment quality mark of an inspection agency approved by the American Lumber Standards Committee Board of Review.
 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.
- D. Application: Treat items indicated on Drawings, and the following:
 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

3. Wood framing members less than 18 inches above grade.
4. Wood floor plates that are installed over concrete slabs directly in contact with earth.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, provide materials that comply with performance requirements in AWPA C20 (lumber) and AWPA C27 (plywood). Identify fire-retardant-treated wood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.
1. Use treatment for which chemical manufacturer publishes physical properties of treated wood after exposure to elevated temperatures, when tested by a qualified independent testing agency according to ASTM D 5664, for lumber and ASTM D 5516, for plywood.
 2. Use treatment that does not promote corrosion of metal fasteners.
 3. Use Exterior type for exterior locations and where indicated.
 4. Use Interior Type A High Temperature (HT), unless otherwise indicated.
- B. 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.

2.4 MISCELLANEOUS LUMBER

- A. General: Provide lumber for support or attachment of other construction, including the following:
1. Blocking.
 2. Cants.
 3. Nailers.
 4. Furring.
- B. For items of dimension lumber size, provide Construction, Stud, or No. 2 grade lumber with 19 percent maximum moisture content and any of the following species:
1. Mixed southern pine; SPIB.
 2. Hem-fir or Hem-fir (north); NLGA, WCLIB, or WWPA.
 3. Spruce-pine-fir (south) or Spruce-pine-fir; NELMA, NLGA, WCLIB, or WWPA.
 4. Eastern softwoods; NELMA.
- C. For exposed boards, provide lumber with 15 percent maximum moisture content and any of the following species and grades:
1. Mixed southern pine, C & Btr Finish grade; SPIB.
 2. Hem-fir or Hem-fir (north), Superior or C & Btr Finish grade; NLGA, WCLIB, or WWPA.
 3. Spruce-pine-fir (south) or Spruce-pine-fir, No. 2 Common grade; NELMA, NLGA, WCLIB, or WWPA.
- D. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:
1. Mixed southern pine, No. 2 grade; SPIB.
 2. Hem-fir or Hem-fir (north), Construction or 2 Common grade; NLGA, WCLIB, or WWPA.
 3. Spruce-pine-fir (south) or Spruce-pine-fir, Construction or 2 Common grade; NELMA, NLGA, WCLIB, or WWPA.

2.5 PANEL PRODUCTS

- A. Miscellaneous Concealed Plywood: Exposure 1 sheathing, span rating to suit framing in each location, and thickness as indicated but not less than 1/2 inch.
- B. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2 inch thick.

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, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
 2. Where carpentry is composed of pressured treated wood, use hot-dipped galvanized complying with ASTM A153/D or higher or stainless steel 304 or 316 nails and/or fasteners.
- B. Nails, Wire, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. 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.
- F. Lag Bolts: ASME B18.2.1.

- G. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
- H. 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.

2.7 METAL FRAMING ANCHORS

- A. General: Provide galvanized steel framing anchors of structural capacity, type, and size indicated and acceptable to authorities having jurisdiction.
- B. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Discard units of material with defects that impair quality of carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.
- B. 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 furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- C. Apply field treatment complying with AWPA M4 to cut surfaces of preservative-treated lumber and plywood.
- D. Securely attach carpentry work as indicated and according to applicable codes and recognized standards.
- E. Countersink fastener heads on exposed carpentry work and fill holes with wood filler.
- F. Use fasteners of appropriate type and length. Pre-drill members when necessary to avoid splitting wood.

3.2 WOOD SLEEPER, BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

3.3 PANEL PRODUCT INSTALLATION

- A. Wood Structural Panels: Comply with applicable recommendations contained in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial," for types of structural-use panels and applications indicated.
 - 1. Comply with "Code Plus" provisions in above-referenced guide.

END OF SECTION 06 10 53

SECTION 06 64 00 – PLASTIC PANELING**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
 1. Glass-fiber reinforced plastic (FRP) wall paneling products and trim accessories.
- B. Related Sections include the following:
 1. Division 07, Section "Joint Protection" for mildew-resistant sealant applied to joints between panel trims and adjoining flooring base and other materials.
 2. Division 09, Section "Gypsum Board Assemblies" for moisture-resistant gypsum board substrate.

1.2 SUBMITTALS

- A. Product Data: For panel products and adhesives.
 1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.
 2. Include data indicating acceptance by authorities having jurisdiction for use in food preparation facilities.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each type of material indicated.
 1. Plastic paneling.
 2. Trim accessories.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed paneling similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Source Limitations: Obtain all plastic paneling products from a single manufacturer listed in Part 2.
- C. 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.
 3. Testing Agency: Acceptable to authorities having jurisdiction.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver sanitary plastic paneling until painting and similar operations that could damage paneling have been completed in installation areas. If paneling must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install plastic paneling until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where sanitary plastic paneling is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 1. Locate concealed framing, blocking, and reinforcements that support sanitary plastic paneling by field measurements before being enclosed and indicate measurements on Shop Drawings.
 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating paneling without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.6 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that paneling can be installed as indicated.

PART 2 - PRODUCTS**2.1 PLASTIC SHEET PANELING**

- A. General: Gelcoat-finished, glass-fiber reinforced plastic panels complying with ASTM D 5319.
 1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire-X Glasbord; Crane Composites Inc.
 - b. Marlite, Standard FRP.
 - c. Nudo Products Inc., Fiber-Lite FRB Liner Panels.
 - d. Sequentia, FRP Panels; Crane Compositions Inc.

2. Nominal Thickness: Not less than 0.09 inch.
3. Surface Finish: Molded pebble texture.
4. Color: As selected by Architect from manufacturer's full range.

2.2 ACCESSORIES

- A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.
 1. Color: As selected by Architect from manufacturer's full range.
- B. Concealed Mounting Splines: Continuous, H-shaped aluminum extrusions designed to fit into grooves routed in edges of factory-laminated panels and be fastened to substrate.
- C. Adhesive: As recommended by plastic paneling manufacturer.
 1. VOC Content: 50 g/L or less when calculated according to 40 CRF 59, Subpart D (EPS Method 24).
- D. Sealant: Single-component, mildew-resistant, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Division 07, Section "Joint Sealants".
 1. VOC Content: 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPS Method 24).

PART 3 - EXECUTION

3.1 PREPARATION

- A. Condition paneling to average prevailing humidity and temperature conditions in installation areas before installation.

3.2 INSTALLATION

- A. Install plastic paneling according to manufacturer's written instructions.
- B. Install panels in a full spread of adhesive.
- C. Install trim accessories with adhesive. Do not fasten through panels.
- D. Fill grooves in trim accessories with sealant before installing panels and bed inside corner trim in a bead of sealant.
- E. Maintain uniform space between adjacent panels and between panels and floors, ceilings, and fixtures. Fill space with sealant.
- F. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective paneling, where possible, to eliminate functional and visual defects; where not possible to repair, replace paneling. Adjust for uniform appearance.
- B. Clean paneling on exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 06 64 00

DIVISION 07
THERMAL AND MOISTURE PROTECTION

SECTION 07 11 13 – BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Cold-applied, asphalt emulsion dampproofing.
- B. Bituminous sheet waterproofing is specified in Division 07, Section "Modified Bituminous Sheet Air Barriers"

1.2 SUBMITTALS

- A. Certificate indicating product supplied conforms to these specifications.
- B. Certification by dampproofing manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).

1.3 PROJECT CONDITIONS

- A. Substrate: Proceed with dampproofing only after substrate construction and penetrating work have been completed.
- B. Weather Limitations: Proceed with dampproofing only when existing and forecasted weather conditions will permit work to be performed according to manufacturer's recommendations and warranty requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Cold-Applied, Asphalt Emulsion Dampproofing:
 - a. Degussa Building Systems; Sonneborn Brand Products.
 - b. Euclid Chemical Co.
 - c. Koppers Industries, Inc.
 - d. Meadows: W.R. Meadows, Inc.
 - e. Henry Co.

2.2 BITUMINOUS DAMPPROOFING

- A. General: Provide products recommended by manufacturer for designated application.
- B. Cold-Applied, Asphalt Emulsion Dampproofing: Asphalt-based emulsions recommended by the manufacturer for dampproofing use when applied according to the manufacturer's instructions.
 - 1. Spray Grade: Emulsified asphalt, prepared with mineral-colloid emulsifying agents without fibrous reinforcement, complying with ASTM D 1227, Type III, Class I.

2.3 MISCELLANEOUS MATERIALS

- A. Primer: Asphalt primer complying with ASTM D 1227, Type III, Class I, except diluted with water as recommended by manufacturer.
- B. Protection Course, Asphalt Board Type: ASTM D 6506, Premolded, 1/8-inch- thick, multi-ply, semirigid board, consisting of a mineral-stabilized asphalt core sandwiched between layers of asphalt-saturated felt, and faced on one side with polyethylene film.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Protection Course II; Degussa Building Systems; Sonneborn Brand Products.
 - b. Bituthene Asphaltic Hardboard; Grace: W.R. Grace & Co.
 - c. PC-2 Protection Course; Meadows: W.R. Meadows, Inc.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrate of projections and substances detrimental to work; comply with recommendations of prime materials manufacturer.
- B. Install cant strips and similar accessories as shown and as recommended by prime materials manufacturer even though not shown.
- C. Fill voids, seal joints, and apply bond breakers, if any, as recommended by prime materials manufacturer, with particular attention at construction joints.

- D. Install separate flashings and corner protection stripping, as recommended by prime materials manufacturer, where indicated to precede application of dampproofing. Comply with details shown and with manufacturer's recommendations. Pay particular attention to requirements at building expansion joints, if any.
- E. Prime substrate as recommended by prime materials manufacturer.
- F. Protection of Other Work: Do not allow liquid and mastic compounds to enter and clog drains and conductors. Prevent spillage and migration onto other surfaces of work by masking or otherwise protecting adjoining work.

3.2 INSTALLATION, GENERAL

- A. Comply with manufacturer's recommendations except where more stringent requirements are indicated and where Project conditions require extra precautions to ensure satisfactory performance of work.
- B. Application: Apply dampproofing to the following surfaces.
 - 1. Exterior, below-grade surfaces of exterior concrete or masonry walls in contact with earth or other backfill and where space is enclosed on opposite side.
 - 2. Back side of concrete or masonry retaining walls and stone facing to prevent percolating of water through the wall or facing.
 - 3. Exterior surface of inside wythe of double-wythe, exterior masonry walls above grade, to prevent water-vapor penetration through the wall.
 - 4. Where indicated on the Drawings.
- C. Cold-Applied Asphalt Dampproofing: For exterior surfaces, provide either emulsified or cut-back, asphalt dampproofing materials, at Contractor's option. For interior surfaces, provide only emulsified asphalt materials.
- D. Bituminous Cant Strips: Install 2-by-2-inch cant strip of bituminous grout at base of vertical dampproofing where it meets horizontal surface.
- E. Apply vertical dampproofing down walls from finished-grade line to top of footing, extend over top of footing, and down a minimum of 6 inches over outside face of footing. Extend 12 inches onto intersecting walls and footings, but do not extend onto surfaces exposed to view when the Project is completed.

3.3 COLD-APPLIED, ASPHALT EMULSION DAMPPROOFING

- A. Spray Grade: Brush or spray apply a coat of asphalt emulsion dampproofing at a rate of 1.5 to 2.5 gal./100 sq. ft., depending on substrate texture, to produce a uniform, dry-film thickness of not less than 15 mils. Apply in 2 coats, if necessary, to obtain required thickness, allowing time for complete drying between coats.

3.4 PROTECTION AND CLEANING

- A. Protect exterior, below-grade dampproofing membrane from damage until backfill is completed. Remove overspray and spilled materials from surfaces not intended to receive dampproofing.

3.5 INSTALLATION OF PROTECTION COURSE

- A. General: Where indicated, install protection course of type indicated over completed-and-cured dampproofing treatment. Comply with dampproofing materials manufacturer's recommendations for method of support or attaching of protection materials. Support with spot application of trowel-grade mastic where not otherwise indicated.

END OF SECTION 07 11 13

SECTION 07 13 26 – SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Rubberized-asphalt sheet waterproofing and protective cover drainage panel.
 - 2. Contractor's Option: Fluid-applied waterproofing.
 - 3. Blind side waterproofing.
- B. Related Sections include the following:
 - 1. Division 07, Section "Joint Protection" for joint-sealant materials and installation.

1.2 PERFORMANCE REQUIREMENTS

- A. Provide waterproofing that prevents the passage of water.

1.3 SUBMITTALS

- A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.
- B. Shop Drawings: Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
- C. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.
- D. Sample Warranty: Copy of special waterproofing manufacturer's and Installer's warranty stating obligations, remedies, limitations, and exclusions before starting waterproofing.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who is acceptable to waterproofing manufacturer to install manufacturer's products.
- B. Source Limitations: Obtain waterproofing materials through one source from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver liquid materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by waterproofing manufacturer.
- C. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- D. Store rolls according to manufacturer's written instructions.
- E. Protect stored materials from direct sunlight.

1.6 PROJECT 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. Special Manufacturer's Warranty: Written warranty, signed by waterproofing manufacturer agreeing to replace waterproofing material that does not comply with requirements or that does not remain watertight during specified warranty period.
 - 1. Warranty does not include failure of waterproofing due to failure of substrate prepared and treated according to requirements or formation of new joints and cracks in substrate exceeding 1/16 inch in width.
 - 2. Warranty Period: Five years after date of Project Acceptance.
- B. Special Installer's Warranty: Written waterproofing Installer's warranty, signed by Installer, covering Work of this Section, for warranty period of two years.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Products: Subject to compliance with requirements, provide one of the following products:
1. Rubberized-Asphalt Sheet Waterproofing:
 - a. Carlisle Coatings & Waterproofing Div.; CCW Mira DRI 860/861.
 - b. W. R. Grace & Co.; Bituthene 3000.
 - c. W.R. Meadows, Inc.; Sealtight Mel-Rol.
 - d. Henry; Blueskin WP 200.
 2. Drainage Board:
 - a. Carlisle Coatings & Waterproofing Div.; Miradrain
 - b. W.R. Meadows, Inc.; Mel-Drain
 - c. Henry; Drain Board
 - d. Tremco, TremDrain NW (Protection Board and Drainage Board)
 3. Protection Board:
 - a. Tremco, TremDrain NW (Protection Board and Drainage Board)
 - b. W.R. Meadows, Inc.
 - c. Henry; 990-31 Protection Board
 4. Blind Side Waterproofing:
 - a. Provide factory made composite sheet of HDPE film with pressure sensitive adhesives that is engineered to apply in a horizontal, blind side application on top of gravel base and under concrete slab that is poured on top of it.
 - b. W.R. Grace & Co.; Preprufe 200.
 - c. Or equals by:
 - 1) Henry.
 - 2) Carlisle.

2.2 RUBBERIZED-ASPHALT SHEET WATERPROOFING

- A. Rubberized-Asphalt Sheet: 60-mil- thick, self-adhering sheet consisting of 56 mils of rubberized asphalt laminated to a 4-mil-thick, polyethylene film with release liner on adhesive side and formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction.
1. Physical Properties: As follows, measured per standard test methods referenced:
 - a. Tensile Strength: 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: 40 lbf minimum; ASTM E 154.
 - f. Hydrostatic-Head Resistance: 150 feet minimum; ASTM D 5385.
 - g. Water Absorption: 0.15 percent weight-gain maximum after 48-hour immersion at 70 deg F; ASTM D 570.
 - h. Vapor Permeance: 0.05 perms; ASTM E 96, Water Method.

2.3 FLUID APPLIED MEMBRANE (CONTRACTOR'S OPTION)

- A. Provide two-part, self-curing, rubber based fluid applied waterproofing material with the following properties:
1. Cured Film Thickness: 0.06 inches.
 2. Solids Content: (ASTM D1644) 100%.
 3. Flexibility, 180 degrees bend over mandrel at 32 degrees C (ASTM D1970): Unaffected.
 4. Elongation (ASTM D412): 500% min.
 5. Peel Adhesion to Concrete (ASTM D903 modified): 5 lbs/inch.
- B. Manufacturers/Products:
1. Subject to compliance with requirements:
 - a. W.R. Grace: Procor.

2.4 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 primer recommended for substrate by manufacturer of sheet waterproofing material.
- C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by manufacturer of sheet waterproofing material.

- D. Sheet Strips: Self-adhering, rubberized-asphalt composite sheet strips of same material and thickness as sheet waterproofing.
- E. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, trowel grade or low viscosity.
- F. Substrate Patching Membrane: Low-viscosity, two-component, asphalt-modified coating.
- G. Mastic, Adhesives, and Tape: Liquid mastic and adhesives, and adhesive tapes recommended by waterproofing manufacturer.

2.5 INSULATION

- A. Extruded-Polystyrene Board Insulation: Rigid, cellular polystyrene thermal insulation formed by the expansion of polystyrene base resin in an extrusion process using hydrochlorofluorocarbons as the blowing agents to comply with ASTM C 578 for type and other requirements indicated below:
 - 1. Type VI, 1.8-lb/cu. ft. minimum density and 40-lb/sq. in. minimum compressive strength.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.
 - 1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.
 - 2. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
 - 3. 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 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.
 - 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 each direction from corner or install membrane strip centered over corner.
 - b. At plaza deck-to-wall intersections, extend liquid membrane or sheet strips onto deck waterproofing and to finished height of sheet flashing.
- 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 RUBBERIZED-ASPHALT SHEET APPLICATION

- A. Install self-adhering sheets according to waterproofing manufacturer's written instructions and recommendations in ASTM D 6135.
- B. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Re-prime 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, rubberized-asphalt sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F.
- D. Horizontal Application: Apply sheets from low point to high point of decks to ensure that side laps shed water.
- E. Apply continuous sheets over sheet strips bridging substrate cracks, construction, and contraction joints.
- F. Seal exposed edges of sheets at terminations not concealed by metal counterflashings or ending in reglets with mastic or sealant.
- 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 sheets extending 6 inches beyond repaired areas in all directions.
- I. Correct deficiencies in or remove sheet waterproofing that does not comply with requirements, repair substrates, reapply waterproofing, and repair sheet flashings.

3.4 BLIND SIDE WATERPROOFING APPLICATION

- A. Install adhesive-coated HDPE sheets according to manufacturer's written instructions.
- B. Place and secure molded-sheet drainage panels over substrate. Lap edges and ends of geotextile to maintain continuity.
- C. Vertical Applications: Install adhesive-coated HDPE sheet with HDPE face against substrate. Accurately align sheets and maintain uniform **3-inch**- minimum lap widths and end laps. Overlap and seal seams and stagger and tape end laps to ensure watertight installation. Mechanically fasten to substrate.
 1. Securely fasten top termination of membrane with continuous metal termination bar anchored into substrate and cover with detailing tape.
- D. Horizontal Applications: Install adhesive-coated HDPE sheet with HDPE face against substrate. Accurately align sheets and maintain uniform **3-inch**- minimum lap widths and end laps. Overlap and seal seams. Overlap, stagger, and seal end laps with detail tape to ensure watertight installation.
- E. Corners: Seal lapped terminations and cut edges of sheet waterproofing at inside and outside corners with detail tape.
- F. Seal penetrations through sheet waterproofing to provide watertight seal with detail tape patches or wraps and a liquid-membrane troweling.
- G. Install sheet waterproofing and auxiliary materials to produce a continuous watertight tie into adjacent waterproofing.
- H. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Tape perimeter of damaged or nonconforming area extending **6 inches** beyond repaired areas in all directions. Apply a patch of sheet waterproofing and firmly secure with detail tape.
- I. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

3.5 FLUID APPLIED MEMBRANE WATERPROOFING APPLICATION

- A. Apply waterproofing according to manufacturer's written instructions.
- B. Apply primer over prepared substrate.
- C. Unreinforced Waterproofing Applications: Mix materials and apply waterproofing by spray, roller, notched squeegee, trowel, or other application method suitable to slope of substrate.
 1. Apply one or more coats of waterproofing to obtain a seamless membrane free of entrapped gases, with an average dry film thickness of 120 mils (3 mm).
 2. Apply waterproofing to prepared wall terminations and vertical surfaces.
 3. Verify wet film thickness of waterproofing every 100 sq. ft.

3.6 INSULATION INSTALLATION

- A. Install one or more layers of insulation to achieve required thickness over waterproofed surfaces. Cut and fit to within 3/4 inch of projections and penetrations.
- B. On vertical surfaces, set insulation units in adhesive or tape applied according to manufacturer's written instructions.

3.7 PROTECTION AND CLEANING

- A. Do not permit foot or vehicular traffic on unprotected membrane.
- B. Protect waterproofing from damage and wear during remainder of construction period.
- C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 07 13 26

SECTION 07 21 00 – THERMAL INSULATION**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
 1. Foundation wall insulation (supporting backfill).
 2. Concealed building insulation
 3. Exposed building insulation.
 4. Roof insulation.
- B. Related Sections include the following:
 1. Division 07 Roofing section(s) for insulation specified as part of roofing construction.
 2. Division 09, Sections "Gypsum Board Assemblies" for installation in metal-framed assemblies of insulation specified by reference to this Section.
 3. Division 22 and 23 Sections "Duct Insulation," "Equipment Insulation," and "Pipe Insulation."

1.2 SUBMITTALS

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

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of building insulation through one source.
- 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.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect plastic insulation as follows:
 1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
 2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
 3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Extruded-Polystyrene Board Insulation: (at foundation and below grade walls.)
 - a. Dow Chemical Company.
 - b. Owens Corning.
 - c. Pactiv Building Products.
 2. Slag-Wool-/Rock-Wool-Fiber Insulation:
 - a. Fibrex Insulations Inc.
 - b. Owens Corning.
 - c. Thermafiber.
 3. Glass Fiber Insulation:
 - a. CertainTeed Corporation.
 - b. Johns Manville Corporation.
 - c. Knauf Fiber Glass.
 - d. Owens Corning.
 - e. <insert manufacturer>

2.2 INSULATING MATERIALS

- A. General: Provide insulating materials that comply with requirements and with referenced standards.
 1. Preformed Units: Sizes to fit applications indicated; selected from manufacturer's standard thicknesses, widths, and lengths.

- B. Extruded-Polystyrene Board Insulation:(at foundation cavity and below grade walls) ASTM C 578, of type and density indicated below, with maximum flame-spread and smoke-developed indices of 75 and 450, respectively:
 - 1. Type IV, 1.60 lb/cu. ft., unless otherwise indicated.
- C. Mineral Fiber Blanket Insulation
 - 1. Batts not exposed to building interior:
 - a. ASTM C665, Type 1 (unfaced), Class B.
 - 2. Batts exposed to building interior:
 - a. ASTM C665, Type III (FSK-25), Class A, Cat. 1.
- D. Extruded Polystyrene Board Insulation for Roof Assemblies:
 - 1. Type: ASTM C 578, type IV, rigid, closed cell type, with integral, high density skin.
 - a. Aged Thermal Resistance: R-5 per inch.
 - b. Board Size: 48" x 96".
 - c. Board Thickness: as required to provide required r-value.
 - d. Compressive Strength: 25 psi.
 - e. Flame Spread/Smoke Developed Values: 5/164 to ASTM E 84.
 - f. FM 4450 or UL 1256 approval required.
 - 2. Products: Subject to technical requirements, provide one of the following:
 - a. Dow Styrofoam Deckmate Plus, Basis of Design.
 - b. Certifoam.
 - c. Owens Corning.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for Sections in which substrates and related work are specified and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances harmful to insulations or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

3.3 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice and snow.
- C. Extend insulation in thickness indicated 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. Water-Piping Coordination: If water piping is located on inside of insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.
- E. Apply single layer of insulation to produce thickness indicated, unless multiple layers are otherwise shown or required to make up total thickness.

3.4 INSTALLATION OF GENERAL BUILDING 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. Seal joints between closed-cell (nonbreathing) insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.
- C. Set vapor-retarder-faced units with vapor retarder towards the side indicated on the drawings. When not indicated, ask the Architect for clarification.
- D. Install mineral-fiber blankets in cavities formed by framing members according to the following requirements:
 - 1. Use blanket widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
 - 2. Place blankets in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically

3.5 PROTECTION

- A. Protect installed insulation and vapor retarders 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 07 21 00

SECTION 07 21 19 – FOAM-IN-PLACE INSULATION**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
 1. Closed-cell spray polyurethane foam on masonry walls as indicated by wall assemblies.
- B. Related Requirements:
 1. Division 01, Section "Quality Requirements" for requirements for mock-up panels.
 2. Division 07, Section "Thermal Insulation" for concealed building insulation.
 3. Division 07, Section "Modified Bituminous Sheet Air Barriers" for self-adhering, vapor-retarding, modified bituminous sheet air barriers.
 4. Division 07, Section "Joint Protection" for Spray Polyurethane Foam sealant.
- C. Coordinate with General Contractor for requirements to construct a mock-up on-site per section 04 20 00 – Unit Masonry.

1.2 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 1. Preparation instructions and recommendations.
 2. Storage and handling requirements and recommendations.
 3. Installation methods.
- B. Manufacturer's Certificates: Certify product's meet or exceed specified requirements.
- C. Qualification Data: For Installer.
- D. Product Test Reports: For each product, for tests performed by a qualified testing agency (as required to show product qualification if not provided by an Evaluation Report).
- E. Evaluation Reports: For spray-applied polyurethane foam-plastic insulation, from a third party accreditation agency.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing polyurethane foam products specified per this section.
- B. Installer Qualifications: Company specializing in performing Work of this section with minimum three years documented experience.
 1. Installer must have a manufacturer's certification for the application.

1.4 PRE-INSTALLATION MEETING

- A. Convene a pre-installation meeting a minimum to two weeks prior to commencing work of this section.
- B. Attendance: Architect, General Contractor, Electrical, Plumbing, & Masonry Contractor, and Spray Foam Contractor.
- C. Agenda: Review mock-up panel, installation sequence, safety requirements, warranty requirements, inspections and application procedures, and scheduling.

1.5 COORDINATION

- A. Ensure that the installation of products of this section is coordinated with affected trades to prevent interruption of construction progress.

PART 2 - PRODUCTS**2.1 CLOSED-CELL SPRAY POLYURETHANE FOAM**

- A. Closed-Cell Spray Polyurethane Foam: ASTM C 1029, Type II, minimum density of **1.9 to 2.2 lb/cu.ft.** and minimum aged R-value at 1-inch thickness of 6.2.
 1. Subject to compliance with requirements, provide products by one of the following:
 - a. NCFI Polyurethanes; Mount Airy, NC; InsulBloc (Basis of Design)
 - b. Henry Company; El Segundo, CA; Permax
 - c. BASF Corp.; WallTie
 2. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 3. Air Leakage: 0.004 CF /min/SF at 1.57 psf cfm/sf when tested in accordance with ASTM E 283 or ASTM E 2178
 4. Certified as Water Resistive Barrier per - AATCC 127 and ASTM E 331.

2.2 FIRE PROPAGATION CHARACTERISTICS:

- A. Passes NFPA 285 testing as part of an approved assembly.
 - 1. Report tested and approved substrates and exterior covering materials per NFPA 285 testing.
 - 2. Potential Heat value per NFPA 259.

2.3 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by insulation manufacturer where required for adhesion of insulation to substrates.
- B. Miscellaneous: Materials recommended by insulation manufacturer where required for insulation repairs and flashing membrane as a transition material.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify that substrates are clean, dry, and free of substances that are harmful to insulation.
- B. Priming: Prime substrates, where recommended by insulation manufacturer. Apply primer to comply with insulation manufacturer's written instructions. Confine primers to areas to be insulated; do not allow spillage or migration onto adjoining surfaces.
- C. Verify substrate construction, substrate penetration work, and related welding and other hot work has been completed.
- D. Establish a Safety Zone to ensure unauthorized workers are not in the application area during the spray foam application. Cordon off area for spray foam application and post warning signs as necessary to prevent entry to the area by other persons not wearing appropriate Personal Protective Equipment (PPE).
- E. Mask off or move materials or equipment in the vicinity of the spray foam application to prevent accidental overspray.

3.2 INSTALLATION

- A. Comply with insulation manufacturer's written instructions applicable to products and applications. Ensure compliance with weather conditions, substrate temperature, chemical temperature, equipment settings, substrate condition, and personal protective equipment (PPE) requirements.
- B. Spray insulation to envelop entire area to be insulated with foam thickness to achieve a minimum R-9.5 and fill voids.
- C. Apply SPF directly to the masonry block in accordance to the manufacturer's installation instructions. Do not exceed the manufacturer's maximum pass thickness. Multiple layers of foam may be applied as required to achieve the required thickness. Total thickness to any area must be applied on the same day.
- D. Cavity Walls: Apply the SPF to an average thickness indicated on the Drawings or specified in the schedule at the end of this section. Minimum thickness of SPF will be within 1/4" of specified thickness. Excess thickness permitted up to point it does not interfere with the installation of the veneer system. The required 1" air space between the SPF surface and the back side of the veneer must be maintained for at least 90% of the wall area. Excess thickness may be trimmed or sanded from the SPF surface.
- E. Where damage occurs that violates the SPF's air seal and moisture seal, repair as needed using the specified spray polyurethane material or the specified foam repair kit material.
- F. If additional SPF layer is required to achieve the minimum thickness on days after the initial foam application, the area must be cleaned of any substance that may hinder proper adhesion of the new layer of foam (dust, dirt, water, etc.) High pressure air, spray water wash or physical brushing may be used as determined by the spray foam contractor to accomplish the cleaning.

3.3 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.
- B. Touch-up, repair or replace damaged products prior to Substantial Completion.

END OF SECTION 07 21 19

SECTION 07 27 13 – MODIFIED BITUMINOUS SHEET AIR BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes self-adhering, vapor-retarding, modified bituminous sheet air barriers.
- B. Related Requirements:
 - 1. Division 04, Section “Unit Masonry” for unit masonry assemblies.
 - 2. Division 07, Section “Foamed-In-Place Insulation” for closed-cell spray polyurethane foam for masonry cavity wall insulation.

1.2 PRE-INSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.

1.3 SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For air-barrier assemblies.
 - 1. Include details for substrate joints and cracks, counter-flashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
- C. Product certificates.
- D. Qualification data.
- E. Product test reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Mockups: Build mockups to set quality standards for materials and execution.
 - 1. Build integrated mockups of exterior wall assembly incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.
 - a. Coordinate construction of mockups to permit inspection by Owner's testing agency of air barrier before external insulation and cladding are installed.
 - b. Include junction with roofing membrane and foundation wall intersection.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Air barrier shall be capable of performing as a continuous vapor-retarding air barrier. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

2.2 SELF-ADHERING SHEET AIR BARRIER

- A. Modified Bituminous Sheet: 40-mil-thick, self-adhering sheet consisting of 36 mils of rubberized asphalt laminated to a 4-mil-thick, cross-laminated polyethylene film with release liner on adhesive side
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Henry Company; Blueskin SA.
 - b. Carlisle Coatings & Waterproofing; CCW-705.
 - c. Grace, W. R. & Co.; Perm-A-Barrier.
 - d. Meadows, W. R., Inc.; SealTight Air-Shield.
 - e. NEI; AC AirSeal.
 - f. Rubber Polymer Corporation; Rub-R-Wall SA.
 - g. Tremco, Incorporated; ExoAir 110.
 - 2. Physical and Performance Properties:
 - a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
 - b. Tensile Strength: Minimum 250 psi; ASTM D 412, Die C.
 - c. Ultimate Elongation: Minimum 200 percent; ASTM D 412, Die C.
 - d. Puncture Resistance: Minimum 40 lbf; ASTM E 154.
 - e. Water Absorption: Maximum 0.15 percent weight gain after 48-hour immersion at 70 deg F; ASTM D 570.
 - f. Vapor Permeance: Maximum 0.05 perm; ASTM E 96/E 96M, Water Method.

2.3 ACCESSORY MATERIALS

- A. General: Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier membrane.
- B. Primer: Liquid primer recommended for substrate by air-barrier material manufacturer.
- C. Termination Mastic: Air-barrier manufacturer's standard cold fluid-applied elastomeric liquid; trowel grade.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- B. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.
- C. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- D. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
- E. 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.

3.2 INSTALLATION

- A. General: Install modified bituminous sheets and accessory materials according to air-barrier manufacturer's written instructions.
 - 1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous air-barrier sheet produced for low-temperature application. Do not install low-temperature sheet if ambient or substrate temperature is higher than 60 deg F.
- B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier sheet on same day. Re-prime areas exposed for more than 24 hours.
- C. Apply and firmly adhere modified bituminous sheets horizontally over area to receive air barrier. 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 airtight installation.
 - 1. Apply sheets in a shingled manner to shed water without interception by any exposed sheet edges.
 - 2. Roll sheets firmly to enhance adhesion to substrate.
- D. Seal top of through-wall flashings to air-barrier sheet.
- E. Seal exposed edges of sheet at seams, cuts, penetrations, and terminations not concealed by metal counter-flashings or ending in reglets with termination mastic.
- F. Install air-barrier sheet and accessory materials to form a seal with adjacent construction and to maintain a continuous air barrier.
- G. Connect and seal exterior wall air-barrier membrane continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- H. Wall Openings: Prime concealed perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transitions and flashing so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames with not less than 1 inch of full contact.
- I. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, doors, and miscellaneous penetrations of air-barrier membrane with foam sealant.
- J. At end of each working day, seal top edge of air-barrier material to substrate with termination mastic.
- K. Repair punctures, voids, and deficient lapped seams in air barrier. Slit and flatten fishmouths and blisters. Patch with air-barrier sheet extending 6 inches beyond repaired areas in all directions.
- L. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.
- M. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

END OF SECTION 07 27 13

SECTION 07 27 26.02 – FLUID-APPLIED MEMBRANE (PERMEABLE) AIR BARRIERS

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. Vapor-permeable, fluid-applied air barriers.
 - 2. Materials and Installation to bridge and seal openings and penetrations of window frames, door frames, and similar leakage paths in the wall.
- B. Related Requirements:
 - 1. Section 06 16 00 "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.

1.3 DEFINITIONS

- A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.
- B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.
- C. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.5 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; dry film thickness; and tested physical and performance properties of products.
- B. Shop Drawings: For air-barrier assemblies.
 - 1. Show locations and extent of air-barrier materials, accessories, and assemblies specific to Project conditions.
 - 2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
 - 3. Include details of interfaces with other materials that form part of air barrier.
- C. Qualification Data: For Installer. Include list of ABAA-certified installers and supervisors employed by Installer, who work on Project.
- D. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.
- E. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
 - 1. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.
- B. Mockups: Build mockups to set quality standards for materials and execution.
 - 1. Build integrated mockups of exterior wall assembly, incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.
 - a. Include junction with roofing membrane, building corner condition, and foundation wall intersection.
 - b. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.
 - 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.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- B. Protect stored materials from direct sunlight.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.
 - 1. Protect substrates from environmental conditions that affect air-barrier performance.
 - 2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous 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, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
- B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested according to ASTM E2357.

2.3 MANUFACTURING

- A. Complete system from one of the following approved manufacturers:
 - 1. Henry Company, Air-Bloc 16MR (Basis of Design).
 - 2. WR Meadows, Air-Shield LM.
 - 3. Prosoco, R-Guard Vapor Barrier.

2.4 AIR BARRIERS, VAPOR PERMEABLE

- A. Vapor-Permeable Air Barrier: Modified bituminous membrane with an installed dry film thickness, according to manufacturer's written instructions, of **35 mils** or thicker over smooth, void-free substrates.
 - 1. Physical and Performance Properties:
 - a. Vapor Permeable Air Barrier Membrane: Air Leakage Rating (ASTM E 2178) less than 0.004 cfm/ft².
 - b. Water Vapor Permeance (ASTM E 96) 12 perms.
 - c. Elongation M: 1,000%.
 - d. UV Resistance: Can be exposed to sunlight for 90 days according to manufacturer's written instructions.

2.5 ACCESSORY MATERIALS

- A. Requirement: Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.
- B. Primer: Liquid primer recommended for substrate by air-barrier material manufacturer
- C. Preformed Silicone 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.
- D. Air Barrier Flashing in liquid or sheet form as required by air barrier manufacturer. Provide air barrier flashing by air barrier manufacturer.

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 Work.

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
 2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
 3. Verify that substrates are visibly dry and free of moisture.
 4. Verify that masonry joints are flush and completely filled with mortar.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. 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 material.
- 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.
- H. Bridge isolation joints, expansion joints, and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement according to manufacturer's written instructions and details.

3.3 ACCESSORIES INSTALLATION

- A. Install accessory materials according to air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.
 1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
 2. Install transition strip on roofing membrane or base flashing so that a minimum of **3 inches** of coverage is achieved over each substrate.
 3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
 4. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
- B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- C. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.
- D. 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.
- E. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that a minimum of **3 inches** of coverage is achieved over each substrate. Maintain **3 inches** of full contact over firm bearing to perimeter frames, with not less than **1 inch** of full contact.
 1. Transition Strip: Roll firmly to enhance adhesion.
- F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.
- G. Seal top of through-wall flashings to air barrier with an additional **6-inch**-wide, transition strip.
- H. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- I. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending **6 inches** beyond repaired areas in strip direction.

3.4 PRIMARY AIR-BARRIER MATERIAL INSTALLATION

- A. Apply air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions and details. Apply air-barrier material within manufacturer's recommended application temperature ranges.
 - 1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
 - 2. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
 - 3. Where multiple prime coats are needed to achieve required bond, allow adequate drying time between coats.
- B. Air Barriers: Apply continuous unbroken air-barrier material to substrates according to the following thickness. Apply air-barrier material 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 coat.
- C. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.5 FIELD QUALITY CONTROL

- A. Inspections: Air-barrier materials, accessories, 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. Air-barrier dry film thickness.
 - 3. Continuous structural support of air-barrier system has been provided.
 - 4. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
 - 5. Site conditions for application temperature and dryness of substrates have been maintained.
 - 6. Maximum exposure time of materials to UV deterioration has not been exceeded.
 - 7. Surfaces have been primed, if applicable.
 - 8. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fish mouths.
 - 9. Termination mastic has been applied on cut edges.
 - 10. Strips and transition strips have been firmly adhered to substrate.
 - 11. Compatible materials have been used.
 - 12. Transitions at changes in direction and structural support at gaps have been provided.
 - 13. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
 - 14. All penetrations have been sealed.
- B. Tests: As determined by testing agency from among the following tests:

3.6 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 recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove, and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials according to air-barrier manufacturer's written instructions.
 - 2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.
- B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended in writing by manufacturer of affected construction.
- C. Remove masking materials after installation.

END OF SECTION 07 27 26.02

SECTION 07 41 13 – MANUFACTURED ROOF PANELS**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
 1. Standing-seam panels (roof applications).
 2. Metal soffit panels.
- B. Related Sections include the following:
 1. Division 05, Section "Steel Decking" for steel roof deck.
 2. Division 06, Section "Miscellaneous Carpentry" for wood framing and sheathing.
 3. Division 07, Section "Roof Accessories" for requirements for curbs, hatches, equipment supports, and pipe portals and snow guards associated with manufactured roof panels provided by this manufacturer as part of the work of this section.
 4. Division 07, Section "Joint Protection" for field-applied sealants.
 5. Division 07, Section "Thermal Insulation" for rigid extruded polystyrene insulation as part of the roof assembly.

1.2 PERFORMANCE REQUIREMENTS

- A. General: Provide manufactured roof panel assemblies complying with performance requirements indicated and capable of withstanding structural movement, thermally induced movement, and exposure to weather without failure or infiltration of water into the building interior.
- B. Air Infiltration: Provide manufactured roof panel assemblies with permanent resistance to air leakage through assembly of not more than 0.09 cfm/sq. ft. of fixed roof area when tested according to ASTM E 1680 at a static-air-pressure difference of 4.0 lbf/sq. ft.
- C. Water Penetration: Provide manufactured roof panel assemblies with no water penetration as defined in the test method when tested according to ASTM E 1646 at a minimum differential pressure of 20 percent of inward acting, wind-load design pressure of not less than 6.24 lb/sq. ft. and not more than 12.0 lb/sq. ft.
- D. [Roofing System Design: Provide a 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 7.
 1. Corner Uplift Pressure: As indicated on Structural Drawings.
 2. Perimeter Uplift Pressure: As indicated on Structural Drawings.
 3. Field-of-Roof Uplift Pressure: As indicated on Structural Drawings.
- E. Structural Performance: Provide manufactured roof panel assemblies capable of safely supporting design loads indicated under in-service conditions with vertical deflection no greater than the following, based on testing manufacturer's standard units according to ASTM E 1592 by a qualified independent testing and inspecting agency.
 1. Maximum Deflection: 1/180 of the span.
- F. Manufacturer shall be recognized as a manufacturer of metal roof panels using the type and design of panels formed in a shop and with fixed equipment by employees of the manufacturer. No portable on-site roll forms may be used.
- G. All shop drawings must be done by the manufacturer and sealed by a professional engineer who is a full-time employee of the manufacturer.

1.3 SUBMITTALS

- A. Product Data: Include manufacturer's product specifications, standard details, certified product test results, and general recommendations, as applicable to materials and finishes for each component and for total panel assemblies.
 1. Provide certified test reports from independent testing agency acceptable to Architect for the following requirements:
 - a. Wind Uplift: UL-580.
 - b. Structural Performance: ASTM E 1592.
 - c. Air infiltration: ASTM E 1680.
 - d. Water infiltration: ASTM E 1646.
 2. Provide sample warranty.
- B. Shop Drawings: Show layouts of panels on roofs, details of edge conditions, joints, panel profiles, supports, anchorages, trim, flashings, underlayment, closures, snow guards, and special details. Distinguish between factory- and field-assembled work.
 1. For installed products indicated to comply with certain design loadings, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

- 2. Indicate details for curbs, hatches, equipment supports, pipe portals and snow guards provided as part of this work.
- C. Samples for Initial Selection: Manufacturer's color charts or chips showing the full range of colors, textures, and patterns available for roof panels with factory-applied finishes.
- D. Mill Certificates: From sheet metal manufacturer, certifying that metal utilized in panel manufacture meets specifications.
- E. Product Test Reports: Indicate compliance of manufactured roof panel assemblies and materials with performance and other requirements based on comprehensive testing of current products.
- F. Warranty Review: Provide a sample warranty that complies with warranty requirements contained herein for review. Along with sample warranty, provide written acceptance of the manufacturer to the project "manufacturer inspections" clauses in the spec.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed metal roof panel projects similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
 - 1. Installer must be certified by the manufacturer under the requirements of the specified warranty.
- B. Manufacturer Qualifications: A firm experienced in manufacturing metal roofing systems similar to those indicated for this Project and with a 10-year record of successful in-service performance.
 - 1. Engineering Responsibility: Preparation of Shop Drawings, testing program development, test result interpretation, and comprehensive engineering analysis by a qualified professional engineer.
 - 2. Manufacturer's Warranty: Warranty requires preapproval by the Architect. Preapproval includes assessment by Architect of manufacturer's ability to provide warranty protection to Owner for specified period.
 - 3. Provide manufactured roof panels and accessories all provided by manufacturer and covered under specified warranty.
- C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where the Project is located and who is experienced in providing engineering services of the kind indicated.
- D. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated without delaying the Work, as documented according to ASTM E 699.
- E. Fire-Test-Response Characteristics: Where fire-resistance-rated roof panel assemblies are indicated, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver panels and other components so they will not be damaged or deformed. Package panels for protection against damage during transportation or handling.
- B. Handling: Exercise care in unloading, storing, and erecting roof panels to prevent bending, warping, twisting, and surface damage.
- C. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weathertight and ventilated covering. Store panels to ensure dryness. Do not store panels in contact with other materials that might cause staining, denting, or other surface damage.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify location of structural members and openings in substrates by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, either establish opening dimensions and proceed with fabricating roof panels without field measurements or allow for trimming panel units. Coordinate roof construction to ensure actual locations of structural members and to ensure opening dimensions correspond to established dimensions.

1.7 WARRANTY

- A. General Warranty: Special warranties specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Finish Warranty: Submit a written warranty, signed by manufacturer, covering failure of the factory-applied exterior finish on metal roof panels within the specified warranty period and agreeing to repair finish or replace roof panels that show evidence of finish deterioration. Deterioration of finish includes, but is not limited to, color fade, chalking, cracking, peeling, and loss of film integrity.

1. Finish Warranty Period: 20 years from date of Substantial Completion.
- C. Special Weathertight Warranty: Submit a written warranty executed by manufacturer agreeing to repair or replace metal roof panel assembly that fails to remain weathertight within the specified warranty period.
 1. Weathertight Warranty Period: 20 years from date of Substantial Completion.
 2. Proration: None.
 3. Limitations of liability: Not less than value of material, NDL.
 4. Include weathertight performance of curbs, hatches, equipment supports, extruded polystyrene insulation, pipe portals and snow guards, provided as part of this work.
 5. Manufacturers Inspection: The manufacturer shall provide inspections at the 25%, 50%, and final completion of the metal roof installation. Inspection report noting deficiencies shall be copied to installer, general contractor, and architect.
 6. Upon completion of the work and prior to final payment, the manufacturer shall conduct final inspection in presence of the general contractor, owner, and architect. Deficiencies in the work shall be recorded and immediately rectified. Final payment will not be certified until manufacturer has given his certification/approval of the work and the required warranty has been reviewed by the architect.
- D. The warranty shall meet the conditions of the project location and design loads without exclusions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Steel Roof Panels: Factory preformed standing seam metal panels, consisting of a 17-inch-wide pan with a vertical leg 1-1/2 inches high, factory formed, mechanically seamed, containing factory applied non-curing sealant. Panels are to be installed with concealed fastener clips to substrate.
- B. Manufacturers: Subject to compliance with requirements design intent of metal roof details for this project, provide one of the following:
 1. AEP-Span.
 2. Fabral.
 3. Dimensional Metals Inc.
 4. MBCI.
 5. McElroy Metals.
 6. Morin, a Kingspan Group Co.
 7. Peterson Aluminum.
 8. Approved Equal.

2.2 METALS

- A. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755 and the following requirements:
 1. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792, Class AZ-55 coating, Grade 40; structural quality.
 2. Thickness: 0.020 inch, unless otherwise indicated or required to meet performance specified herein.

2.3 SOFFIT PANEL ASSEMBLIES

- A. Exterior Soffit Panels: Fabricate panel face sheets to the profile or configuration indicated; and of the material, finish, and thickness indicated. Design joints between panels to form weathertight seals.
 1. Panel Configuration: 12 inch pencil groove x 1 inch, perforated and non-perforated, .032-inch thick aluminum, unless otherwise indicated.

2.4 UNDERLAYMENT MATERIALS

- A. Felts: ASTM D 226, Type II (No. 30), asphalt-saturated organic felts.
- B. Self-Adhering, Polymer-Modified, Bituminous Sheet Underlayment: ASTM D 1970, minimum of 40 mils thick. Provide primer when recommended by underlayment manufacturer.
 1. Provide underlayment over entire substrate.
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. WinterGuard; CertainTeed Corporation.
 - b. Bituthene Ice and Water Shield; Grace: W.R. Grace & Co.
 - c. Polyguard Deck Guard; Polyguard Products, Inc.
 - d. Polyken 640 Underlayment Membrane; Polyken Technologies.
 - e. TW Underlayment; Tamko Building Products.
 - f. Stormguard; GAF Building Materials Corporation.

g. CCW WIP 300 HT; Carlisle Coating & Waterproofing.

2.5 MISCELLANEOUS MATERIALS

- A. General: Provide materials and accessories required for a complete roof panel assembly and as recommended by panel manufacturer, unless otherwise indicated.
- B. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads.
 - 1. Use galvanized (G-90) fasteners for exterior applications.
 - 2. Provide exposed fasteners with heads matching color of panel by means of plastic caps or factory-applied coating where approved shop drawings indicate exposed fasteners.
- C. Accessories: Unless otherwise specified, provide components required for a complete roof panel assembly including trim, copings, fasciae, mullions, sills, corner units, ridge closures, clips, seam covers, battens, flashings, gutters, sealants, gaskets, fillers, closure strips, and similar items. Match materials and finishes of panels.
 - 1. Closure Strips: Closed-cell, self-extinguishing, expanded, cellular, rubber or cross-linked, polyolefin-foam flexible closure strips. Cut or premold to match configuration of panels. Provide closure strips where indicated or necessary to ensure weathertight construction.
 - 2. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.
 - 3. Elastomeric Joint Sealant: ASTM C 920, of base polymer, type, grade, class, and use classifications required to seal joints in panel roofing and remain weathertight. Provide sealant recommended by panel manufacturer, except that no silicone sealant will be accepted.
- D. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat, unless otherwise indicated. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
- E. Expansion-Joint Sealant: For hooked-type expansion joints that must be free to move, provide nonsetting, nonhardening, nonmigrating, heavy-bodied polyisobutylene sealant.
- F. Primer: Rust-inhibitive primer recommended by panel manufacturer for finish coat.
- G. Roof hatches, roof curbs, piping portals and flashings and equipment supports: Refer to Division 07, Section "Roof Accessories."
- H. Splashblocks: Premolded polyethylene units acceptable to manufacturer for use at points of concentrated water delivery on roof from downspouts.
- I. Tape: BT-20 (protected wrap) for rigid isolation joints.
- J. Snow Guards: Seam clamp type, no adhesives or thru-fastened products allowed. Manufacturer's standard.

2.6 FABRICATION

- A. General: Fabricate and finish panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Fabricate panel joints with captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will minimize noise from movements within panel assembly.
- C. Fabricate gutters, downspouts, and other accessories to match profiles indicated on drawings.
 - 1. Gutters: Fabricate from the following material:
 - a. Same material and finish as roof panels.
 - b. Size: 6 x 6 inches, unless otherwise indicated.
 - 2. Downspouts: Fabricate from the following material:
 - a. Same material and finish as roof panels.
 - b. Size: 4 x 5 inches, unless otherwise indicated.
 - c. Coordinate with downspout boot specified in Division 07, Section "Sheet Metal Flashing and Trim."

2.7 FINISH

- A. Fluoropolymer 2-Coat Coating System: 2-coat, thermocured system composed of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight with a total minimum dry film thickness of 1.0 mil and 30 percent reflective gloss when tested according to ASTM D 523.
 - 1. Durability: Provide coating field tested under normal range of weather conditions for a minimum of 20 years without significant peel, blister, flake, chip, crack, or check in finish; without chalking in excess of a chalk rating of 8 according to ASTM D 4214; and without fading in excess of 5 Hunter units.
 - 2. Color: As selected by Architect from manufacturer's full range of colors.

3. Furnish appropriate air-drying spray finish in matching color for touchup.

2.8 PANEL SUPPORTS AND ANCHORAGE

- A. Secondary Framing: Provide components complying with the Light Gage Structural Institute's "Guide Specifications," "Manufactured Roof and Wall Panel Systems."
 1. Base or Sill Angles: Fabricate from 0.079-inch- thick, cold-formed, galvanized steel sections.
 2. Secondary structural members, except columns and beams, shall be manufacturer's standard sections fabricated from 0.079-inch- thick, cold-formed galvanized steel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements indicated for conditions affecting performance of metal panel roofing.
 1. Panel Supports and Anchorage: Examine roof framing to verify that purlins, angles, channels, and other secondary structural panel support members and anchorage have been installed according to written instructions of panel manufacturer.
 2. Do not proceed with roof panel installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordinate metal panel roofing with rain drainage work; flashing; trim; and construction of decks, parapets, walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.
- B. Promptly remove protective film, if any, from exposed surfaces of metal panels. Strip with care to avoid damage to finish.

3.3 PANEL INSTALLATION

- A. General: Comply with panel manufacturer's written instructions and recommendations for installation, as applicable to project conditions and supporting substrates. Anchor panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 1. Field cutting exterior panels by torch is not permitted.
 2. Install panels with concealed fasteners.
 3. Install panels over solid substrate with minimum 3:12 slope.
- B. [Self-Adhering Bituminous Sheet Underlayment: Install over entire substrate prior to installation of metal roofing pressure plates. Overlap as recommended by manufacturer.]
- C. Accessories: Install components required for a complete roof panel assembly including trim, copings, fasciae, ridge closures, clips, seam covers, battens, flashings, gutters, sealants, gaskets, fillers, closure strips, and similar items.
- D. Separate dissimilar metals by painting each metal surface in area of contact with a bituminous coating, by applying rubberized-asphalt underlayment to each metal surface, or by other permanent separation as recommended by manufacturers of dissimilar metals.
- E. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not otherwise indicated, types recommended by panel manufacturer.
 1. Install weather seal under ridge cap. Flash and seal panels at eave and rake with rubber approved waterproofing membrane or other closures to exclude weather.
 2. Seal panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by panel manufacturer.
 3. Prepare joints and apply sealants to comply with requirements of Division 07, Section "Joint Protection", except that no silicone sealants will be accepted.
- F. Standing-Seam Roof Panel Assembly: Fasten panels to supports with concealed clip according to panel manufacturer's written instructions.
 1. Install clips at each support with self-drilling/self-tapping fasteners.
 2. At end laps of panels, install tape calk between panels.
 3. Seaming: Complete seaming of panel joints by operating portable power-driven equipment of type recommended by panel manufacturer to provide a weathertight joint.
 4. To prevent panel slippage down slope, hem panels at eave and fasten at top. No exposed fasteners allowed.
- G. Metal Soffit Panels: Provide metal soffit panels full width of soffits. Install panels perpendicular to support framing.
- H. Installation Tolerances: Shim and align panel units 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.

3.4 CLEANING AND PROTECTING

- A. Damaged Units: Replace panels and other components of the Work that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
- B. Cleaning: Remove temporary protective coverings and strippable films, if any, as soon as each panel is installed. On completion of panel installation, clean finished surfaces as recommended by panel manufacturer and maintain in a clean condition during construction.

END OF SECTION 07 41 13

SECTION 07 42 13 – METAL WALL PANELS**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
 - 1. Metal wall panels.
- B. Related Sections include the following:
 - 1. Division 05, Section "Steel Decking" for steel roof deck.
 - 2. Division 06, Section "Miscellaneous Carpentry" for wood framing and sheathing.
 - 3. Division 07, Section "Sheet Metal Flashing and Trim" for flashing and other sheet metal work that is not part of metal wall panel assemblies.
 - 4. Division 07, Section "Joint Protection" for field-applied sealants.

1.2 PERFORMANCE REQUIREMENTS

- A. General: Provide manufactured wall panel assemblies complying with performance requirements indicated and capable of withstanding structural movement, thermally induced movement, and exposure to weather without failure or infiltration of water into the building interior.
- B. Water Penetration: Provide manufactured roof panel assemblies with no water penetration as defined in the test method when tested according to AAMA 501.1 at a minimum differential pressure of 20 percent of inward acting, wind-load design pressure of not less than 6.24 lb/sq. ft. and not more than 12.0 lb/sq. ft.
- C. Manufacturer shall be recognized as a manufacturer of metal wall panels using the type and design of panels formed in a shop and with fixed equipment by employees of the manufacturer. No portable on-site roll forms may be used.
- D. All shop drawings must be done by the manufacturer and sealed by a professional engineer who is a full-time employee of the manufacturer.

1.3 SUBMITTALS

- A. Product Data: Include manufacturer's product specifications, details, certified product test results, and recommendations, as applicable to materials and finishes for each component and for total panel assemblies.
 - 1. Provide certified test reports from independent testing agency acceptable to Architect for the following requirements:
 - a. Uplift: UL-580.
 - b. Structural Performance: ASTM E 1592.
 - c. Air infiltration: ASTM E 1680.
 - d. Water infiltration: ASTM E 1646.
 - 2. Provide sample warranty.
- B. Shop Drawings: Show layouts of panels on roofs, details of edge conditions, joints, panel profiles, supports, anchorages, trim, flashings, underlayment, closures, snow guards, and special details. Distinguish between factory- and field-assembled work.
 - 1. For installed products indicated to comply with certain design loadings, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 2. Indicate details for curbs, hatches, equipment supports, pipe portals and snow guards provided as part of this work.
- C. Samples for Initial Selection: Manufacturer's color charts or chips showing the full range of colors, textures, and patterns available for roof panels with factory-applied finishes.
- D. Mill Certificates: From sheet metal manufacturer, certifying that metal utilized in panel manufacture meets specifications.
- E. Product Test Reports: Indicate compliance of manufactured roof panel assemblies and materials with performance and other requirements based on comprehensive testing of current products.
- F. [Warranty Review: Provide a sample warranty that complies with warranty requirements contained herein for review.]

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed metal wall panel projects similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
 - 1. Installer must be certified by the manufacturer under the requirements of the specified warranty.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver panels and other components so they will not be damaged or deformed. Package panels for protection against damage during transportation or handling.
- B. Handling: Exercise care in unloading, storing, and erecting panels to prevent bending, warping, twisting, and surface damage.
- C. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weathertight and ventilated covering. Store panels to ensure dryness. Do not store panels in contact with other materials that might cause staining, denting, or other surface damage.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify location of structural members and openings in substrates by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.7 WARRANTY

- A. General Warranty: Special warranties specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Finish Warranty: Submit a written warranty, signed by manufacturer, covering failure of the factory-applied exterior finish on metal wall panels within the specified warranty period and agreeing to repair finish or replace wall panels that show evidence of finish deterioration. Deterioration of finish includes, but is not limited to, color fade, chalking, cracking, peeling, and loss of film integrity.
 - 1. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Steel Wall Panels: Factory preformed concealed fastener metal wall panels, consisting of a 12-inch wide pan with a leg 1 inch high, factory formed, containing factory applied non-curing sealant. Panels are to be installed with concealed fastener clips to substrate.
- B. Manufacturers: Subject to compliance with requirements design intent of metal wall details for this project, provide one of the following:
 - 1. MBCI, "FW-120-2" Basis of Design.
 - 2. Fabral.
 - 3. Centria Architectural Systems.
 - 4. McElroy Metals.
 - 5. Morin, a Kingspan Group Co.
 - 6. Peterson Aluminum.
 - 7. AEP-Span.

2.2 METALS

- A. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755 and the following requirements:
 - 1. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792, Class AZ-55 coating, Grade 40; structural quality.
 - 2. Thickness: 24 ga., unless otherwise indicated or required to meet performance specified herein.

2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and accessories required for a complete roof panel assembly and as recommended by panel manufacturer, unless otherwise indicated.
- B. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads.
 - 1. Use galvanized (G-90) fasteners for exterior applications.
 - 2. Provide exposed fasteners with heads matching color of panel by means of plastic caps or factory-applied coating where approved shop drawings indicate exposed fasteners.
- C. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat, unless otherwise indicated. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

- D. Expansion-Joint Sealant: For hooked-type expansion joints that must be free to move, provide nonsetting, nonhardening, nonmigrating, heavy-bodied polyisobutylene sealant.
- E. Primer: Rust-inhibitive primer recommended by panel manufacturer for finish coat.

2.4 FABRICATION

- A. General: Fabricate and finish panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Fabricate panel joints that provide a tight seal and prevent metal-to-metal contact, in a manner that will minimize noise from movements within panel assembly.

2.5 FINISH

- A. Fluoropolymer 2-Coat Coating System: 2-coat, thermo-cured system composed of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight with a total minimum dry film thickness of 1.5 mil and 30 percent reflective gloss when tested according to ASTM D 523.
 - 1. Durability: Provide coating field tested under normal range of weather conditions for a minimum of 20 years without significant peel, blister, flake, chip, crack, or check in finish; without chalking in excess of a chalk rating of 8 according to ASTM D 4214; and without fading in excess of 5 Hunter units.
 - 2. Color: As selected by Architect from manufacturer's full range of colors, both standard & premium colors.
 - 3. Furnish appropriate air-drying spray finish in matching color for touchup.

2.6 PANEL SUPPORTS AND ANCHORAGE

- A. Secondary Framing: Provide components complying with the Light Gage Structural Institute's "Guide Specifications," "Manufactured Roof and Wall Panel Systems."
 - 1. Base or Sill Angles: Fabricate from 0.079-inch- thick, cold-formed, galvanized steel sections.
 - 2. Secondary structural members, except columns and beams, shall be manufacturer's standard sections fabricated from 0.079-inch- thick, cold-formed galvanized steel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements indicated for conditions affecting performance of metal panel roofing.
 - 1. Panel Supports and Anchorage: Examine framing to verify that purlins, angles, channels, and other secondary structural panel support members and anchorage have been installed according to written instructions of panel manufacturer.
 - 2. Do not proceed with wall panel installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordinate metal panel with rain drainage work; flashing; trim; and construction of decks, parapets, walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.
- B. Promptly remove protective film, if any, from exposed surfaces of metal panels. Strip with care to avoid damage to finish.

3.3 PANEL INSTALLATION

- A. General: Comply with panel manufacturer's written instructions and recommendations for installation, as applicable to project conditions and supporting substrates. Anchor panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Field cutting exterior panels by torch is not permitted.
 - 2. Install panels with concealed fasteners.
- B. Separate dissimilar metals by painting each metal surface in area of contact with a bituminous coating, by applying rubberized-asphalt underlayment to each metal surface, or by other permanent separation as recommended by manufacturers of dissimilar metals.
- C. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not otherwise indicated, types recommended by panel manufacturer.

3.4 CLEANING AND PROTECTING

- A. Damaged Units: Replace panels and other components of the Work that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
- B. Cleaning: Remove temporary protective coverings and strippable films, if any, as soon as each panel is installed. On completion of panel installation, clean finished surfaces as recommended by panel manufacturer and maintain in a clean condition during construction.

END OF SECTION 07 42 13.

SECTION 07 42 43 – COMPOSITE WALL PANELS**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes metal-faced composite wall panels.
- B. Related Sections:
 - 1. Division 05 Section "Cold-Formed Metal Framing" for cold-formed metal framing supporting metal-faced composite wall panels.

1.2 DEFINITION

- A. Metal-Faced Composite Wall Panel Assembly: Metal-faced composite wall panels, attachment system components, miscellaneous metal framing, and accessories necessary for a complete weathertight wall system.

1.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Metal-faced composite wall panel assemblies shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/sq. ft. of wall area when tested according to ASTM E 283 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 1.57 lbf/sq. ft.
- C. Rainscreen Performance: Panel system shall be pressure-equalized rainscreen tested and complaint per AAMA 508.07 and tested to AAMA 509-09 requirements with a water rating of 1.
- D. Structural Performance: Provide metal-faced composite wall panel assemblies capable of withstanding the effects of the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 330:
 - 1. Wind Loads: Determine loads based on the following minimum design wind pressures:
 - a. Uniform pressure of 20 lbf/sq. ft., acting inward or outward.
 - b. Uniform pressure as indicated on Drawings.
 - 2. Deflection Limits: Metal-faced composite wall panel assemblies shall withstand wind loads with horizontal deflections no greater than 1/175 of the span at the perimeter and 1/60 of the span anywhere in the panel.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

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 each type of metal-faced composite wall panel and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of metal-faced composite wall panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Distinguish among factory-, shop-, and field-assembled work.
 - 1. Accessories: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:
 - a. Flashing and trim.
 - b. Anchorage systems.
- C. Samples for Initial Selection: For each type of metal-faced composite wall panel indicated with factory-applied color finishes.
 - 1. Include similar Samples of trim and accessories involving color selection.
 - 2. Include manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each sealant exposed to view.
- D. 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.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

- F. Field quality-control reports.
- G. Maintenance Data: For metal wall panels to include in maintenance manuals.
- H. Warranties: Samples of special warranties.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Qualifications:
 - 1. Installer Qualifications: Installer experienced in performing work of this section who has specialized in the installation of work similar to that required for this project.
 - a. Certificate: When requested, submit certificate indicating qualification.
 - 2. Fabricator Qualifications: Company with at least 3 years of experience on similar sized metal panel projects and qualified by the panel material manufacturer. Capable of providing field service representation during construction.
- C. Fabrication Location: Panels shall be factory assembled at fabricator's shop. Panels shall not be assembled on site.
- D. Source Limitations: Obtain each type of metal-faced composite wall panel from single source from single manufacturer.
- E. Fire-Resistance Ratings: Where indicated, provide metal-faced composite wall panels 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.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
- F. Preinstallation Conference: Conduct conference at Project site.
 - 1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, metal-faced composite wall panel Installer, metal-faced composite wall panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal-faced composite wall panels including installers of doors, windows, and louvers.
 - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 3. Review methods and procedures related to metal-faced composite wall panel installation, including manufacturer's written instructions.
 - 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
 - 5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal-faced composite wall panels.
 - 6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
 - 7. Review temporary protection requirements for metal-faced composite wall panel assembly during and after installation.
 - 8. Review wall panel observation and repair procedures after metal-faced composite wall panel installation.
- G. Mock-up Sample Wall: Provide complete sample installation of all products, types, and conditions with the construction of a Mock-up wall assembly. Owner and Architect shall inspect and approve the mock-up wall prior to installation on building.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, metal-faced composite wall panels, and other manufactured items so as not to be damaged or deformed. Package metal-faced composite wall panels for protection during transportation and handling.
- B. Unload, store, and erect metal-faced composite wall panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Store metal-faced composite wall panels vertically, covered with suitable weathertight and ventilated covering. Store metal-faced composite wall panels to ensure dryness, with positive slope for drainage of water. Do not store metal-faced composite wall panels in contact with other materials that might cause staining, denting, or other surface damage. Do not allow storage space to exceed 120 deg F.
- D. Retain strippable protective covering on metal-faced composite wall panel for period of panel installation.

1.7 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal-faced composite wall panels to be performed according to manufacturer's written instructions and warranty requirements.
- B. Field Measurements: Verify locations of structural members and wall opening dimensions by field measurements before metal-faced composite wall panel fabrication and indicate measurements on Shop Drawings.

1.8 COORDINATION

- A. Coordinate metal-faced composite wall panel assemblies with rain drainage work, flashing, trim, and construction of studs, soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal-faced composite wall panel assemblies that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal-faced composite wall panels that show 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 PANEL MATERIALS

- A. Aluminum Sheet: Coil-coated sheet, ASTM B 209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - 1. Surface: Smooth, flat finish.
 - 2. Exposed Coil-Coated Finishes:
 - a. Three-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 3. 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.

2.2 MISCELLANEOUS METAL FRAMING (Materials below do not replace rain screen framing specified in Section 07.)

- A. Miscellaneous Metal Framing, General: ASTM C 645, cold-formed metallic-coated steel sheet, ASTM A 653/A 653M, G60 hot-dip galvanized or coating with equivalent corrosion resistance unless otherwise indicated.
- B. Subgirts: Manufacturer's standard C- or Z-shaped sections 0.064-inch nominal thickness.
- C. Zee Clips: 0.079-inch nominal thickness.
- D. Base or Sill Channels: 0.079-inch nominal thickness.
- E. Hat-Shaped, Rigid Furring Channels:
 - 1. Nominal Thickness: As required to meet performance requirements.
 - 2. Depth: 1-1/2 inches.
- F. Cold-Rolled Furring Channels: Minimum 1/2-inch-wide flange.
 - 1. Nominal Thickness: As required to meet performance requirements.
 - 2. Depth: As indicated.
 - 3. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with nominal thickness of 0.040 inch.
 - 4. 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.
- G. Fasteners for Miscellaneous Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten miscellaneous metal framing members to substrates.

2.3 MISCELLANEOUS MATERIALS

- A. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by manufacturer for type of use and finish indicated.
- B. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal-faced composite wall panels by means of plastic caps or factory-applied coating. Provide EPDM, PVC, or neoprene sealing washers.

2.4 METAL-FACED COMPOSITE WALL PANELS

- A. General: Provide factory-formed and -assembled, metal-faced composite wall panels fabricated from two metal facings bonded, using no glues or adhesives, to solid, extruded thermoplastic core; formed into profile for installation method indicated. Include attachment system components and accessories required for weathertight system.
 - 1. Fire-Retardant Core: Noncombustible, with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. 3A Composites; Color 1 (refer to drawings) Alucobond Plus, "Silver Mystic" Basis of Design.
 - b. Alcoa Inc.; Reynobond FR.
 - c. ALPOLIC, Division of Mitsubishi Chemical America, Inc.; ALPOLIC/fr.
 - d. Fairview Architectural NA, VirtaBond Fr.
 - 3. Fabricators:
 - a. 3A Composites; Alucobond Plus. (Basis of Design)
 - b. Centria Architectural Systems: Formabond II.
 - c. Firestone Building Products; Series 1200.
 - d. Altech Panel Systems; Accur-Trac DS.
 - e. Kistler McDougall Corp.
 - f. SPS Corp.; RS-100.
 - g. Fairview Architectural NA.
- B. Aluminum-Faced Composite Wall Panels: Formed with 0.020-inch-thick, coil-coated aluminum sheet facings that meet or exceed values of AAMA 2605 where relevant to coil coatings.
 - 1. Panel Thickness: 0.157 inch.
 - 2. Core: Fire retardant.
 - 3. Exterior Finish: 3-coat fluoropolymer.
 - a. Color: As selected by Architect from manufacturer's full range.
 - 4. Joint Type: Wet Seal.
- C. Attachment System Components: Formed from material compatible with panel facing.
 - 1. Include manufacturer's standard perimeter extrusions with integral weather stripping, panel stiffeners, panel clips, and anchor channels.

2.5 ACCESSORIES

- A. Wall Panel Accessories: Provide components required for a complete metal-faced composite wall panel assembly including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal-faced composite wall panels unless otherwise indicated.
- B. Flashing and Trim: Formed from 0.018-inch-minimum thickness, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal-faced composite wall panels.

2.6 FABRICATION

- A. General: Fabricate and finish metal-faced composite wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Fabricate metal-faced composite wall panels in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.

- C. Metal-Faced Composite Wall Panels: Factory form panels in a continuous process with no glues or adhesives between dissimilar materials. Trim and square edges of sheets with no displacement of face sheets or protrusion of core material.
 - 1. Form panel lines, breaks, and angles to be sharp and true, with surfaces free from warp and buckle.
 - 2. Fabricate panels with sharply cut edges, with no displacement of face sheets or protrusion of core material.
 - 3. Fabricate panels with panel stiffeners, as required to comply with deflection limits, attached to back of panels with structural silicone sealant or bond tape.
 - 4. Dimensional Tolerances:
 - a. Panel Bow: 0.8 percent maximum of panel length or width.
 - b. Squareness: 0.25 inch maximum.
- D. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 - 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 - 4. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
 - 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 - 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal-faced composite wall panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal-faced composite wall panel manufacturer for application, but not less than thickness of metal being secured.

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 abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal-faced composite wall panel supports, and other conditions affecting performance of the Work.
 - 1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal-faced composite wall panel manufacturer.
 - 2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal-faced composite wall panel manufacturer.
 - 3. Verify that weather-resistant barrier has been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal-faced composite wall panels to verify actual locations of penetrations relative to seam locations of panels before panel installation.
- C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Framing: Install subgirts, base angles, sills, furring, and other miscellaneous wall panel support members and anchorage according to ASTM C 754 and metal-faced composite wall panel manufacturer's written instructions.

3.3 METAL-FACED COMPOSITE WALL PANEL INSTALLATION

- A. General: Install metal-faced composite wall panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts and subgirts unless otherwise indicated. Anchor panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. Commence metal-faced composite wall panel installation and install minimum of 300 sq. ft. in presence of factory-authorized representative.
 2. Shim or otherwise plumb substrates receiving metal-faced composite wall panels.
 3. Flash and seal metal-faced composite wall panels at perimeter of all openings. Do not begin installation until weather barrier and flashings that will be concealed by panels are installed.
 4. Install flashing and trim as metal-faced composite wall panel work proceeds.
 5. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated or, if not indicated, as necessary for waterproofing.
 6. Provide weathertight escutcheons for pipe and conduit penetrating exterior walls.
- B. Fasteners:
1. Aluminum Wall Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior and aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action as recommended by metal-faced composite wall panel manufacturer.
- D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weathertight performance of metal-faced composite wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by panel manufacturer.
1. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."
- E. Attachment System Installation, General: Install attachment system required to support metal-faced composite wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.
1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.
 2. Do not begin installation until weather barrier and flashings that will be concealed by composite panels are installed.
- F. Clip Installation: Attach panel clips to supports at each metal-faced composite wall panel joint at locations, spacings, and with fasteners recommended by manufacturer. Attach routed-and-turned flanges of wall panels to panel clips with manufacturer's standard fasteners.
1. Seal horizontal and vertical joints between adjacent panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Division 07 Section "Joint Sealants."
- G. Rainscreen-Principle Installation: Provide manufacturer's standard pressure-equalized, rainscreen-principle system with vertical channel that provides support and complete secondary drainage system, draining at base of wall. Notch vertical channel to receive support pins. Install vertical channels supported by channel brackets or adjuster angles and at locations, spacings, and with fasteners recommended by manufacturer. Attach wall panels by engaging horizontal support pins into notches in vertical channels and into flanges of wall panels. Leave horizontal and vertical joints with open reveal.
1. Install wall panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.
 2. Do not apply sealants to joints unless otherwise indicated on Drawings.

3.4 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal-faced composite wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.

2. 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 weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.5 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal-faced composite wall panel units within installed tolerance of 1/4 inch in 20 feet, non-accumulative, on level, plumb, and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Water Penetration: Test areas of installed system indicated on Drawings for compliance with system performance requirements according to ASTM E 1105 at minimum differential pressure of 20 percent of inward-acting, wind-load design pressure as defined by SEI/ASCE 7, but not less than 6.24 lbf/sq. ft.
- C. Water-Spray Test: After completing the installation of 75-foot-by-2-story minimum area of metal-faced composite wall panel assembly, test assembly for water penetration according to AAMA 501.2 in a 2-bay area directed by Architect.
- D. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust completed metal-faced composite wall panel installation, including accessories.
- E. Metal-faced composite wall panels will be considered defective if they do not pass tests and inspections.
- F. Additional tests and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- G. Prepare test and inspection reports.

3.7 CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as metal-faced composite wall panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal-faced composite wall panel installation, clean finished surfaces as recommended by panel manufacturer. Maintain in a clean condition during construction.
- B. After metal-faced composite wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal-faced composite wall panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 42 43

SECTION 07 42 60 – RAIN SCREEN ATTACHMENT SYSTEM**PART 1 - GENERAL****1.1 SUMMARY**

- A. This section includes the following:
 - 1. Exterior wall panel support system used with continuous insulation.
- B. Related Sections include the following:
 - 1. Division 4, Section "Unit Masonry".
 - 2. Division 5, Section "Cold Formed Metal Framing".
 - 3. Division 7, Section "Thermal Insulation" for insulation as part of rainscreen assembly.
 - 4. Division 7, Section "Metal Wall Panels".
 - 5. Division 7, Section "Joint Protection" for Spray Polyurethane Foam Insulation.

1.2 REFERENCE STANDARDS

1. AAMA - American Architectural Manufacturers Association (www.aamanet.org)
 - a. AAMA 501.1 – Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure; 2005
2. ASCE American Society of Civil Engineers (www.asce.org)
 - a. ASCE 7 – Minimum Design Loads for Buildings and Other Structures; 2010
3. ASTM International (American Society for Testing and Materials; www.astm.org)
 - a. ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2011
 - b. ASTM C203 - Standard Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation; 2012
 - c. ASTM C209 - Standard Test Methods for Cellulosic Fiber Insulating Board; 2012
 - d. ASTM C272 - Standard Test Method for Water Absorption of Core Materials for Sandwich Constructions; 2012
 - e. ASTM C356 – Standard Test Method for Linear Shrinkage of Preformed High-Temperature Thermal Insulation Subjected to Soaking Heat; 2010
 - f. ASTM C518 – Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2010
 - g. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2012
 - h. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2010
 - i. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2009
 - j. ASTM C1104 - Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation; 2013
 - k. ASTM C1177 – Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2008
 - l. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2013
 - m. ASTM C1363 - Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus; 2011
 - n. ASTM C1396 – Standard Specification for Gypsum Board; 2013
 - o. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2010
 - p. ASTM D570 – Standard Test Method for Water Absorption of Plastics; 2010
 - q. ASTM D635 – Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2010
 - r. ASTM D696 - Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between –30°C and 30°C with a Vitreous Silica Dilatometer; 2008
 - s. ASTM D792 – Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement; 2008
 - t. ASTM D1621 - Standard Test Method for Compressive Properties of Rigid Cellular Plastics; 2010
 - u. ASTM D1622 - Standard Test Method for Apparent Density of Rigid Cellular Plastics; 2008
 - v. ASTM D1623 - Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics; 2009
 - w. ASTM D2126 - Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging; 2009
 - x. ASTM D2583 - Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor; 2013
 - y. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2012

- z. ASTM D4385 - Standard Practice for Classifying Visual Defects in Thermosetting Reinforced Plastic Pultruded Products; 2010
- aa. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials; 2013
- bb. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials; 2012
- cc. ASTM E 283 - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004.
- dd. ASTM E 330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2010
- ee. ASTM E 331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2009
- 4. NFPA – National Fire Protection Association (www.nfpa.org)
 - a. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components; 2012
- 5. UL – United Laboratories (www.ul.com)
 - a. UL 94 - Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; 2013
 - b. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; 2008

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, installation instructions and Material Safety Data Sheets (MSDS) for each component product required for complete wall system. Submit manufacturer's product literature and descriptions of testing performed on system components to indicate that they will meet or exceed performance specified herein.
- B. Shop Drawings: Submit fabrication and installation layouts of continuous insulation wall panel support system and exterior cladding system; including details of edge conditions, joints, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
 - 1. Provide distinction between factory-assembled, shop-assembled, and field-assembled work.
 - 2. Provide details of following items at full scale.
 - a. Manufacturer's standard sheet metal trims.
 - b. Components of wall panel construction, anchorage methods, and hardware.
 - 3. Include professional engineer's stamp or seal on shop drawings for attachments and anchors.
- C. Coordination Drawings: Submit to-scale exterior elevations that have the following items shown and coordinated with each other, using input from installers of these items as follows:
 - 1. Exterior wall panel system and attachments.
 - 2. Continuous insulation wall panel support system.
 - 3. Insulation layout.
 - 4. Wall-mounted items including doors, windows, louvers, and lighting fixtures.
 - 5. Wall penetrations, such as from pipes, electrical fixtures, and other utilities.
- D. Test and Inspection Reports: Submit test and inspection reports on each type of exterior wall panel system provided for project based on evaluation of comprehensive tests performed by qualified testing agency.
- E. Thermal Modeling: Comprehensive three-dimensional thermal modeling report indicating framing systems impact on exterior insulation rated R-value.
- F. Structural Calculations:
 - 1. Submit façade attachment/support framing system manufacturer's comprehensive analysis of design loads, including dead loads, live loads, wind loads and thermal movement, signed and sealed by a licensed engineer in North Carolina.
- G. Samples: Submit following materials samples for verification:
 - 1. Girts: Two 12-inch long samples of each type and component.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Minimum five (5) years of experience specializing in the manufacturing of façade attachment/support framing similar to those specified.
 - 2. Must demonstrate conformance to testing requirements.
 - 3. Design provided by a professional engineer experienced in the design of curtain wall systems, anchors, fasteners and licensed in the State of North Carolina.
- B. Installer Qualifications:
 - 1. Installer is factory trained and approved by wall panel support system manufacturer.
 - 2. Installer is in good standing with manufacturer as qualified installer for work of this Section.
 - 3. Installer has an onsite superintendent or foreman overseeing installation on site during work of this Section.
 - 4. Installer is able to document a minimum 5 completed projects of equivalent scope and quality.

- C. Engineer's Qualifications: Design structural supports and anchorages under direct supervision of a Structural Engineer experienced in design for this type of Work and licensed in the State of North Carolina.

1.5 COORDINATION

- A. Coordination: Coordinate panel assemblies with rain drainage, flashing, trim, stud back-up, soffits, and other adjoining work.

1.6 PRE-INSTALLATION MEETING

- A. Participants: Authorized representatives of the General Contractor, installation subcontractor, Owner, Architect, Structural Engineer, continuous insulation wall panel support system manufacturer's representative, installer's whose work interfaces with or affects wall panels including installers of doors, windows, and louvers, and Manufacturer's technical representative.
- B. Meeting Timing: Minimum 4 weeks prior to commencement of work under this Section and related work that may affect work of this Section.
- C. Review and document methods, procedures and manufacturer's installation guidelines and safety procedures for insulated sheathing, flashings, support framing / attachment system, finish panels, and penetration and gap sealant.
- D. Review construction schedule and confirm availability of products, applicator/installer personnel, equipment and facilities.
- E. Review means and methods related to installation, including manufacturer's written instructions.
- F. Examine support conditions for compliance with requirements, including alignment and attachment to structural members.
- G. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affects this Work.
- H. Review temporary protection requirements for during and after installation of this Work.
- I. Review governing regulatory requirements and requirements for insurance and certificates.
- J. Review field quality control procedures.

1.7 MOCK-UPS

- A. Mockups: Provide mockups to verify selections, to demonstrate aesthetic effects, and to establish quality standards for fabrication and installation.
 - 1. Build mockup of typical continuous insulation wall panel assembly as shown on Drawings including corner, soffits, supports, attachments, and accessories.
 - 2. Include at least four exterior wall panels to represent a four-way panel joint and showing full thickness.
 - 3. Approval of mockups does not constitute approval of deviation from Contract Documents within mockups unless these deviations are approved by Architect in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of completed Work if undisturbed upon date of Substantial Completion.
 - 5. Do not begin work of this Section until façade mock-up has been inspected and approved by manufacturer's representative on site and Architect's acceptance of mock-up is given in writing.
 - 6. Protect and maintain accepted mock-up as standard of quality for work of this Section.

1.8 QUALITY CONTROL

- A. Single source responsibility:
 - 1. Furnish all engineered façade attachment/support framing system components under direct responsibility of single manufacturer to avoid performance issues. Provide only products from manufacturers that have been tested to meet required testing specified.
- B. Field Measurements: Contractor is responsible for all field measurements, verifying actual supporting and adjoining construction before fabrication; record field measurements on project record shop drawings.
 - 1. Verify locations of structural members and wall opening dimensions by field measurements before wall panel support system fabrication and indicate measurements on Shop Drawings.
 - 2. Coordinate with construction schedule.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Ordering: Comply with manufacturers' ordering instructions and lead time requirements to avoid construction delays.
- B. Delivery: Deliver materials and components in manufacturers' original, unopened and undamaged containers or bundles, fully identified. Exercise care to avoid damage during unloading, storing and installation.
- C. Store, protect and handle materials and components in accordance with manufacturer recommendations to prevent damage, contamination, and deterioration. Keep materials clean, dry, and free of dirt and other foreign matter, and protect from damage due to weather or construction activities.

- D. Handle components in strict compliance with manufacturer's written instructions and recommendations, and in a manner to prevent bending, warping, twisting, and surface damage.

1.10 PROJECT CONDITIONS

- A. Environmental Requirements: Undertake installation work only when weather conditions are in compliance with manufacturers' specific environmental requirements and when conditions will permit work to be performed in accordance with manufacturer recommendations and warranty requirements.

1.11 SEQUENCING

- A. Coordinate construction to ensure that assemblies fit properly to supporting and adjoining construction; coordinate schedule with construction in progress to avoid delaying work.

1.12 WARRANTY

- A. Manufacturer Warranties:
 1. Attachment/Support Framing System: Limited warranty
 - a. Length: Written ten (10) years.
 - b. Covers components of the attachment system, including structural failure of components when all the materials and component are supplied and installed per manufactures requirements.
 - c. Includes labor and material for removal and replacement of defective material.
 - d. Includes labor to remove and reinstall façade finish panels, finish closures and façade finish accessories necessary to access defective material.
- B. Contractor's Warranties: 2-year labor warranty, starting from date of Substantial Completion, to cover repair of materials found to be defective as a result of installation errors.
- C. Limitation of Warranties: Exclude repairs, replacement, and corrective work to the substrate, primary structure, finish panels, and/or property – unless otherwise noted above. Warranties exclude mechanical damage due to abuse, neglect, primary structure failure, or forces of nature greater than normal weather conditions.

1.13 MAINTENANCE

- A. Extra Materials: For use by Owner in building maintenance and repair, provide 3 percent additional material in new, unopened cartons, packaged with protective covering for storage and identified with appropriate labels.
 1. Custom attachment system components.

PART 2 - PRODUCTS

2.1 PERFORMANCE CRITERIA

- A. Constructed system complies with the North Carolina Energy Code in compliance at the time the project is permitted.
- B. Structural: Provide system tested in accordance with ASTM E330 and certified to be without permanent deformation or failure of structural members in accordance with design wind velocities for project geographic location and probability of occurrence based on data from wind velocity maps such as provided in ASCE 7 and as approved by authorities having jurisdiction.
 1. Structural Design: Exterior-insulated rain screen wall assemblies capable of withstanding effects of load and stresses from dead loads, wind loads, snow loads and normal thermal movement without evidence of permanent defects of assemblies or components.
 2. As indicated in the structural drawings.
- C. Air Infiltration Test: Maximum of 0.06 cfm/sq ft of wall area in accordance with ASTM E283 or ASTM 2357 at an air pressure differential of 6.27 lbf/sq ft across assembly.
- D. Water Penetration Test:
 1. Static: No uncontrolled water penetration at a static pressure of 2.86 lbf/sq ft in accordance with ASTM E331.
- E. Hygrothermal: Provide system designed in accordance with ASHRAE 160, to pass requisite 30 day, 7 day and 24 hour wall moisture content requirements. Testing and validation shall be done through WUFI or other approved transient hygrothermal/moisture modeling systems.
- F. System Thermal Design: Installed continuous insulation system including insulation, composite framing support, sub-girts, clips and cladding attachment shall not have thermal bridging of fasteners or framing that creates a continuous metal path from the exterior surface of the insulation to the stud framing inside the wall cavity or interior face of wall. System thermal design shall meet/exceed the thermal and design requirements as stated in with the North Carolina Energy Code in compliance at the time the project is permitted.
 1. Thermal Resistance: As stated in the design documents.
 2. Thermal Performance Test: Provide thermal resistance (R-value) indicated, in compliance with ASTM C1363, corrected to 15 mph outside and still air inside, with as-installed condition including fastening and joints.

- a. Provide efficiency of no less than <86-95>percent, with a maximum temperature differential of 18 degrees F from the interior wall surface to interior wall cavity and node locations with a 70 degree exterior to interior wall temperature delta.
 - b. Provide test unit with at least one insulation panel horizontal and vertical joint the length and height of the test chamber area.
 - c. Or Provide finite element analysis of three dimensional simulation of the described wall assembly stamped by professional engineer in compliance with the performance requirements and exceeding it by 3%.
- G. Temperature: Comply with structural loading requirements within temperature range of minus 55 degrees F to 180 degrees F.
- H. Fire-Test-Response Characteristics: Provide wall panel support system with the following fire-test-response characteristics determined by the indicated test standard as applied by UL or other testing and inspection agency acceptable to authorities having jurisdiction.
- 1. System complies with NFPA 285: Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components Using the Intermediate Scale, Multistory Test Apparatus.
 - 2. Include fire-stopping measures at floor line in stud cavity, per code, when wall assembly extends beyond edge of floor line.
- I. Wind cycling (air pressure cycling) performance: Attachment system must show conformance to the following results when tested in accordance with ASTM E1886.
- 1. A total of 4,500 air pressure cycles. Cycles must include 50 cycles at a maximum pressure of 90 pounds both positive and negative. Average cycle time must not be less than 3.25 seconds for both negative and positive cycles. No damage or deformation must be seen at end of test.

2.2 RAINSCREEN FRAMING SUPPORT SYSTEM

- A. Contractor to select from the following rainscreen material systems:
- 1. Cold Formed Metal Box Girt Material: ASTM A792, Commercial Steel (CS), Grade B, 50 ksi Yield, Minimum AZ55.
 - 2. -or-
 - 3. Composite Framing Support (CFS): CFS shall consist of polyester and vinyl ester bioresin matrix with recycled materials, ultra-violet inhibitor, fire retardant additives, and integral continuous metal inserts the length of profile. CFS shall be reinforced with glass strand rovings used internally for longitudinal (lengthwise) strength and continuous strand glass mats or stitched reinforcements used internally for transverse (crosswise) strength.
- B. Cold Formed Metal Box Girt System Option:
- 1. Vertical Box Girt: Minimum 0.0475-inch thick (18 gauge) cold-formed steel.
 - 2. Depth: 0.75 inches
 - 3. Attachment: Regularly spaced, pre-punched, centrally located holes to receive wall fasteners with thermally isolated washer assembly for attachment to substructure.
 - 4. Cold Formed Metal Box Rainscreen Manufacturers:
 - a. Knight Wall Systems
 - b. Or approved equal.
 - 5. Accessories:
 - a. Fasteners: Stainless steel as instructed by manufacturer.
 - 1) Thermoset Polyester coating that exhibits 1,000 hours of salt spray resistance.
 - 2) Horizontal rail to vertical girt connection: Self-drill hex-head screw fasteners spaced and specified in engineering calculations.
 - 3) Steel Studs: Self-drill hex-head screw fasteners of sufficient length to provide solid attachment through rigid insulation to substructure as indicated in engineering calculations.
 - 4) Concrete and Masonry Wall Anchors: Mechanical and adhesive anchors, bolts, nuts and washers suited to use.
 - a) Mechanical Anchors – Conforming to North Carolina State Building Code.
 - b) Adhesive Anchors – Conforming to North Carolina State Building Code.
 - b. Thermal Isolating Washers: Minimum 0.125 inch thick Polyoxymethylene copolymer (POM) washers with integral centering lip to act as a thermal break between wall anchor fastener and box girt.
 - 1) Basis of Design: ThermaStop Isolator by Knight Wall Systems
 - 2) Or approved equal.
 - 6. Galvanic Protection: Separate and prevent contact between dissimilar metals
- C. CFS System Option: Basis of Design as detailed in drawings
- 1. Height: Simple Z-GreenGirt or Strongit; depth sized to specified CI rigid insulation
 - 2. On Center Spacing: Coordinate with Stud spacing and engineering shop drawings.
 - 3. CFS Orientation: Vertical.
 - a. Provide continuous non-corrosive steel insert for engagement of fasteners, 16 gage with G90 coating designation in compliance with ASTM A653.

- 1) Steel insert shall fully engage with adjacent CFS at ends.
- 2) Sub-girts and other exterior wall panel support accessories shall be anchored to steel insert set into and part of the CFS.
4. Provide integral compression seal in CFS sections to ensure insulation panel will not dislodge and to stop air movement throughout system.
5. CFS section to have integral anti-siphon grooves on exterior flanges.
6. CFS section to have force distribution zones integrally designed into profile.
7. CFS to have spline seals for adjacent insulation units.
8. Surface Burning Characteristics:
 - a. Flame Spread: 25 or less, when tested in accordance with ASTM E84.
 - b. Smoke Development: 450 or less, when tested in accordance with ASTM E84.
9. Flammability: UL 94.
10. Self-Extinguishing: ASTM D635.
11. Profile Visual Requirements: ASTM D4385.
12. Tensile Stress: Engineered lengthwise and crosswise tensile stress is in compliance with performance loading criteria and specified safety factors, in accordance with ASTM D638.
13. Compressive Stress: Engineered lengthwise and crosswise compressive stress is in compliance with performance loading criteria and specified safety factors, in accordance with ASTM D695.
14. Flexural Stress: Engineered lengthwise and crosswise flexural stress is in compliance with performance loading criteria and specified safety factors, in accordance with ASTM D790.
15. Modulus of Elasticity: Engineered to meet the performance loading criteria and specified safety factors.
16. Barcol Hardness: 45, in accordance with ASTM D2583.
17. Water Absorption: Less than 0.46 percent by weight, within 24 hours, in accordance with ASTM D570.
18. Density: Within range of 0.062 to 0.070 lbs/cu in, in accordance with ASTM D792.
19. Lengthwise Coefficient of Thermal Expansion: 7.0 x 10⁻⁶ inch/inch/degrees F, in accordance with ASTM D696.
20. Notched Izod Impact, Lengthwise: 24 ft lbs/in, in accordance with ASTM D256 within temperature range indicated.
21. Notched Izod Impact, Crosswise: 4 ft lbs/in, in accordance with ASTM D256 within temperature range indicated.
22. CFS Rainscreen Manufacturers:
 - a. Basis of Design: Advanced Architectural Products (AAP), SMARTci
 - b. Or Approved Equal
23. Accessories:
 - a. Provide accessories necessary for a complete wall panel support system including metal closure trim, transition angle, strapping, tie-in brackets and similar items.
 - b. Fasteners: Corrosion-resistant, self-tapping and self-drilling screws, bolts, nuts, and other fasteners as recommended by panel support system manufacturer for project application.
 - 1) Cladding to Greengirt: Use standard Tek® brand screws.
 - 2) Greengirt to Stud Wall Framing: Use standard Tek® brand screws.
 - 3) Greengirt to Concrete/CMU: Use Tapcon® brand anchors.
 - c. Flashing and Trim: Match material, finish, and color of adjacent wall panels.
 - 1) Thickness: At least 0.040 inch.
 - d. Sealants: Provide sealants as recommended by exterior wall panel manufacturer for openings within wall panels and perimeter conditions.

2.3 RAINSCREEN INSULATION

- A. Insulation Single Source Responsibility; Refer to Division 7, “Thermal Insulation” for insulation with rainscreen assemblies.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas of this work, and project conditions with installer present for compliance with requirements for installation tolerances, substrates, wall panel support conditions, and other conditions affecting performance of this Work.
- B. Examine structural wall framing to ensure that angles, channels, studs, and other structural support members have been installed within alignment tolerances required by continuous insulation wall panel support system manufacturer.
- C. Verify that metal wall studs, opening framing, bridging, bracing and other framing support members and anchorage have been installed within wall system alignment tolerances and requirements.
- D. Examine rough-in for components and systems penetrating wall panel support system to coordinate actual locations of penetrations relative to exterior wall panel joint locations prior to installation.
- E. Verify that mechanical and electrical services for exterior walls have been installed and tested and, if appropriate, verify that adjacent materials and finishes are dry and ready to receive insulation.

- F. Ensure weather-resistant barrier (WRB) is installed in conformance with WRB manufacturer's instructions and discontinuities in WRB are properly flashed and sealed prior to installing support framing and attachment system.
- G. Do not proceed with installation until unsatisfactory conditions have been corrected.
 - 1. Commencement of installation constitutes acceptance of existing conditions and acceptance of responsibility for satisfactory performance.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Prepare sub-girt, base angles, sills, furring, and other wall panel support members and provide anchorage in accordance with ASTM C754 for gypsum panel type substrates and panel manufacturer's installation instructions.

3.3 METAL BOX GIRT/COLD-FORMED METAL FRAMING INSTALLATION

- A. Preparation: Verify vertical girt spacing and framing clearances relative to studs or other points of attachment.
- B. Installation:
 - 1. Install Flashing liquid behind each vertical girt running continuously prior to girt installation.
 - 2. Use laser or chalk line to mark starting height of vertical box girt.
 - 3. Mount vertical box girts, fastened at 16 inches on center (as determined by the manufactures engineering calculations – 32 inches on center can be used) on exterior of wall, using one self-tapping screw for each attachment hole or for every second attachment hole in box girt, as indicated by engineering calculations.
 - a. Where vertical obstructions are present and unavoidable (i.e. window openings), use laser or chalk line to restart vertical girt or horizontal rail.
 - b. The cavity must be clear and free from air flow and drainage obstructions.
 - c. Use shearing instruments (i.e. snips, nibbler, etc.) for cutting metal framing components. Saws are not recommended, as the sparks produced during cutting will damage the anti-corrosion coating. If sparks are generated during cutting, be sure the portion of the component to be installed on the building is protected from sparks and that any stockpile near the cutting station is also protected.
 - d. The systems components should not be cut while installed on the building, unless using a shearing instrument.

3.4 COMPOSITE FRAMING SUPPORT INSTALLATION

- A. Install wall panel support system in accordance with manufacturer's installation instructions.
- B. Install system to fill-in exterior spaces without gaps or voids. Do not compress panel insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within plane of insulation.
- E. Exposed insulation must be protected from open flame and kept dry at all times.
- F. Exterior wall insulation panels are not intended to be left exposed for periods of time in excess of 60 days without adequate protection.
 - 1. When extended exposure is anticipated, protect exposed insulation surfaces including corners, window and door openings with a compatible liquid sealant.
- G. Install wall panel support system in compliance with exterior wall panel orientation, sizes, and locations as indicated on Drawings.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing agency to perform field tests and inspections.

3.6 CLEANING AND PROTECTION

- A. Protect installed products from damage until date of Substantial Completion.
- B. Ensure that insulation panels are not exposed to moisture.
 - 1. Remove wet insulation panels or allow them to completely dry prior to installation of exterior wall panel system.
- C. Replace damaged insulation panels prior to date of Substantial Completion.
- D. Leave surfaces clean and free of debris and residue. Where required, clean exposed surfaces in accordance with manufacturer's instructions.

END OF SECTION 07 42 16

SECTION 07 54 23 – THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Adhered TPO membrane roofing system.
 - 2. Roof insulation.
- B. Related Sections:
 - 1. Division 06 Section "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
 - 2. Division 07 Section "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings, and counter-flashings.
 - 3. Division 07 Section "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.2 DEFINITIONS

- A. Roofing Terminology: See ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

1.3 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.
- 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. Corner Uplift Pressure: As indicated on Structural Drawings
 - 2. Perimeter Uplift Pressure: As indicated on Structural Drawings
 - 3. Field-of-Roof Uplift Pressure: As indicated on Structural Drawings
 - 4. Safety Factor: As indicated on Structural Drawings

1.4 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.
- C. Samples for Verification: For the following products:
 - 1. 12-by-12-inch square of sheet roofing, of color specified, including T-shaped side and end lap seam.
 - 2. 12-by-12-inch square of roof insulation.
 - 3. Six insulation fasteners of each type, length, and finish.
 - 4. Six roof cover fasteners of each type, length, and finish.
 - 5. Three samples of polymer clad flashings for color selection
- D. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system.
- E. 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.
- F. 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.
- G. Research/Evaluation Reports: For components of membrane roofing system.
- H. Maintenance Data: For roofing system to include in maintenance manuals.
- I. Warranties: Sample of special warranties.

- J. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is FM Approvals approved for membrane roofing system identical to that used for this Project.
- 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.
- C. Source Limitations: Obtain components for membrane roofing system from same manufacturer as membrane roofing.
- 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.
 - 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.

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. Special Warranty: Manufacturer's standard or customized 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. Failure includes roof leaks.
 - 1. Warranty Period: 20 years from date of Substantial Completion.
- B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of membrane roofing system such as membrane roofing, base flashing, roof insulation, fasteners, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:
 - 1. Warranty Period: Two years from date of Substantial Completion.
- C. The warranty shall meet the conditions of the project location and design loads without exclusions.

PART 2 - PRODUCTS**2.1 TPO MEMBRANE ROOFING**

- A. Fabric-Reinforced Thermoplastic Polyolefin Sheet: ASTM D 6878, internally fabric or scrim reinforced, uniform, flexible TPO sheet.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlisle SynTec Incorporated.
 - b. Firestone Building Products Company.
 - c. GAF Materials Corporation.
 - d. GenFlex Roofing Systems.
 - e. Johns Manville.
 - f. Sarnafil, Inc.
 - 2. Thickness: 60 mils
 - 3. Exposed Face Color: White

2.2 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 unreinforced thermoplastic polyolefin sheet flashing, 55 mils thick, minimum, of same color as sheet membrane.
- C. Bonding Adhesive: Manufacturer's standard.
- D. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately **1 by 1/8-inch** thick; with anchors.
- E. 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.
- F. 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.

2.3 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured or approved by TPO membrane roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated and that produce FM Approvals-approved roof insulation.
 - 1. Manufacturers:
 - a. Johns Manville
 - b. GAF
 - c. Atlas Roofing
 - d. Carlisle SynTec
 - e. Dow Chemical Company
 - f. Owens-Corning
- B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2[Grade 3], 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.

2.4 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. Cover Board: ASTM C 208, Type II, Grade 2, cellulosic-fiber insulation board, 1/2 inch thick.

2.5 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads, approximately 3/16 inch thick, and acceptable to membrane 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 and that roof drain bodies are securely clamped in place.
 - 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 Division 05 Section "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.
- C. 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.

3.3 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. Mechanically Fastened Insulation: Install 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 to resist uplift pressure at corners, perimeter, and field of roof.

3.4 ADHERED MEMBRANE ROOFING INSTALLATION

- A. Adhere membrane roofing over areas to receive roofing and install according to membrane roofing system manufacturer's written instructions.
- 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. Bonding Adhesive: Apply to substrate and underside of membrane roofing at rate required by manufacture and allow to partially dry before installing membrane roofing. Do not apply to splice area of membrane roofing.
- E. In addition to adhering, mechanically fasten membrane roofing securely at terminations, penetrations and perimeter of roofing.
- F. Apply membrane roofing with side laps shingled with slope of roof deck where possible.
- 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.

3.5 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 to substrate and underside of sheet flashing at required rate and allow to partially dry. 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.

3.6 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.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform roof tests and inspections and to prepare test reports.
- B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
 1. Notify Architect or Owner 48 hours in advance of date and time of inspection.
- C. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.
- D. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.8 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. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.9 ROOFING INSTALLER'S WARRANTY

- A. WHEREAS <Insert name> of <Insert address>, 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: <Insert date>.
 7. Warranty Period: <Insert time>.
 8. Expiration Date: <Insert 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 115 mph;
 - 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 <Insert day> day of <Insert month>, <Insert year>.
1. Authorized Signature: <Insert signature>.
 2. Name: <Insert name>.
 3. Title: <Insert title>.

END OF SECTION 07 54 23

SECTION 07 62 00 – SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes sheet metal flashing and trim in the following categories:
 - 1. Roof-drainage systems.
 - 2. Roof downspout boots.
 - 3. Metal flashing.
 - 4. Reglets.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 04, Section "Unit Masonry" for through-wall flashing and other integral masonry flashings specified as part of masonry work.
 - 2. Division 07, Section "Roof Accessories" for roof drains, set-on-type curbs, equipment supports, pipe portals, roof hatches, vents, and other manufactured roof accessory units.
 - 3. Division 07, Section "Manufactured Roof Expansion Joints" for metal-flange roof expansion joints.
 - 4. Division 07, Section "Joint Protection" for elastomeric sealants.
 - 5. Division 07 Roofing Sections for warranty requirements for flashing and roofing accessories installed integral with roofing membrane as part of roofing-system work.

1.2 PERFORMANCE REQUIREMENTS

- A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing.
- B. Fabricate and install flashings at roof edges to comply with recommendations of FM Loss Prevention Data Sheet 1-49 for the applicable local code requirements for design wind speed.

1.3 SUBMITTALS

- A. Product Data including manufacturer's material and finish data, installation instructions, and general recommendations for each specified flashing material and fabricated product.
- B. Shop Drawings of each item specified showing layout, profiles, methods of joining, and anchorage details.
- C. Samples of sheet metal flashing, trim, and accessory items, in the specified finish. Where finish involves normal color and texture variations, include Sample sets composed of 2 or more units showing the full range of variations expected.
 - 1. 8-inch- square Samples of specified sheet materials to be exposed as finished surfaces.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experience Installer who has completed sheet metal flashing and trim work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

1.5 PROJECT CONDITIONS

- A. Coordinate Work of this Section with interfacing and adjoining Work for proper sequencing of each installation. Ensure best possible weather resistance, durability of Work, and protection of materials and finishes.

PART 2 - PRODUCTS

2.1 METALS

- A. Sheet Metals:
 - 1. Prefinished Galvanized Steel: Smooth commercial quality galvanized steel (ASTM A653), coating class G-90, primed both sides and factory finished on one side with Kynar based fluoropolymer coating. Color to be selected by Architect from manufacturer's full selection of available colors.

2.2 REGLETS

- A. General: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces and compatible with flashing indicated.
- B. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, steel and EPDM weatherproofing washers, and with channel for sealant at top edge.
- C. Stucco Type: Provide with upturned fastening flange and extension leg of length to match thickness of applied finish materials.
- D. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
- E. Flexible Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
- F. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of the counterflashing lower edge.

1. Material: 22-ga., galvanized.
- G. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Fry Reglet Corporation.
 2. Hickman: W.P. Hickman Co.
 3. Keystone Flashing Company.
 4. Sandell Mfg. Co
 5. Cheney Flashing.

2.3 DOWNSPOUT BOOT

- A. Manufacturers: Subject to requirements, provide cast iron product comparable to basis of design product listed:
 1. McKinley Iron Works, Inc. (817) 335-1268, Type DS-2.
 2. Barry Pattern & Foundry Co., Inc., (205) 841-8725.

2.4 MISCELLANEOUS MATERIALS AND ACCESSORIES

- A. Fasteners: Same metal as sheet metal flashing or other non-corrosive metal as recommended by sheet metal manufacturer. Match finish of exposed heads with material being fastened.
- B. Asphalt Mastic: SSPC-Paint 12, solvent-type asphalt mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil dry film thickness per coat.
- C. Mastic Sealant: Polyisobutylene; non-hardening, non-skinning, nondrying, non-migrating sealant.
- D. Elastomeric Sealant: Generic type recommended by sheet metal manufacturer and fabricator of components being sealed. No silicone caulk accepted.
- E. Adhesives: Type recommended by flashing sheet metal manufacturer for waterproof and weather-resistant seaming and adhesive application of flashing sheet metal.
- F. Paper Slip Sheet: 5-lb/square red rosin, sized building paper conforming to FS UU-B-790, Type I, Style 1b.
- G. Polyethylene Underlayment: ASTM D 4397, minimum 6-mil- thick black polyethylene film, resistant to decay when tested according to ASTM E 154.
- H. Metal Accessories: Provide sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of Work, matching or compatible with material being installed; non-corrosive; size and thickness required for performance.
- I. Gutter Screen: 1/4-inch hardware cloth installed in sheet metal frames. Fabricate screen and frame of same basic material as gutters and downspouts.
- J. Roofing Cement: ASTM D 4586, Type I, asbestos free, asphalt based.

2.5 FABRICATION, GENERAL

- A. Sheet Metal Fabrication Standard: Fabricate sheet metal flashing and trim to comply with recommendations of SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of the item indicated.
- B. Comply with details shown to fabricate sheet metal flashing and trim that fit substrates and result in waterproof and weather-resistant performance once installed. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
- C. Form exposed sheet metal Work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems.
- D. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
- E. Expansion Provisions: Space movement joints at maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- F. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
- G. Separate metal from non-compatible metal or corrosive substrates by coating concealed surfaces at locations of contact with asphalt mastic or other permanent separation as recommended by manufacturer.
- H. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of sheet metal exposed to public view.
- I. Fabricate cleats and attachment devices from same material as sheet metal component being anchored or from compatible, non-corrosive metal recommended by sheet metal manufacturer.
 1. Size: As recommended by SMACNA manual or sheet metal manufacturer for application but never less than thickness of metal being secured.

2.6 SHEET METAL FABRICATIONS

- A. General: Fabricate sheet metal items in thickness or weight needed to comply with performance requirements but not less than that listed below for each application and metal.
- B. Sheet metal thickness as outlined below:
 - 1. Gutter: 24-ga. Kynar finish (match metal roof color).
 - 2. Downspouts: 24-ga. Kynar finish (match metal roof color).
 - 3. Eave Strip: 24-ga. Kynar finish (standard color).
 - 4. Receiver Metal:
 - a. 24-ga. Kynar finish (standard color).
 - b. 22-ga. clip anchors (as necessary).
 - 5. Counter Flashing: 24 ga. Kynar finish (standard color)
 - 6. Scupper: 24 ga. Kynar finish (match metal roof color).
 - 7. Collector Head: 24 ga. Kynar finish (standard color).
 - 8. Conduit Housing: 24 ga. Kynar finish (standard color).
 - 9. Weathercap: 26 ga. stainless steel.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine substrates and conditions under which sheet metal flashing and trim are to be installed and verify that Work may properly commence. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Unless otherwise indicated, install sheet metal flashing and trim to comply with performance requirements, manufacturer's installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Anchor units of Work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install Work with laps, joints, and seams that will be permanently watertight and weatherproof.
- B. Install exposed sheet metal Work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
- C. Roof-Edge Flashings: Secure metal flashings at roof edges according to FM Loss Prevention Data Sheet 1-49 for specified wind zone.
- D. Expansion Provisions: Provide for thermal expansion of exposed sheet metal Work. Space movement joints at maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- E. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards. Fill joint with sealant and form metal to completely conceal sealant.
 - 1. Use joint adhesive for nonmoving joints specified not to be soldered.
 - 2. Corner sections shall be field or shop fabricated with horizontal legs extending a maximum 18 inches from the corner juncture. The corner miter shall be formed by standing seam joint (see below).
 - 3. Joints between metal coping sections shall be mechanical, either standing seam or "drive" type joints as indicated on the drawings. Joints shall be inherently watertight on vertical faces by lapping of the metal sections a minimum of 2 inches. Drive cleats shall extend approximately ½ inch down the vertical metal sections at the front and rear of the coping section. Standing seam joint ends shall be crimped to form a chamfered corner. Corner miters shall be standing seam with a minimum 1 inch overlap on vertical faces. The overlap shall be sealed with caulk and secured by pop rivets installed 1 inch on center.
- F. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
- G. Separations: Separate metal from non-compatible metal or corrosive substrates by coating concealed surfaces, at locations of contact, with asphalt mastic or other permanent separation as recommended by manufacturer.
 - 1. Underlayment: Where installing stainless steel or aluminum directly on cementitious or wood substrates, install a slip sheet of red-rosin paper and a course of polyethylene underlayment.
 - 2. Bed flanges of Work in a thick coat of roofing cement where required for waterproof performance.
- H. Install reglets to receive counterflashing according to the following requirements:
 - 1. Where reglets are shown in concrete, furnish reglets for installation under Division 03, Section "Cast-in-Place Concrete."
 - 2. Where reglets are shown in masonry, furnish reglets for installation under Division 04, Section "Unit Masonry."

- I. Counterflashings: Coordinate installation of counterflashings with installation of assemblies to be protected by counterflashing. Install counterflashings in reglets or receivers. Secure in a waterproof manner by means of snap-in installation and sealant, lead wedges and sealant, interlocking folded seam, or blind rivets and sealant. Lap counterflashing joints a minimum of 2 inches and bed with sealant.
- J. Roof-Drainage System: Install drainage items fabricated from sheet metal, with straps, adhesives, and anchors recommended by SMACNA's Manual or the item manufacturer, to drain roof in the most efficient manner. Coordinate roof-drain flashing installation with roof-drainage system installation. Coordinate flashing and sheet metal items for steep-sloped roofs with roofing installation.
- K. Splash Pans: Install where downspouts discharge on low-sloped roofs, unless otherwise shown. Set in roof cement or sealant compatible with roofing membrane.

3.3 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.
- B. Provide final protection and maintain conditions that ensure sheet metal flashing and trim Work during construction is without damage or deterioration other than natural weathering at the time of Substantial Completion.

END OF SECTION 07 62 00

SECTION 07 71 00 – MANUFACTURED ROOF SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Copings.
 - 2. Fasciae.
 - 3. Gravel stops.
- B. Related Sections include the following:
 - 1. Division 07, Section "Sheet Metal Flashing and Trim" for shop- and field-fabricated metal flashing and counterflashing, scuppers, gutters and downspouts, trim and fascia units, roof expansion-joint covers, and miscellaneous sheet metal accessories.
 - 2. Division 07, Section "Manufactured Roof Expansion Joints" for roof expansion-joint covers.
 - 3. Division 07, Section "Roof Accessories" for manufactured curbs, roof hatches, pipe portals and flashings, and equipment supports. Roof accessories installed integrally with roofing membrane are specified in roofing system Sections as roofing work.

1.2 SUBMITTALS

- A. Product Data: For each type of product specified. Include details of construction relative to materials, dimensions of individual components, profiles, and finishes.
- B. Shop Drawings: Indicate layout, joining, profiles, accessories, anchorage, flashing connections, and relationship to supporting structure and to adjoining roof and wall construction.
- C. Samples for Initial Selection: Manufacturer's sample finishes showing the full range of colors and textures available for units with factory-applied color finishes.
- D. Samples for Verification: Of the following products, in manufacturer's standard sizes, showing the full range of color, texture, and pattern variations expected. Prepare Samples from the same material to be used for the Work. Furnish straight Samples in lengths specified below or where corner pieces are required for Project; furnish corner Samples with each leg in lengths specified below:
 - 1. Copings: 8 inches long.
 - 2. Fasciae: 8-inch- long sections of each distinctly different fascia component, including scuppers and extenders (if any), exposed as finish work.
 - 3. Gravel Stops: 8 inches long, including scuppers if specified.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Provide manufactured roof specialties capable of withstanding wind loads, structural movement, thermally induced movement, and exposure to weather without failing.
- B. Provide manufactured roofing specialties, incorporating roof edge treatment that complies with recommendations of FM Approvals Loss Prevention Data Sheet 1-49 for the following Wind Zone:
 - 1. Wind pressure per the Building Code requirements for project location.
- C. Provide manufacturer's roofing specialties designed in accordance with ANSI/SPRI ES-1.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of manufactured roof specialty from one source and by a single manufacturer.

1.5 PROJECT CONDITIONS

- A. Coordinate work of this Section with adjoining work for proper sequencing of each installation to ensure best-possible weather resistance and protection of materials and finishes against damage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Manufactured Roof Specialties:
 - a. ATAS International, Inc.
 - b. Cheney Flashing Company.
 - c. Hickman: W.P. Hickman Co.
 - d. Merchant and Evans, Inc.
 - e. MM Systems Corp.

- f. Petersen Aluminum Corp.

2.2 METALS

- A. Galvanized Steel Sheets: ASTM A 653, G90 coating designation; commercial quality; at least 0.034 inch thick, unless otherwise indicated.

2.3 COPINGS

- A. Provide copings in shapes and sizes indicated, with shop-fabricated corners. Include anchor plates formed from at least 0.028-inch- thick, galvanized steel sheet; cleats or other attachment devices; concealed splice plates; and trim and other accessories indicated or required for complete installation, with no exposed fasteners.

2.4 FASCIAE

- A. Provide fasciae in shapes and sizes indicated, with shop-mitered and -welded corners. Include water dams formed from at least 0.028-inch- thick, galvanized steel sheet; anchor plates; cleats or other attachment devices; concealed splice plates; and trim and other accessories indicated or required for complete installation, with no exposed fasteners.

2.5 GRAVEL STOPS

- A. Provide gravel stops in shapes and sizes indicated, with shop-mitered and -welded corners. Include water dams formed from at least 0.028-inch- thick, galvanized steel sheet; anchor plates; cleats or other attachment devices; concealed splice plates; and trim and other accessories indicated or required for complete installation, with no exposed fasteners.

2.6 ACCESSORIES

- A. General: Provide manufacturer's standard accessories designed and manufactured to match and fit roof edge treatment system indicated.
- B. Exposed Fasteners: Stainless steel, nonmagnetic, of manufacturer's standard type and size for product and application indicated. Match finish of exposed heads with material being fastened.
- C. Concealed Fasteners: Same metal as item fastened or other noncorrosive metal as recommended by manufacturer.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
- E. Asphalt Mastic: SSPC-Paint 12, solvent-type asphalt mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil dry film thickness per coat.
- F. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.
- G. Foam-Rubber Seal: Manufacturer's standard foam.
- H. Adhesives: Type recommended by manufacturer for substrate and project conditions and formulated to withstand minimum 60-lbf/sq. ft. wind-uplift force.

2.7 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.
- C. Finish manufactured roof specialties after fabrication and assembly if products are not fabricated from prefinished metals.
- 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 unacceptable. 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 METAL FINISHES

- A. Fluoropolymer 2-Coat Coating System: Manufacturer's standard 2-coat, thermocured system composed of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 1402, Test Method 7.
 - 1. Color and Gloss: Match Architect's sample.
 - 2. Color and Gloss: As selected by Architect from manufacturer's full range of colors and glosses.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, roof edges, and parapets for suitable conditions for roof edge system installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Promptly remove protective film, if any, from exposed surfaces of finished metals. Strip with care to avoid damage to finish.
- B. Prepare concrete, concrete masonry block, cement plaster, and similar surfaces to receive roof edge system specified. Install blocking, cleats, water dams, and other anchoring and attachment accessories and devices required.

3.3 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Coordinate with installation of roof deck and other substrates to receive work of this Section and with vapor retarders, roofing insulation, roofing membrane, flashing, and wall construction, as required to ensure that each element of the Work performs properly and that combined elements are waterproof and weathertight. Anchor products securely to structural substrates to withstand lateral and thermal stresses and inward and outward loading pressures.
- B. Isolation: Where metal surfaces of units contact dissimilar metal or corrosive substrates, including wood, apply bituminous coating on concealed metal surfaces or provide other permanent separation as recommended by aluminum producer.
- C. Expansion Provisions: Install running lengths to allow controlled expansion for movement of metal components in relation not only to one another but also to adjoining dissimilar materials, including flashing and roofing membrane materials, in a manner sufficient to prevent water leakage, deformation, or damage.

3.4 CLEANING AND PROTECTING

- A. Clean exposed metal surfaces according to manufacturer's written instructions. Touch up damaged metal coatings.
- B. Protection: Provide protective measures as required to ensure work of this Section will be without damage or deterioration at the time of Substantial Completion.

END OF SECTION 07 71 00

SECTION 07 71 29 – MANUFACTURED ROOF EXPANSION JOINTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Metal-flanged bellows-type roof expansion assemblies.
- B. Related Sections include the following:
 - 1. Division 06, Section "Miscellaneous Carpentry" for wooden curbs for mounting roof expansion assemblies.
 - 2. Division 07, Section "Sheet Metal Flashing and Trim" for shop- and field-fabricated sheet metal flashing, and other sheet metal items.
 - 3. Division 07, Section "Roof Specialties" for other manufactured roof items.

1.2 PERFORMANCE REQUIREMENTS

- A. General: Provide roof expansion joint assemblies that, when installed, remain watertight within movement limitations required by project requirements.

1.3 SUBMITTALS

- A. Product Data: Include manufacturer's product specifications, construction details, material and finish descriptions, installation instructions, and dimensions of individual components.
- B. Shop Drawings: Include plans, elevations, sections, details, joints, splices, locations of joints and splices, anchorage details, intersections, transitions, fittings, and attachments to other Work. Where joint assemblies change planes, provide isometric drawings depicting how components interconnect to achieve continuity.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed installation of roof expansion joint assemblies similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Source Limitations: Obtain roof expansion joint assemblies approved by roofing membrane manufacturer and that are part of roofing membrane warranty.

1.5 SCHEDULING

- A. Coordinate delivery and installation of expansion joint assemblies to prevent damage and provide timely integration of units with roofing membranes and flashing.

1.6 WARRANTY

- A. General Warranty: Special warranty 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, signed by roof expansion assembly manufacturer and Installer agreeing to repair or replace roof expansion assemblies that leak, deteriorate in excess of rates specified in manufacturer's published product literature, or otherwise fail to perform within specified warranty period.
- C. Warranty Period: Same as roofing system warranty; refer to Division 07 roofing section(s).

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, manufacturers whose comparable products may be incorporated into the Work include, but are not limited to, the following:
 - 1. Extruded Aluminum Roof Expansion Joint Assemblies:
 - a. Basis of Design: C/S Systems RJ-27LP (roof to roof); RJ-28LP (roof to wall).
 - b. Architectural Art Manufacturing, Inc.
 - c. Balco Metalines, a division of Balco, Inc.
 - d. WP Hickman Company.
 - e. Joint Master, a division of InPro Corp.
 - f. MM Systems Corporation.
 - g. Nystrom Inc.
 - h. Watson Bowman Acme Corp.

2.2 SHEET METALS

- A. Sheet Aluminum: ASTM B 209 alloy 3003-H14, 5052-H32, or 6061-T6, mill finish, minimum 0.032 inch thick.
- B. Extruded Aluminum: ASTM B 221, Alloy 6063-T5, minimum 0.040 inch thick.
- C. Aluminum Finishes:
 - 1. Mill Finish: AA-M10 (Mechanical Finish: as fabricated; no other applied finish unless buffing is required to remove scratches, welding, or grinding produced in fabrication process).
 - 2. 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 611.
- D. Galvanized Steel Sheet: ASTM A 653/A 653M, hot-dip zinc-coating designation G90, stretcher-leveled standard of flatness and either commercial steel or forming steel, minimum 0.019 inch thick.

2.3 MISCELLANEOUS MATERIALS

- A. Roof Cement: ASTM D 4586, Type II.
- B. Mineral-Fiber Blanket: ASTM C 665.
- C. Silicone Extrusions: Classified according to ASTM D 2000, UV stabilized and do not propagate flame.

2.4 ALUMINUM ROOF EXPANSION ASSEMBLIES

- A. Aluminum Roof Expansion Assemblies: Provide assemblies consisting of aluminum base members with sloped cants and provisions for anchoring and sealing to roofing membrane or flashing in a waterproof-sealed joint. Provide free-to-move, extruded-aluminum cover plate anchored against displacement and waterproofed by integral seals. Provide prefabricated units for corner and joint intersections and horizontal and vertical transitions, including those to other building expansion joints, splicing units, adhesives, coatings, and other components as recommended by roof expansion assembly manufacturer for complete installation. Fabricate assemblies specifically for curb to wall.
 - 1. Base Frame Members: Extruded aluminum with mill finish.
 - 2. Extruded-Aluminum Covers: Minimum 0.080-inch thick with clear finish.
 - 3. Moisture Barrier: Semi-concealed captive, polymeric sheet bellows unit of neoprene, EPDM, reinforced chlorinated polyethylene or PVC not less than 30 mils (0.8 mm) thick.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's written instructions for handling and installing roof expansion assemblies and materials, unless more stringent requirements are indicated.
- B. Coordinate installation of roof expansion joint assembly materials and associated work so complete assemblies comply with assembly performance requirements.
- C. Extend roof expansion joint assemblies over curbs, parapets, valleys, and other elements in the construction profile, as applicable, with factory-fabricated transitions to provide continuous, uninterrupted, waterproof roof expansion assemblies.
- D. Splice roof expansion joint assemblies with materials provided by roof expansion assembly manufacturer for this purpose, according to manufacturer's written instructions, to provide continuous, uninterrupted, waterproof roof expansion assemblies.
- E. Provide uniform profile of expansion joint assembly throughout length of each installation; do not stretch polymeric sheets.
- F. Install mineral-fiber blanket insulation to fill joint space within joint and moisture barrier.
- G. Bed anchorage flanges in cement or sealant recommended by manufacturer and securely nail to curbs and cant strips as recommended by manufacturer, but not less than 6 inches o.c.
- H. Anchor roof expansion joint assemblies in the manner indicated, complying with manufacturer's written instructions.
- I. Provide not less than a 4-inch embedding of flanges in bituminous membranes, with hot bitumen or roof cement. Cover with stripping material and install according to requirements in Division 07 roofing section.

3.2 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensures roof expansion joint assemblies are without damage or deterioration at time of Substantial Completion.

END OF SECTION 07 71 29

SECTION 07 81 00 – APPLIED FIREPROOFING**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
 - 1. Concealed sprayed fire-resistive materials.
- B. Related Sections include the following:
 - 1. Division 05, Section "Structural Steel Framing" for surface conditions required for structural steel receiving sprayed fire-resistive materials.
 - 2. Division 07, Section "Thermal Insulation" for fire-safing insulation.
 - 3. Division 07 Section "Firestopping" for through-penetration firestopping systems.

1.2 DEFINITIONS

- A. Concealed sprayed fire-resistive material is applied surfaces that are concealed from view behind other construction when the Work is completed.

1.3 SUBMITTALS

- A. Product Data: For each fire-resistive product specified.
- B. Shop Drawings: Structural framing plans indicating the following:
 - 1. Locations and types of surface preparations required before applying sprayed fire-resistive material.
 - 2. Extent of sprayed fire-resistive material for each construction and fire-resistance rating, including the following:
 - a. Applicable fire-resistive design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
 - b. Minimum thicknesses needed to achieve required fire-resistance ratings of structural components and assemblies.
- C. Product Certificates: Signed by manufacturer of sprayed fire-resistive material certifying that the products furnished comply with requirements.
- D. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
- E. 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.
- F. Compatibility and Adhesion Test Reports: For primers and other coatings applied to structural steel. Provide reports from a qualified independent testing and inspecting agency engaged by Contractor. Confirm that primers and coatings proposed for application in shop or field are compatible with fire-resistive material. Instruct laboratory to determine compatibility according to requirements specified in "Quality Assurance" Article.
- G. Product Test Reports: Indicate that physical properties of proposed sprayed fire-resistive materials comply with specified requirements based on comprehensive testing of current product formulations by a qualified testing and inspecting agency according to requirements specified in "Quality Assurance" Article.
- H. Research/Evaluation Reports: Evidence of sprayed fire-resistive material's compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer certified, licensed, or otherwise qualified by sprayed fire-resistive material manufacturer as having the necessary experience, staff, and training to install manufacturer's products according to specified requirements. A manufacturer's willingness to sell its sprayed fire-resistive materials to Contractor or to an installer engaged by Contractor does not in itself confer qualification on the buyer.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the 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 sprayed fire-resistive materials that are similar to those indicated for this Project in material, design, and extent.
- C. Testing Agency Qualifications: An independent testing and inspecting agency with the experience and capability to conduct the testing indicated without delaying the Work, as documented according to ASTM E 699.
- D. Testing of Fire-Resistive Materials: By a qualified testing and inspecting agency engaged by Contractor or manufacturer according to the following requirements:
 - 1. Sprayed fire-resistive materials are randomly selected for testing from bags bearing the applicable classification marking of UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

- 2. Testing is performed on specimens whose application the independent testing and inspecting agency witnessed during preparation and conditioning. Include in test reports a full description of preparation and conditioning of laboratory test specimens.
- E. Testing for Compatibility and Adhesion: Engage a qualified testing and inspecting agency to prepare compatibility and adhesion test reports required in "Submittals" Article based on testing that complies with the following requirements:
 - 1. Testing for bond per ASTM E 736 and requirements specified in UL's "Fire Resistance Directory" about coating materials.
 - 2. Verify that manufacturer of fire-resistive material has not found primers or coatings to be incompatible with fire-resistive material based on its own laboratory testing or field experience.
- F. Source Limitations: Obtain each type of sprayed fire-resistive material from one source and by a single manufacturer.
- G. Fire-Test-Response Characteristics: Provide sprayed fire-resistive materials and assemblies identical to those tested for the following fire-test-response characteristics per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify packages (bags) containing sprayed fire-resistive material with appropriate markings of applicable testing and inspecting agency.
 - 1. Fire-Resistance Ratings: As indicated by reference to fire-resistive designs listed in UL's "Fire Resistance Directory," or in the comparable publication of another testing and inspecting agency acceptable to authorities having jurisdiction, for sprayed fire-resistive material serving as direct-applied protection, tested per ASTM E 119.
 - 2. Surface-Burning Characteristics: As indicated for each sprayed fire-resistive product required, tested per ASTM E 84.
- H. Provide products containing no detectable asbestos as determined according to the method specified in 40 CFR, 763, Subpart E, Appendix E, Section 1, "Polarized Light Microscopy."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to Project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; shelf life, if applicable; and fire-resistance ratings applicable to Project.
- B. Use materials with limited shelf life within period indicated. Remove from Project site and discard materials whose shelf life has expired.
- C. Store materials inside, under cover, aboveground, so they are kept dry until ready for use. Remove from Project site and discard materials that have deteriorated.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply sprayed fire-resistive material when ambient or substrate temperatures are 40 deg F or lower, unless temporary protection and heat is provided to maintain temperatures at or above this level for 24 hours before, during, and for 24 hours after product application.
- B. Ventilation: Ventilate building spaces during and after application of sprayed fire-resistive material. Use natural means or, where this is inadequate, forced-air circulation until fire-resistive material dries thoroughly.

1.7 SEQUENCING

- A. Sequence and coordinate application of sprayed fire-resistive materials with other related work specified in other Sections to comply with the following requirements:
 - 1. Provide temporary enclosures for interior applications to prevent deterioration of fire-resistive material due to exposure to unfavorable environmental conditions.
 - 2. Avoid unnecessary exposure of fire-resistive material to abrasion and other damage likely to occur during construction operations subsequent to its application.
 - 3. Do not apply fire-resistive material to metal roof deck substrates until roofing has been completed; prohibit roof traffic during application and drying of fire-resistive material.
 - 4. Do not begin applying fire-resistive material until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.
 - 5. Defer installing ducts, piping, and other items that would interfere with applying fire-resistive material until application of fire protection is completed.
 - 6. Do not install enclosing or concealing construction until after fire-resistive material has been applied, inspected, tested, and corrections have been made to defective applications.

1.8 WARRANTY

- A. General Warranty: The special warranty 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: Submit a written warranty, executed by Contractor and cosigned by Installer, agreeing to repair or replace sprayed fire-resistive materials that fail within the specified warranty period.
 - 1. Failures include, but are not limited to, cracking, flaking, eroding in excess of specified requirements; peeling; and delaminating of sprayed fire-resistive materials from substrates due to defective materials and workmanship within the specified warranty period.
 - 2. Not covered under the warranty are failures due to damage by occupants and Owner's maintenance personnel, exposure to environmental conditions other than those investigated and approved during fire-response testing, and other causes not reasonably foreseeable under conditions of normal use.
- C. Warranty Period: two (2) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCEALED SPRAYED FIRE-RESISTIVE MATERIALS

- A. General: For concealed applications of sprayed fire-resistive materials, provide manufacturer's standard products complying with requirements indicated in this Article for material composition and physical properties representative of installed products.
- B. Material Composition: As follows:
 - 1. Cementitious sprayed fire-resistive material consisting of factory-mixed, dry formulation of gypsum or portland cement binders and lightweight mineral or synthetic aggregates mixed with water at Project site to form a slurry or mortar for conveyance and application.
- C. Physical Properties: Minimum values, unless otherwise indicated, or higher values required to attain designated fire-resistance ratings, measured per standard test methods referenced with each property listed as follows:
 - 1. Dry Density: 15 lb/cu. ft. for average and individual densities regardless of density indicated in referenced fire-resistive design, or greater if required to attain fire-resistance ratings indicated, per ASTM E 605 or AWCI Technical Manual 12-A, Section 5.4.5 "Displacement Method."
 - 2. Thickness: Provide minimum average thickness required for fire-resistive design indicated according to the following criteria, but not less than 0.375 inch, per ASTM E 605.
 - a. Where the referenced fire-resistive design lists a thickness of 1 inch or greater, the minimum allowable individual thickness of sprayed fire-resistive material is the design thickness minus 0.25 inch.
 - b. Where the referenced fire-resistive design lists a thickness of less than 1 inch but more than 0.375 inch, the minimum allowable individual thickness of sprayed fire-resistive material is the greater of 0.375 inch or 75 percent of the design thickness.
 - c. No reduction in average thickness is permitted for those fire-resistive designs whose fire-resistance ratings were established at densities of less than 15 lb/cu. ft.
 - 3. Bond Strength: 150 lbf/sq. ft. per ASTM E 736 under the following conditions:
 - a. Field test sprayed fire-resistive material that is applied to flanges of wide-flange structural-steel members on surfaces matching those that will exist for remainder of steel receiving fire-resistive material.
 - b. If surfaces of structural steel receiving sprayed fire-resistive material are primed or otherwise painted, perform series of bond tests specified in UL's "Fire Resistance Directory" for coating materials.
 - c. Minimum thickness of sprayed fire-resistive material tested in laboratory shall be 0.75 inch.
 - 4. Compressive Strength: 5.21 lbf/sq. in. as determined in the laboratory per ASTM E 761. Minimum thickness of sprayed fire-resistive material tested shall be 0.75 inch and minimum dry density shall be as specified, but not less than 15 lb/cu. ft.
 - 5. Corrosion Resistance: No evidence of corrosion per ASTM E 937.
 - 6. Deflection: No cracking, spalling, delamination, or the like per ASTM E 759.
 - 7. Effect of Impact on Bonding: No cracking, spalling, delamination, or the like per ASTM E 760.
 - 8. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. in 24 hours per ASTM E 859. For laboratory tests, minimum thickness of sprayed fire-resistive material is 0.75 inch, maximum dry density is 15 lb/cu. ft., test specimens are not purged by mechanically induced air velocities, and tests are terminated after 24 hours.
- D. Fire-Test-Response Characteristics: Provide sprayed fire-resistive materials with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Flame Spread: 10 or less.
 - 2. Smoke Developed: 0.
- E. Fungal Resistance: No observed growth on specimens per ASTM G 21.
- F. Products: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cementitious Sprayed Fire-Resistive Material:
 - a. Pyrolite 15; Carbolite Co., Fireproofing Products Div.

- b. Monokote Type MK-6 HY; W.R. Grace & Co.--Conn., Construction Products Div.
- c. Cafco 300; Isolatek International Corp., Cafco Products.

2.2 AUXILIARY FIRE-RESISTIVE MATERIALS

- A. General: Provide auxiliary fire-resistive materials that are compatible with sprayed fire-resistive materials and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistive designs indicated.
- B. Substrate Primers: For use on each substrate and with each sprayed fire-resistive product, provide primer that complies with one or more of the following requirements:
 - 1. Primer's bond strength complies with requirements specified in UL's "Fire Resistance Directory" for coating materials based on a series of bond tests per ASTM E 736.
 - 2. Primer is identical to those used in assemblies tested for fire-test-response characteristics of sprayed fire-resistive material per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Adhesive for Bonding Fire-Resistive Material: Product approved by manufacturer of sprayed fire-resistive material.
- D. Metal Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required to comply with fire-resistive designs indicated and fire-resistive product manufacturer's written recommendations. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive sprayed fire-resistive material.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, to determine whether they are in satisfactory condition to receive sprayed fire-resistive material. A substrate is in satisfactory condition if it complies with the following:
 - 1. Substrates comply with requirements in the Section where the substrate and related materials and construction are specified.
 - 2. Substrates are free of oil, grease, rolling compounds, incompatible primers, loose mill scale, dirt, or other foreign substances capable of impairing bond of fire-resistive material with substrate under conditions of normal use or fire exposure.
 - 3. Objects penetrating fire-resistive material, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
 - 4. Substrates are not obstructed by ducts, piping, equipment, and other suspended construction that will interfere with applying fire-resistive material.
- B. Conduct tests according to fire-resistive material manufacturer's written recommendations to verify that substrates are free of oil, rolling compounds, and other substances capable of interfering with bond.
- C. Do not proceed with installation of fire-resistive material until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances that could impair bond of fire-resistive material, including oil, grease, rolling compounds, incompatible primers, and loose mill scale.
- B. Prime substrates where recommended in writing by fire-resistive material manufacturer, unless compatible shop primer has been applied and is in satisfactory condition to receive fire-resistive material.
- C. Cover other work subject to damage from fallout or overspray of fire-resistive materials during application. Provide temporary enclosure as required to confine spraying operations, protect the environment, and ensure maintenance of adequate ambient conditions for temperature and ventilation.

3.3 INSTALLATION, GENERAL

- A. Comply with fire-resistive material manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to convey and spray on fire-resistive material, as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.
- B. Apply sprayed fire-resistive material that is identical to products tested as specified in Part 1 in "Product Test Reports" in "Submittals" Article, with respect to rate of application, accelerator use, sealers, topcoats, tamping, troweling, water overspray, or other materials and procedures affecting test results.
- C. Install metal lath, as required, to comply with fire-resistance ratings and fire-resistive material manufacturer's written recommendations for conditions of exposure and intended use. Securely attach lath to substrate in position required for support and reinforcement of fire-resistive material. Use anchorage devices of type recommended in writing by fire-resistive material manufacturer. Attach lathing accessories where indicated or required for secure attachment to substrate.

- D. Coat substrates with adhesive before applying fire-resistive material where required to achieve fire-resistance rating or as recommended in writing by fire-resistive material manufacturer for material and application indicated.
- E. Extend fire-resistive material in full thickness over entire area of each substrate to be protected. Unless otherwise recommended in writing by fire-resistive material manufacturer, install body of fire-resistive covering in a single course.
- F. Spray apply fire-resistive materials to maximum extent possible. Following the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by manufacturer.
- G. For applications over encapsulant materials, including lockdown (post-removal) encapsulants, apply sprayed fire-resistive material that differs in color from that of the encapsulant over which it is applied.

3.4 INSTALLING CONCEALED SPRAYED FIRE-RESISTIVE MATERIALS

- A. Apply concealed fire-resistive material in thicknesses and densities indicated, but not less than those required to achieve fire-resistance ratings designated for each condition and comply with requirements for thickness specified in Part 2 "Concealed Sprayed Fire-Resistive Materials" Article.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.
 - 1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.
- B. Testing and inspecting of completed applications of sprayed fire-resistive material will take place in successive stages, in areas of extent and using methods as follows. Do not proceed with application of fire-resistive material for the next area until test results for previously completed applications of fire-resistive material show compliance with requirements.
 - 1. Extent: For each 1000-sq. ft. area, or partial area, on each floor, testing and inspecting agency will evaluate the following characteristics. Tested values must equal or exceed values indicated and values required for approved fire-resistance design.
 - a. Thickness for Floors, Roofs, and Walls: From the average of 10 measurements from a 144-sq. in. sample area, with sample width of not less than 6 inches per ASTM E 605.
 - b. Thickness for Structural Frame Members: From a sample of 25 percent of structural members per floor, taking 9 measurements at a single cross section for structural frame beams or girders, 7 measurements of a single cross section for joists and trusses, and 12 measurements of a single cross section for columns per ASTM E 605.
 - c. Density for Floors, Roofs, Walls, and Structural Frame Members: At frequency and from sample size indicated for determining thickness of each type of construction, per ASTM E 605 or AWCI Technical Manual 12-A, Section 5.4.5, "Displacement Method."
 - d. Bond Strength for Floors, Roofs, Walls, and Structural Framing Members: Cohesion and adhesion at frequency and from sample size indicated for determining thickness of each type of construction, per ASTM E 736.
 - 2. When testing discovers applications of fire-resistive material not in compliance with requirements, testing and inspecting agency will perform additional random testing to determine extent of noncompliance.
- C. Remove and replace applications of fire-resistive material where test results indicate that they do not comply with specified requirements for cohesion and adhesion or for density, or both.
- D. Apply additional fire-resistive material per manufacturer's written instructions where test results indicate that thickness 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 CLEANING, PROTECTING, AND REPAIR

- A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.
- B. Protect fire-resistive material, according to advice of product manufacturer and Installer, from damage resulting from construction operations or other causes so fire protection will be without damage or deterioration at the time of Substantial Completion.
- C. Coordinate application of fire-resistive material with other construction to minimize the need to cut or remove fire protection. As installation of other construction proceeds, inspect fire-resistive material and patch any damaged or removed areas.
- D. Repair or replace work that has not been successfully protected.

END OF SECTION 07 81 00

SECTION 07 84 00 – FIRESTOPPING**PART 1 - GENERAL****1.1 SUMMARY**

- A. This 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. Walls and partitions.
 - 2. Smoke barriers.
- B. Related Sections include the following:
 - 1. Division 04, Section "Unit Masonry" for construction of openings in masonry walls.
 - 2. Division 07, Section "Thermal Insulation" for safin insulation and accessories.
 - 3. Division 07, Section "Applied Fireproofing."
 - 4. Division 09, Section "Gypsum Board Assemblies" for construction of openings in gypsum walls.
 - 5. Division 22 and 23 Sections specifying duct and piping penetrations.
 - 6. Division 26 and 27 Sections specifying cable and conduit penetrations.

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.
- B. F-Rated Systems: Provide through-penetration firestop systems with F-ratings, 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, 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 to storage areas containing combustible materials.
- 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 (100 mm) 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.

1.3 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 engineer judgment drawing developed by through-penetration firestop system manufacturer's fire-protection engineer in accordance with the provisions of the International Firestop Council.
- C. 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.
- D. Product Certificates: Signed by manufacturers of through-penetration firestop system products certifying that products furnished comply with requirements.

- E. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products, such as the following:
1. Classified System drawings from the Underwriters Laboratories Fire Resistance Directory Volume

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed through-penetration firestop systems similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, from a single manufacturer.
- 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."
 - 2) Approved equal, approved by local code authority.
- D. Installer Training: Individuals performing the installation of firestop systems shall be trained by a direct representative of the firestop materials manufacturer, not a distributor or agent.

1.5 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 multi-component materials.
- B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.6 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.

1.7 COORDINATION

- A. Coordinate size and location of cast-in-place firestop devices to accommodate planned pipe and cable runs. Ensure proper placement of devices before placement of concrete.
- B. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
- C. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
- D. 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.
- E. 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. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hilti, Inc.
 2. 3M Fire Protection Products.
 3. Tremco.
 4. Nelson Firestopping.
 5. Carboline.
 6. W.R. Grace.
 7. Rectorshield, Bio-Fire Shield.
 8. Approved equal.

2.2 FIRESTOPPING, GENERAL

- A. Compatibility: Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.
- B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by 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.
 - d. Fillers for sealants.
 2. Temporary forming materials.
 3. Substrate primers.
 4. Collars.
 5. Steel sleeves.

2.3 FILL MATERIALS

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces and non-sag formulation for openings in vertical and other surfaces requiring a non-slumping, gunnable sealant, unless indicated firestop system limits use to non-sag grade for both opening conditions.
 2. Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces.
 3. Grade for Vertical Surfaces: Non-sag formulation for openings in vertical and other surfaces.
- B. Intumescent Acrylic Sealant – firestop sealant that expands when exposed to heat. Protects penetrations containing combustible and non-combustible penetrants.
- C. Foam "sponge-like" blocks: Re-penetratable intumescent blocks that may be friction fit, deformed, or cut to fit in through penetration openings.

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.
- C. Manufacturer's installation instructions shall be followed. In situations where the requirements of this section differ from those of the manufacturer, the more conservative requirements shall govern.

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 IDENTIFICATION

- A. Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:
 - 1. Designation/Indication that the penetration is fire-rated.
 - 2. Through-penetration firestop system designation of applicable testing and inspecting agency.
 - 3. Date of installation.
 - 4. Through-penetration firestop system manufacturer's name.
 - 5. Installer's name.

3.5 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 Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce through-penetration firestop systems complying with specified requirements.

END OF SECTION 07 84 00

SECTION 07 84 43 – FIRE-RESISTIVE JOINT SEALANTS**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes fire-resistive joint systems for the following:
 1. Floor-to-wall joints.
 2. Head-of-wall joints.
 3. Wall-to-wall joints.

- B. Related Sections include the following:
 1. Division 04, Section "Unit Masonry" for construction of openings in masonry walls.
 2. Division 07, Section "Thermal Insulation" for perimeter fire-containment systems if not specified in this Section.
 3. Division 07, Section "Manufactured Roof Expansion Joints" for fire-resistive roof expansion joints.
 4. Division 07, Section "Firestopping" for systems installed in openings in walls and floors with and without penetrating items.
 5. Division 07, Section "Joint Protection" for non-fire-resistive joint sealants.
 6. Division 07, Section "Expansion Control" for fire-resistive joint systems consisting of metal frames and [covers] [preformed seals] [strip seals] [compression seals <Insert description>].
 7. Division 09, Section "Gypsum Board Assemblies" for construction of openings in gypsum walls.

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 assembly in which fire-resistive joint systems are installed:
 1. Fire-resistance-rated load-bearing walls, including partitions.
 2. Fire-resistance-rated non-load-bearing walls, including partition.
- B. Fire Resistance of Joint Systems: Wall and floor assembly ratings are indicated, provide fire rated joint 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.

1.3 SUBMITTALS

- A. Product Data: For each type of product required to meet the performance requirements.
- B. Shop Drawings: For each fire-resistive joint system, show each kind of construction condition in which joints are installed and relationships to adjoining construction. Include fire-resistive joint system design designation of testing and inspecting agency acceptable to authorities having jurisdiction that demonstrates 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.
 2. Where Project conditions require modification of qualified testing and inspecting agency's illustration to suit a particular through-penetration firestop condition, submit engineer judgment drawing developed by joint firestop system manufacturer's fire-protection engineer in accordance with the provisions of the International Firestop Council.
- C. Product Certificates: For each type of fire-resistive joint system, signed by product manufacturer.
- D. Qualification Data: For Installer.
- E. Evaluation Reports: Evidence of fire-resistive joint systems' compliance with ICBO ES AC30, from the ICBO Evaluation Service.
- F. Research/Evaluation Reports: For each type of fire-resistive joint system.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fire-resistive joint systems for each kind of joint and construction condition required by Building Code through one source from a single manufacturer.
- B. Fire-Test-Response Characteristics: Provide fire-resistive joint systems that comply with the following requirements and those specified in "Performance Requirements" Article:

1. Fire-resistance 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 fire-resistive joint systems acceptable to authorities having jurisdiction.
2. Fire-resistive joint systems are identical to those tested per UL 2079. Perimeter fire-containment systems are identical to those tested per UL 2079. Provide rated systems complying with the following requirements:
 - a. Fire-resistive joint system products bear classification marking of qualified testing and inspecting agency.
 - b. Fire-resistive joint systems correspond to those required by Building Code by referencing system designations listed by the following:
 - 1) UL in its "Fire Resistance Directory."
 - 2) Other testing agency acceptable to the authorities having jurisdiction.
- C. Installer Training: Individuals performing the installation of firestop systems shall be trained by a direct representative of the firestop materials manufacturer, not a distributor or agent.

1.5 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 multi-component 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.

1.6 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.

1.7 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. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.
 - a. Fire-Resistive Joint Systems:
 - 1) Hilti, Inc.
 - 2) 3M Fire Protection Products.
 - 3) Tremco, Inc.
 - 4) Nelson Firestopping.
 - 5) Carboline.
 - 6) W.R. Grace.
 - 7) Rectorshield, Bio-Fire Shield.
 - 8) Approved equal.
 - b. Perimeter Fire-Containment Systems:
 - 1) Specified Technologies Inc.
 - 2) United States Gypsum Company.
 - 3) Hilti, Inc.
 - 4) 3M Fire Protection Products.
 - 5) Nelson Firestopping.
 - 6) Carboline.

- 7) W.R. Grace.
- 8) Rectorshield, Bio-Fire Shield.
- 9) Approved equal.

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.
- C. Products/Materials:
 1. General: Provide fire-resistive joint systems utilizing the following products/materials and bearing the appropriate UL testing approval for the application as required by the Building Code:
 - a. Cast-in-place firestop devices.
 - b. Latex sealants.
 - c. Factory assembled collars.
 - d. Intumescent putties.
 - e. Intumescent composite sheets.
 - f. Intumescent wrap strips.
 - g. Pillows/bags of glass fiber cloth
 - h. Silicone foams.
 - i. Silicone sealants.
 - j. Other material approved by Building Code authorities having jurisdiction and by the Architect and as required by the approved UL assembly.

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.
- 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 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 Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

END OF SECTION 07 84 43

SECTION 07 90 00 – JOINT PROTECTION**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes sealants for the following applications, including those specified by reference to this Section:
1. Exterior joints in the following vertical surfaces and nontraffic horizontal surfaces:
 - a. Control and expansion joints in unit masonry.
 - b. Control and expansion joints in cast-in-place concrete.
 - c. Joints between architectural precast concrete units.
 - d. Joints between metal panels.
 2. Joints between different materials listed above.
 - a. Perimeter joints between materials listed above and roofing systems.
 - b. Perimeter joints between materials listed above and frames of doors, windows and louvers.
 - c. Perimeter joints between materials listed above and piping and other fixtures penetrating building envelope.
 - d. Control and expansion joints in ceiling and overhead surfaces.
 - e. Other joints as indicated.
 3. Exterior joints in the following horizontal traffic surfaces:
 - a. Control, expansion, and isolation joints in cast-in-place concrete slabs where indicated.
 - b. Other joints as indicated.
 4. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings where indicated.
 - c. Tile control and expansion joints.
 - d. Vertical control joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
 - e. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
 - f. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - g. Joints between casework and equipment and adjoining walls and floors.
 - h. Other joints as indicated and as required by authorities having jurisdiction.
 5. Interior joints in the following horizontal traffic surfaces:
 - a. Control and expansion joints in tile flooring.
 - b. Other joints as indicated.
- B. Related Sections include the following:
1. Division 04, Section "Unit Masonry" for masonry control and expansion joint fillers and gaskets.
 2. Division 07, Section "Firestopping" for fire-resistant building joint-sealant systems.
 3. Division 08, Section "Glazing" for glazing sealants.
 4. Division 09, Section "Gypsum Board Assemblies" for sealing perimeter joints of gypsum board partitions to reduce sound transmission.
 5. Division 09, Section "Acoustical Panel Ceilings" for sealing edge moldings at perimeters of acoustical ceilings.

1.2 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric 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 SUBMITTALS

- A. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- B. Samples for Verification: For each color of brick control joint selected by Architect, install up to six 18-inch samples in actual field conditions. Once Architect has selected color, remove any non-conforming colors.
- C. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.

- B. Store and handle materials in compliance with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: 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 ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 deg F.
 - 3. When joint substrates are wet.
- B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
- C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

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 Installer's Warranty: Written warranty, signed by Installer agreeing 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.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products indicated for each type in the sealant schedules at the end of Part 3.

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. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range for this characteristic.

2.3 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealant Standard: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant in the Elastomeric Joint-Sealant Schedule at the end of Part 3, including those referencing ASTM C 920 classifications for type, grade, class, and uses.
- B. Additional Movement Capability: Where additional movement capability is specified in the Elastomeric Joint-Sealant Schedule, provide products with the capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand the specified percentage change in the joint width existing at the time of installation and remain in compliance with other requirements of ASTM C 920 for uses indicated.
- C. Continuous-Immersion-Test-Response Characteristics: Where elastomeric sealants will be immersed continuously in water, provide products that have undergone testing according to ASTM C 1247, including initial six-week immersion period and additional immersion periods specified below, and have not failed in adhesion or cohesion when tested with substrates indicated for Project.
 - 1. Three additional four-week immersion periods.
- D. 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.

2.4 SOLVENT-RELEASE JOINT SEALANTS

- A. Acrylic-Based Solvent-Release Joint-Sealant Standard: Comply with ASTM C 1311 for each product of this description indicated in the Solvent-Release Joint-Sealant Schedule at the end of Part 3.

2.5 LATEX JOINT SEALANTS

- A. Latex Sealant Standard: Comply with ASTM C 834 for each product of this description indicated in the Latex Joint-Sealant Schedule at the end of Part 3.

2.6 PREFORMED JOINT SEALANTS

- A. Preformed Foam Sealants: For each product of this description indicated in the Preformed Joint-Sealant Schedule at the end of Part 3, provide manufacturer's standard preformed, pre-compressed, impregnated, open-cell foam sealant manufactured from high-density urethane foam impregnated with a nondrying, water-repellent agent; factory produced in pre-compressed sizes and in roll or stick form to fit joint widths indicated and to develop a watertight and airtight seal when compressed to the degree specified by manufacturer; and complying with the following:

1. Properties: Permanently elastic, mildew resistant, nonmigratory, nonstaining, and compatible with joint substrates and other joint sealants.
2. Impregnating Agent: Chemically stabilized acrylic.
3. Density: Manufacturer's standard.
4. Backing: Pressure-sensitive adhesive, factory applied to one side with protective wrapping.
5. Sealant: Provide bead of matching medium-modulus silicone at exterior point of contact to masonry.

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. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to **minus 26 deg F**. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.
- 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 SPRAY POLYURETHANE FOAM

- A. Requirements:
 1. Compliance with all applicable codes, including NFPA 286.
 2. Freeze/thaw stable.
 3. Paintable.
 4. UL classified.
 5. Able to fill/seal/insulate gaps up to 3" wide.
 6. Provides durable, airtight, waterproof bond.
 7. Applied with applicator gun.

2.9 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 with 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 to comply with joint sealant manufacturer's written instructions and the following requirements:
 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 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.
 - a. Metal.
 - b. Glass.

- c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- 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 OF JOINT SEALANTS

- A. General: Comply with joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and back of joints.
- E. Install sealants by proven techniques to 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 provided for each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. 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 sealants from surfaces adjacent to joint.
 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.
 4. Provide flush joint configuration, per Figure 5B in ASTM C 1193, where indicated.
 5. Provide recessed joint configuration, per Figure 5C in ASTM C 1193, of recess depth and at locations indicated.
 - a. Use masking tape to protect adjacent surfaces of recessed tooled joints.

3.4 CLEANING

- A. Clean off excess sealants 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 the original work.

3.6 ELASTOMERIC JOINT-SEALANT SCHEDULE

- A. At glass-to-metal, metal-to-metal, metal-to-masonry, and masonry-to-masonry conditions.
1. Medium-Modulus Neutral-Curing Silicone Sealant
 2. Products: Provide one of the following:
 - a. 756 H.P.; Dow Corning.
 - b. Silglaze II; GE Silicones.
 - c. Spectrum 2; Tremco.
 - d. Pecora Corporation.
 3. Type and Grade: S (single component) and NS (nonsag).
 4. Class: 25.
 5. Additional Movement Capability: 50 percent movement in extension and 50 percent movement in compression for a total of 100 percent movement.

6. Uses Related to Exposure: NT (nontraffic).
 7. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
 - a. Use O Joint Substrates: Aluminum coated with a high-performance coating and glass.
 8. Sealant Colors: As selected by Architect from manufacturer's full range of color.
- B. At composite wall panels systems:
1. Medium-Modulus Neutral-Curing Silicone Sealant.
 2. Products: Provide one of the following subject to approval of ACM manufacturer:
 - a. 795; Dow Corning.
 - b. Silpruf; GE Silicones.
 - c. Spectrem 2; Tremco.
 - d. Pecora Corporation.
 3. Type and Grade: S (single component) and NS (nonsag).
 4. Class: 50
 5. Additional Movement Capability: 50% movement in extension and 50% movement in compression for a total of 100% movement.
 6. Use Related to Exposure: NT (nontraffic).
 7. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.
 - a. Uses Related to Exposure: NT (nontraffic).
 8. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
 - a. Use O Joint Substrates: Aluminum coated with a high-performance coating and masonry.
 9. Sealant Colors: As selected by Architect from manufacturer's full range of color as follows:
 - a. ACM panels to dissimilar material: Match ACM color.
- C. At interior fixture-to-flooring and fixture-to-finished wall conditions:
1. Mildew-Resistant Silicone Sealant
 2. Provide products formulated with fungicide that are intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and temperature extremes:
 3. Products: Provide one of the following:
 - a. 786 Mildew Resistant; Dow Corning.
 - b. Sanitary 1700; GE Silicones.
 - c. Tremsil 600 White; Tremco.
 - d. Pecora Corporation.
 4. Type and Grade: S (single component) and NS (nonsag).
 5. Class: 25.
 6. Use Related to Exposure: NT (nontraffic).
 7. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.
 - a. Use O Joint Substrates: Coated glass, color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, and ceramic tile.
 8. Sealant Colors: As selected by Architect from manufacturer's full range of color.]
- D. At horizontal traffic-bearing joints
1. Multicomponent Nonsag Urethane Sealant
 2. Products: Provide one of the following:
 - a. Chem-Calk 2641; Bostik Inc.
 - b. Vulkem 227; Mameco International.
 - c. Vulkem 922; Mameco International.
 - d. Dynatred; Pecora Corporation.
 - e. PSI-270; Polymeric Systems, Inc.
 - f. NP 2; Sonneborn Building Products Div., ChemRex Inc.
 3. Type and Grade: M (multicomponent) and NS (nonsag).
 4. Class: 25.
 5. Uses Related to Exposure: T (traffic) and NT (nontraffic).
 6. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.
 - a. Use O Joint Substrates: brick, concrete.
 7. Sealant Colors: As selected by Architect from manufacturer's full range of color as follows:
 - a. At tile floors: Match grout.
 - b. At other floors: Match flooring.

3.7 LATEX JOINT-SEALANT SCHEDULE

- A. Interior non-movement painted joints
1. Latex Sealant:

2. Products: Provide one of the following:
 - a. Chem-Calk 600; Bostik Inc.
 - b. NuFlex 330; NUCO Industries, Inc.
 - c. LC 160 All Purpose Acrylic Caulk; Ohio Sealants, Inc.
 - d. AC-20; Pecora Corporation.
 - e. PSI-701; Polymeric Systems, Inc.
 - f. Sonolac; Sonneborn Building Products Div., ChemRex, Inc.
 - g. Tremflex 834; Tremco.
3. Applications: Interior, paintable non-movement joints not subjected to temperature change or differential movement of materials.

3.8 PREFORMED JOINT-SEALANT SCHEDULE

- A. Exterior masonry-to-masonry building expansion joints 1 inch wide or greater.
- B. Preformed Foam Sealant: Where joint sealants of this type are indicated, provide products complying with the following:
 1. Products: Provide one of the following:
 - a. Basis of design product: Emseal Colorseal; Emseal Joint Systems, Ltd.
 - b. Polytite Manufacturing Corporation.
 - c. Sealform, Ltd.
 2. Sealant Colors: As selected by Architect from manufacturer's full range of color as follows:
 - a. At brick masonry: Match brick face.

3.9 SPRAY POLYURETHANE FOAM SEALANT SCHEDULE

- A. Provide in gaps in exterior building envelope to seal gaps between construction assemblies as shown on drawings.
- B. Products:
 1. Heatlok Soy - 200.
 2. Equivalent project tested for compliance.

END OF SECTION 07 90 00

SECTION 07 95 00 – EXPANSION CONTROL**PART 1 - GENERAL****1.1 SUMMARY**

- A. Types of joints for which architectural joint systems are specified include the following:
 - 1. Interior wall and ceiling joints.
 - 2. Interior soffit joints.
 - 3. Exterior wall expansion joints
- B. Related Sections include the following:
 - 1. Division 03, Section "Cast-in-Place Concrete" for block-outs and cast-in anchorage and frames for architectural joint systems in concrete floors, and walls.
 - 2. Division 07, Section "Sheet Metal Flashing and Trim" for sheet metal roof and wall joint systems.
 - 3. Division 07, Section "Manufactured Roof Expansion Joints" for factory-fabricated roof joint systems.
 - 4. Division 07, Section "Joint Protection" for elastomeric sealants and preformed compressed-foam sealants without metal frames.

1.2 SUBMITTALS

- A. Product Data: Include manufacturer's product specifications, construction details, material and finish descriptions, and dimensions of individual components and seals.
- B. Shop Drawings: For each joint system specified, provide the following:
 - 1. Placement Drawings: Include line diagrams showing entire route of each joint system, plans, elevations, sections, details, joints, splices, locations of joints and splices, and attachments to other Work. Where joint systems change planes, provide Isometric Drawings depicting how components interconnect to achieve continuity of joint covers and fillers.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain architectural joint systems through one source from a single manufacturer. Coordinate compatibility with adjoining joint systems specified in other Sections. Occasionally we have joints located in fire-rated assemblies.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of architectural joint systems and are based on the specific systems indicated. Other manufacturers' systems complying with requirements may be considered. Refer to Division 01, Section "Product Requirements."
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Basis-of-Design Products: The design for each architectural joint system specified in Part 2 "Architectural Joint Systems" Article below is based on the products named. Subject to compliance with requirements, provide either the named products or comparable products by one of the other manufacturers listed.

2.2 MATERIALS

- A. Aluminum: ASTM B 221, alloy 6063-T5 for extrusions; ASTM B 209, alloy 6061-T6 for sheet and plate.
 - 1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.
- B. Preformed Seals: Single or multicellular extruded elastomeric seals designed with or without continuous, longitudinal, internal baffles. Formed to be installed in frames or with anchored flanges, in color indicated or, if not indicated, as selected by Architect from manufacturer's standard colors.
- C. Accessories: Manufacturer's standard anchors, clips, fasteners, set screws, spacers, flexible moisture barrier and filler materials, drain tubes, lubricants, adhesives, and other accessories compatible with material in contact, as indicated or required for complete installations.

2.3 ARCHITECTURAL JOINT SYSTEMS

- A. General: Provide joint systems of design, basic profile, materials, and operation indicated. Provide units with the capability to accommodate joint widths indicated and variations in adjacent surfaces.
 - 1. Furnish units in longest practicable lengths to minimize number of end joints. Provide hairline mitered corners where joint changes directions or abuts other materials.

2. Include closure materials and transition pieces, tee-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous joint systems.
- B. Architectural Joint System AJSM: Metal frames and covers for joints on masonry walls.
 1. Manufacturers:
 - a. Basis-of-Design Product: C/S Allway System.
 - b. Balco Inc.
 - c. Watson Bowman Acme.
 - d. The C/S Group.
 - e. M.M. Systems.
 2. Nominal Joint Width: As indicated.
 3. Type of Movement Capability: Expansion and contraction.
 4. Cyclic-Movement-Test-Response Characteristics: No evidence of visual fatigue, inability to cycle between designated joint widths, or other types of failure as determined by testing products identical to those indicated per ASTM E 1399 including Appendix X3.
 5. Exposed Cover Material: Aluminum.
 6. Exposed Frame Material: Same material and finish as exposed cover material.
 7. Moisture Barrier: Provide manufacturer's standard unit.
 8. Fire-Resistance Ratings: Provide manufacturer's standard fire barrier with a rating not less than that of adjacent construction.
- C. Architectural Joint System AJSG: Metal frames and covers for joints on gypsum board walls, ceilings, and soffits.
 1. Manufacturers:
 - a. Basis-of-Design Product: C/S Allway System, AFW.
 - b. Balco Inc.
 - c. Watson Bowman Acme.
 - d. The C/S Group.
 - e. M.M. Systems.
 2. Nominal Joint Width: As indicated.
 3. Type of Movement Capability: Expansion and contraction.
 4. Cyclic-Movement-Test-Response Characteristics: No evidence of visual fatigue, inability to cycle between designated joint widths, or other types of failure as determined by testing products identical to those indicated per ASTM E 1399 including Appendix X3.
 5. Exposed Cover Material: Aluminum.
 6. Exposed Frame Material: Same material and finish as exposed cover material.
 7. Moisture Barrier: Provide manufacturer's standard unit.
 8. Fire-Resistance Ratings: Provide manufacturer's standard fire barrier with a rating not less than that of adjacent construction.

2.4 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.5 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrates according to architectural joint system manufacturer's written instructions.
- B. Coordinate and furnish anchorages, Placement Drawings, and instructions for installing joint systems to be embedded in or anchored to concrete or to have recesses formed into edges of concrete slab for later placement and grouting-in of frames.

- C. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary to secure joint systems to in-place construction, including threaded fasteners with drilled-in expansion shields for masonry and concrete where anchoring members are not embedded in concrete. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of joint systems.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for handling and installing architectural joint assemblies and materials, unless more stringent requirements are indicated.
- B. Coordinate installation of architectural joint assembly materials and associated work so complete assemblies comply with assembly performance requirements.
- C. Terminate exposed ends of exterior architectural joint assemblies with factory-fabricated termination devices to maintain waterproof system.
- D. Install factory-fabricated transitions between building expansion-joint cover assemblies and roof expansion-joint assemblies, specified in Division 07, Section "Manufactured Roof Expansion Joints," to provide continuous, uninterrupted, watertight construction.
- E. Metal Frames: Perform cutting, drilling, and fitting required to install joint systems.
1. Install joint cover assemblies in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
 2. Allow adequate free movement for thermal expansion and contraction of metal to avoid buckling.
 3. Set covers in horizontal surfaces at elevations that place exposed surfaces flush with adjoining finishes.
 4. Locate wall, ceiling, and soffit covers in continuous contact with adjacent surfaces.
 5. Securely attach in place with required accessories.
 6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches from each end and not more than 24 inches o.c.
- F. Continuity: Maintain continuity of joint systems with a minimum number of end joints and align metal members. Cut and fit ends to produce joints that will accommodate thermal expansion and contraction of metal to avoid buckling of frames. Adhere flexible filler materials, if any, to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.
- G. Extruded Preformed Seals: Install seals to comply with manufacturer's written instructions and with minimum number of end joints.
1. For straight sections, provide preformed seals in continuous lengths.
 2. Vulcanize or heat-weld field splice joints in preformed seal material to provide watertight joints using procedures recommended by manufacturer.
 3. Apply adhesive, epoxy, or lubricant adhesive approved by manufacturer to both frame interfaces before installing preformed seals.
 4. Seal transitions according to manufacturer's written instructions.
- H. Joint Systems with Seals: Seal end joints within continuous runs and joints at transitions according to manufacturer's written instructions to provide a watertight installation.
- I. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and end joints.

3.3 CLEANING AND PROTECTION

- A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

END OF SECTION 07 95 00

**DIVISION 08
OPENINGS**

SECTION 08 11 13 – HOLLOW METAL DOORS AND FRAMES**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
 - 1. Steel doors and frames, including side lights and borrowed light frames.
- B. Related Sections include the following:
 - 1. Division 04, Section "Unit Masonry" for installing anchors and grouting frames in masonry construction.
 - 2. Division 08, Section "Prefinished Wood Doors" for wood doors installed in interior steel frames.
 - 3. Division 08, Section "Fiberglass Doors" for FRP doors installed in exterior steel frames.
 - 4. Division 08, Section "Door Hardware" for door hardware and weather stripping.
 - 5. [Division 08, Section "Glazing" for glass in glazed openings in doors and frames.
 - 6. Division 09, Section "Gypsum Board Assemblies" for spot-grouting frames installed in steel-framed gypsum board partitions.
 - 7. Division 09, Section "Painting" for field painting factory-primed doors and frames.

1.2 DEFINITIONS

- A. Steel Sheet Thicknesses: Thickness dimensions, including those referenced in ANSI/SDI A250.8, are minimums as defined in referenced ASTM standards for both uncoated steel sheet and the uncoated base metal of metallic-coated steel sheets.

1.3 SUBMITTALS

- A. Shop Drawings: Show the following:
 - 1. Elevations of each door design.
 - 2. Details of doors including vertical and horizontal edge details.
 - 3. Frame details for each frame type including dimensioned profiles.
 - 4. Details and locations of reinforcement and preparations for hardware.
 - 5. Details of each different wall opening condition.
 - 6. Details of anchorages, accessories, joints, and connections.
 - 7. Coordination of glazing frames and stops with glass and glazing requirements.
- B. Door Schedule: Use same reference designations indicated on Drawings in preparing schedule for doors and frames.

1.4 QUALITY ASSURANCE

- A. Steel Door and Frame Standard: Comply with ANSI/SDI A 250.8, unless more stringent requirements are indicated.
- B. Fire-Rated Door 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 252.
 - 1. Test Pressure: Test at atmospheric pressure.
 - 2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a testing agency acceptable to authorities having jurisdiction that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
 - 3. Temperature-Rise Rating: Where indicated, provide doors that have a temperature-rise rating of 450 deg F maximum in 30 minutes of fire exposure.
- C. Fire-Rated Window Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 257.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory-finished doors and frames.
- B. Inspect doors and frames on delivery for damage, and notify shipper and supplier if damage is found. Minor damages may be repaired provided refinished items match new work and are acceptable to Architect. Remove and replace damaged items that cannot be repaired as directed.
- C. Store doors and frames at building site under cover. Place units on minimum 4-inch- high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber. If door packaging becomes wet, remove cartons immediately. Provide minimum 1/4-inch spaces between stacked doors 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. Hollow Metal Doors and Frames:

- a. Amweld Building Products, Inc.
- b. Ceco Door Products; an Assa Abloy Group company.
- c. Curries Company; an Assa Abloy Group company.
- d. D & D Associates, Inc.
- e. Mesker Door, Inc.
- f. Pioneer Industries Inc.
- g. Republic Builders Products.
- h. Steelcraft; an Ingersoll-Rand company.
- i. Fleming Door Products, Ltd.; an Assa Abloy Group company.

2.2 MATERIALS

- A. Hot-Rolled Steel Sheets: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- B. Cold-Rolled Steel Sheets: ASTM A1008/A1008M, Commercial Steel (CS), Type B; stretcher-leveled standard of flatness.
- C. Metallic-Coated Steel Sheets: ASTM A 653/A 653M, Commercial Steel (CS), Type B, with an A60 zinc-iron-alloy (galvannealed) coating; stretcher-leveled standard of flatness.
- D. Supports and Anchors: Fabricated from not less than 18-gauge thick steel sheet; 18-gauge thick A-60 galvannealed steel where used with galvannealed steel frames.
- E. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where items are to be built into exterior walls, hot-dip galvanize complying with ASTM A 153, Class C or D as applicable.
- F. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.

2.3 DOORS

- A. General: Provide doors of sizes, thicknesses, and designs indicated.
- B. Interior Doors: Provide doors complying with requirements indicated below by referencing ANSI/SDI 250.8, for level and model and ANSI/SDI A250.4 for physical-endurance level:
 1. Level 2 and Physical Performance Level B (Heavy Duty), Model 2 (Seamless).
 2. 18 gauge cold rolled steel face.
- C. Exterior Doors: Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8, for level and model and ANSI A250.4 for physical-endurance level:
 1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 (Seamless).
 2. 16-gauge thick metallic-coated steel face.
- D. Vision Lite Systems: Manufacturer's standard kits consisting of glass lite moldings to accommodate glass thickness and size of vision lite indicated.

2.4 FRAMES

- A. General: Provide steel frames for doors, transoms, sidelights, borrowed lights, and other openings that comply with ANSI/SDI A250.8, and with details indicated for type and profile. Conceal fastenings, unless otherwise indicated.
- B. Frames of 16-gauge steel sheet for:
 1. Level 2 steel doors.
 2. Wood doors, unless otherwise indicated.
- C. Frames of 14-gauge steel sheet for:
 1. Door openings wider than 48 inches.
 2. Level 3 steel doors, unless otherwise indicated.
- D. Supports and Anchors: Fabricated from not less than 18-gauge, electrolytic zinc-coated or metallic-coated steel sheet.
 1. Wall Anchors in Masonry Construction: 0.177-inch- diameter, steel wire complying with ASTM A 510 may be used in place of steel sheet.
- E. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where zinc-coated items are to be built into exterior walls, comply with ASTM A 153/A 153M, Class C or D as applicable.

2.5 FABRICATION

- A. General: Fabricate steel door and frame units to comply with ANSI A250.8 and to be rigid, neat in appearance, and free from defects including warp and buckle. Where practical, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at Project site.
- B. Exterior Door Construction: For exterior locations and elsewhere as indicated, fabricate doors, panels, and frames from metallic-coated steel sheet. Close top and bottom edges of doors flush as an integral part of door construction or by addition of 16 ga. thick, metallic-coated steel channels or galvannealed steel channels with channel webs placed even with top and bottom edges.

- C. Interior Door Faces: Fabricate exposed faces of doors and panels, **[including stiles and rails of nonflush units,]** from the following material:
 - 1. Hot-rolled steel sheet.
 - 2. Metallic-coated steel sheet where indicated.
 - 3. Galvanealed sheet steel.
- D. Core Construction: One of the following manufacturer's standard core materials that produce a door complying with SDI standards:
 - 1. Vertical steel stiffeners with 1-lb. density insulation for Level 3 and 4 doors.
 - 2. Rigid mineral-fiber board as required for fire rated doors.
 - 3. Rigid polystyrene conforming to ASTM C 591 for Level 2 interior doors.
- E. Clearances for Non-Fire-Rated Doors: Not more than 1/8 inch at jambs and heads, except not more than 1/4 inch between pairs of doors. Not more than 3/4 inch at bottom.
- F. Clearances for Fire-Rated Doors: As required by NFPA 80.
- G. Single-Acting, Door-Edge Profile: Beveled edge.
- H. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- I. Fabricate concealed stiffeners, reinforcement, edge channels, **[louvers,]** and moldings from either cold- or hot-rolled or galvanealed steel sheet.
- J. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.
- K. Thermal-Rated (Insulating) Assemblies: At exterior locations and elsewhere as shown or scheduled, provide doors fabricated as thermal-insulating door and frame assemblies and tested according to ASTM C1363 on fully operable door assemblies.
 - 1. Unless otherwise indicated, provide thermal-rated assemblies with R-value of 4.0 deg F x h x sq. ft. /BTU or better.
- L. Sound-Rated (Acoustical) Assemblies: Where shown or scheduled, provide door and frame assemblies fabricated as sound-reducing type, tested according to ASTM E 1408, and classified according to ASTM E 413.
 - 1. Unless otherwise indicated, provide acoustical assemblies with STC sound ratings of [33] or better.
- M. Hardware Preparation: Prepare doors and frames to receive mortised and concealed hardware according to final door hardware schedule and templates provided by hardware supplier. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for door and frame preparation for hardware.
 - 1. For concealed overhead door closers, provide space, cutouts, reinforcement, and provisions for fastening in top rail of doors or head of frames, as applicable.
- N. Frame Construction: Fabricate frames to shape shown.
 - 1. Fabricate frames with mitered or coped and continuously welded corners and seamless face joints.
 - 2. Provide welded frames with temporary spreader bars.
- O. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied hardware may be done at Project site.
- P. Locate hardware as indicated on Shop Drawings or, if not indicated, according to ANSI A250.8.
- Q. Glazing Stops: Manufacturer's standard, formed from 22-gauge steel sheet.
 - 1. Provide nonremovable stops on outside of exterior doors and on secure side of interior doors for glass, **[louvers,]** and other panels in doors.
 - 2. Provide screw-applied, removable, glazing stops on inside of glass, **[louvers,]** and other panels in doors.
 - 3. Astragals: As required by NFPA 80 to provide fire ratings indicated.

2.6 FINISHES

- A. Prime Finish: Manufacturer's standard, factory-applied coat of rust-inhibiting primer complying with ANSI/SDI A250.10 for acceptance criteria.
- B. Galvaneal steel doors and frames shall receive manufacturer's standard rust prohibitive treatment for dry passivation process or factory-applied coat of rust inhibiting primer conforming to ANSI/SDI A250.10 for acceptance criteria.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install steel doors, frames, and accessories according to Shop Drawings, manufacturer's data, and as specified.
- B. Placing Frames: Comply with provisions in ANSI/SDI A250.11, unless otherwise indicated. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
 - 1. Except for frames located in existing walls or partitions, place frames before construction of enclosing walls and ceilings.

2. In masonry construction, provide at least three wall anchors per jamb; install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Acceptable anchors include masonry wire anchors and masonry T-shaped anchors.
 3. In existing concrete or masonry construction, provide at least three completed opening anchors per jamb; install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Set frames and secure to adjacent construction with bolts and masonry anchorage devices.
 4. In metal-stud partitions, provide at least three wall anchors per jamb; install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Attach wall anchors to studs with screws.
 5. Install fire-rated frames according to NFPA 80.
 6. For openings 90 inches or more in height, install an additional anchor at hinge and strike jambs.
- C. Door Installation: Comply with ANSI A250.8. Fit hollow-metal doors accurately in frames, within clearances specified in ANSI A250.8. Shim as necessary to comply with SDI 122 and ANSI/DHI A115.1G.
1. Fire-Rated Doors: Install within clearances specified in NFPA 80.
 2. Smoke-Control Doors: Install to comply with NFPA 105.

3.2 ADJUSTING AND CLEANING

- A. Prime-Coat Touchup: Immediately after installation, sand smooth any rusted or damaged areas of prime coat and apply touch up of compatible air-drying primer.
- B. Dry passivated galvanized steel doors and frames shall be cleaned to remove foreign materials prior to finish painting. Deep scratches inflicted on galvanized doors and frames shall be repaired with the application of zinc-rich primer, either brush or spray applied after the surface has been cleaned.

END OF SECTION 08 11 13

SECTION 08 14 29 – PREFINISHED WOOD DOORS**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
 1. Solid-core doors with wood-veneer faces (stain finish).
 2. Factory finishing flush wood doors.
 3. Factory fitting flush wood doors to frames and factory machining for hardware.
- B. Related Sections include the following:
 1. Division 08, Section "Glazing" for glass view panels in flush wood doors.

1.2 SUBMITTALS

- A. 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 doors to be factory finished and finish requirements.
 4. Indicate fire ratings for fire doors.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain flush wood doors through one source from a single manufacturer.
- B. Quality Standard: Comply with the following standard:
 1. AWI Quality Standard: AWI's "Architectural Woodwork Quality Standards" for grade of door, core, construction, finish, and other requirements.
- C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
 1. Temperature-Rise Rating: At stairwell enclosures, provide doors that have a temperature-rise rating of 450 deg F maximum in 30 minutes of fire exposure.
 2. Labeled wood for fire doors shall comply with UL 10C for positive pressure and smoke and draft control. Coordinate requirements of UL 10C with Division 08, Section "Door Hardware". Category B Doors with "S" label to be validated.
 3. Door producer shall certify the finish hardware schedule.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect doors during transit, storage, and handling to prevent damage, soiling, and deterioration. Comply with requirements of referenced standard and manufacturer's written instructions.
 1. Individually package doors in cardboard cartons and wrap bundles of doors in plastic sheeting.
- B. Mark each door with individual opening numbers used on Shop Drawings. Use removable tags or concealed markings.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until building is enclosed, wet-work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

1.6 WARRANTY

- A. General Warranty: Door manufacturer's warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Door Manufacturer's Warranty: Submit written agreement on door manufacturer's standard form, signed by manufacturer, Installer, and Contractor, agreeing to repair or replace defective doors that have warped (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section or that show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span, or do not comply with tolerances in referenced quality standard.
 1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 2. Warranty shall be in effect during the following period of time after the date of Substantial Completion:
 - a. 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. Flush Wood Doors:
 - a. Algoma Hardwoods Inc.
 - b. Eggers Industries.
 - c. Oshkosh Architectural Door Co.
 - d. V-T Industries Inc.
 - e. Marshfield Door Systems Inc.
 - f. Lambton Doors.
 - g. Mohawk Flush Doors Inc.; a Masonite company.
 - h. Graham; an Assa Abloy Group company.

2.2 DOOR CONSTRUCTION, GENERAL

- A. Doors for Transparent Finish: Comply with the following requirements:
 1. Grade: Custom (Grade A faces).
 2. Faces: Birch, plain sliced.
 3. Match between Veneer Leaves: Book match.
 4. Match within Door Faces: Running match.
 5. Pair and Set Match: Provide for pairs of doors and for doors hung in adjacent sets.
 6. Stiles: Same species as face.

2.3 SOLID-CORE DOORS

- A. Interior Veneer-Faced Doors: Comply with the following requirements:
 1. Core: Structural Composite Lumber (SCL) Core: SCL-5.
 2. Construction: Five plies with stiles and rails bonded to core, then entire unit abrasive planed before veneering.
 3. 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 doors indicated to have kick, mop, or armor plates.
 - c. 5-inch midrail blocking, in doors to have exit devices.
- B. Fire-Rated Doors: Comply with the following requirements:
 1. Construction: Construction and core specified above for type of face indicated or manufacturer's standard mineral-core construction as required to provide fire rating indicated.
 2. Blocking: For mineral-core doors, provide composite blocking with improved screw-holding capability approved for use in doors of fire ratings indicated and as follows:
 - a. As necessary to eliminate need for through-bolting hardware.
 3. Edge Construction: At hinge stiles, provide manufacturer's standard laminated-edge construction with improved screw-holding capability and split resistance and with outer stile matching face veneer.
 4. Pairs: Provide fire-rated pairs with fire-retardant stiles that are labeled and listed for kinds of applications indicated without formed-steel edges and astragals.

2.4 LITE FRAMES

- A. Wood Beads for Light Openings in Wood Doors:
 1. Wood Species: Same species as door faces.
 2. Profile: Manufacturer's standard shape.
 3. At 20-minute, fire-rated, wood-core doors, provide wood beads and metal glazing clips approved for such use.
- B. Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.0478-inch- thick, cold-rolled steel sheet, factory primed and approved for use in doors of fire rating indicated.

2.5 FABRICATION

- A. Fabricate flush wood doors in sizes indicated for Project site fitting.
- B. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels, unless otherwise indicated:
 1. Comply with clearance requirements of referenced quality standard for fitting. Comply with requirements of NFPA 80 for fire-rated doors.
- C. 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 measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.
- D. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of door(s) required.
 1. Light Openings: Trim openings with moldings of material and profile indicated.
 2. [Louvers: Factory install louvers in prepared openings.]

2.6 FACTORY FINISHING

- A. General: Comply with referenced quality standard's requirements for factory finishing.
- B. Finish wood doors at factory.
- C. Transparent Finish: Comply with requirements indicated for grade, finish system, staining effect, and sheen.
 - 1. Grade: Premium.
 - 2. Staining: As selected by Architect from manufacturer's full range of colors.
 - 3. Effect: Filled finish.
 - 4. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine 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 plumb jambs and level heads.
 - 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Division 08, Section "Door Hardware."
- B. Manufacturer's Written Instructions: Install wood doors to comply with manufacturer's written instructions, 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 AND PROTECTING

- A. Operation: Re-hang or replace doors that do not swing or operate freely.
- B. Finished Doors: Refinish or replace doors damaged during installation.
- C. Protect doors as recommended by door manufacturer to ensure that wood doors are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 08 14 29

SECTION 08 41 13 – ALUMINUM ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Exterior entrance systems.
 - 2. Exterior Sun Control devices
- B. Related sections include the following:
 - 1. Division 07, Section "Joint Protection" for joint sealants installed as part of aluminum entrance and storefront systems.
 - 2. Division 08, Section "Door Hardware" for hardware items not specified under this section.
 - 3. Division 08, Section "Glazing."

1.2 SYSTEM DESCRIPTION

- A. General: Provide aluminum entrance and storefront systems capable of withstanding loads and thermal and structural movement requirements indicated without failure, based on testing manufacturer's standard units in assemblies similar to those indicated for this Project. Failure includes the following:
 - 1. Air infiltration and water penetration exceeding specified limits.
 - 2. Framing members transferring stresses, including those caused by thermal and structural movement, to glazing units.
- B. Glazing: Physically and thermally isolate glazing from framing members.
- C. Thermally Broken Construction: Provide systems that isolate aluminum exposed to exterior from aluminum exposed to interior with a material of low thermal conductance.
- D. Wind Loads: Provide entrance and storefront systems, including anchorage, capable of withstanding wind-load design pressures calculated according to requirements of authorities having jurisdiction or the American Society of Civil Engineers' ASCE 7, "Minimum Design Loads for Buildings and Other Structures," 6.4.2, "Analytical Procedure," whichever are more stringent.
 - 1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches and 1/240 of clear span plus ¼ inch for spans greater than 14 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to ¾ inch, whichever is less.
 - 2. Static-Pressure Test Performance: Provide entrance and storefront systems that do not evidence material failures, structural distress, failure of operating components to function normally, or permanent deformation of main framing members exceeding 0.2 percent of clear span when tested according to ASTM E 330.
 - a. Test Pressure: 150 percent of inward and outward wind-load design pressures.
 - b. Duration: As required by design wind velocity; fastest 1 mile of wind for relevant exposure category.
- E. Seismic Loads: Provide entrance and storefront systems, including anchorage, capable of withstanding the effects of earthquake motions calculated according to requirements of authorities having jurisdiction or ASCE 7, "Minimum Design Loads for Buildings and Other Structures," Section 9, "Earthquake Loads," whichever are more stringent.
- F. Dead Loads: Provide entrance- and storefront-system members that do not deflect an amount which will reduce glazing bite below 75 percent of design dimension when carrying full dead load.
 - 1. Provide a minimum 1/8-inch clearance between members and top of glazing or other fixed part immediately below.
 - 2. Provide a minimum 1/16-inch clearance between members and operable windows and doors.
- G. Live Loads: Provide entrance and storefront systems, including anchorage, that accommodate the supporting structures' deflection from uniformly distributed and concentrated live loads indicated without failure of materials or permanent deformation.
- H. Air Infiltration: Provide entrance and storefront systems with permanent resistance to air leakage through fixed glazing and frame areas of not more than 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a static-air-pressure difference of 6.24 lbf/sq. ft.
- I. Water Penetration: Provide entrance and storefront systems that do not evidence water leakage through fixed glazing and frame areas when tested according to ASTM E 331 at minimum differential pressure of 20 percent of inward-acting wind-load design pressure as defined by ASCE 7, "Minimum Design Loads for Buildings and Other Structures," but not less than 12.0 lbf/sq. ft. Water leakage is defined as follows:
 - 1. Uncontrolled water infiltrating systems or appearing on systems' normally exposed interior surfaces from sources other than condensation. Water controlled by flashing and gutters that is drained back to the exterior and cannot damage adjacent materials or finishes is not water leakage.
- J. Thermal Movements: Provide entrance and storefront systems, including anchorage, that accommodate thermal movements of systems and supporting elements resulting from the following maximum change (range) in ambient and surface temperatures without buckling, damaging stresses on glazing, failure of joint sealants, damaging loads on fasteners, failure of doors or other operating units to function properly, and other detrimental effects.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- K. Structural-Support Movement: Provide entrance and storefront systems that accommodate structural movements including, but not limited to, sway and deflection.
- L. Condensation Resistance: Provide storefront systems with condensation resistance factor (CRF) of not less than 53 when tested according to AAMA 1503.1.
- M. Average Thermal Conductance: Provide storefront systems with average U-values of not more than 0.45 Btu/sq. ft. x h x deg F when tested according to AAMA 1503.1.
- N. Dimensional Tolerances: Provide entrance and storefront systems that accommodate dimensional tolerances of building frame and other adjacent construction.

1.3 SUBMITTALS

- A. Product Data: For each product specified. Include details of construction relative to materials, dimensions of individual components, profiles, and finishes.
- B. Shop Drawings: For entrance and storefront systems. Show details of fabrication and installation, including plans, elevations, sections, details of components, provisions for expansion and contraction, and attachments to other work.
 1. For entrance systems, include hardware schedule and indicate operating hardware types, quantities, and locations.
- C. Samples for Verification: Of each type of exposed finish required in manufacturer's standard sizes. Where finishes involve normal color and texture variations, include Sample sets showing the full range of variations expected.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer to assume engineering responsibility and perform work of this Section who has specialized in installing entrance and storefront systems similar to those required for this Project and who is acceptable to manufacturer.
 1. Engineering Responsibility: Prepare data for entrance and storefront systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Source Limitations: Obtain each type of entrance and storefront system through one source from a single manufacturer.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of entrance and storefront systems and are based on the specific systems indicated. Other manufacturers' systems with equal performance characteristics may be considered. Refer to Division 01, Section "Substitutions."
 1. Do not modify intended aesthetic effect, as judged solely by Architect, except with Architect's approval and only to the extent needed to comply with performance requirements. Where modifications are proposed, submit comprehensive explanatory data to Architect for review.
- D. Welding Standards: Comply with applicable provisions of AWS D1.2, "Structural Welding Code--Aluminum."

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating systems without field measurements. Coordinate construction to ensure actual dimensions correspond to established dimensions.

1.6 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: Submit a written warranty executed by the manufacturer agreeing to repair or replace components of entrance and storefront systems that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, the following:
 1. Structural failures including, but not limited to, excessive deflection.
 2. Failure of system to meet performance requirements.
 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 4. Failure of operating components to function normally.
 5. Water leakage through fixed glazing and frame areas.
- C. Warranty Period: 2 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 manufacturers comparable to the basis of design product listed:
 - 1. EFCO Corp., S406, Basis of Design.
 - 2. Oldcastle Glass Engineered Products.
 - 3. Kawneer North America; an Alcoa company.
 - 4. U.S. Aluminum
 - 5. Tubelite
 - 6. YKK AP America Inc.
 - 7. Wausau Window and Wall Systems.
 - 8. Traco.
- B. Sun Control Device Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers comparable to the basis of design product listed:
 - 1. EFCO Corp., XTherm E-Shade (Basis of Design)
 - 2. Kawneer North America
 - 3. The Aerolite Company
 - 4. Construction Specialties

2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated, complying with the requirements of standards indicated below.
 - 1. Sheet and Plate: ASTM B 209.
 - 2. Extruded Bars, Rods, Shapes, and Tubes: ASTM B 221.
 - 3. Extruded Structural Pipe and Tubes: ASTM B 429.
 - 4. Bars, Rods, and Wire: ASTM B 211.
 - 5. Welding Rods and Bare Electrodes: AWS A5.10.
- B. Steel Reinforcement: Complying with ASTM A 36 for structural shapes, plates, and bars; ASTM A 611 for cold-rolled sheet and strip; or ASTM A 570 for hot-rolled sheet and strip.
- C. Glazing as specified in Division 08, Section "Glazing."
- D. Glazing Gaskets: Manufacturer's standard pressure-glazing system of black, resilient glazing gaskets, setting blocks, and shims or spacers, fabricated from an elastomer of type and in hardness recommended by system and gasket manufacturer to comply with system performance requirements. Provide gasket assemblies that have corners sealed with sealant recommended by gasket manufacturer.
- E. Framing system gaskets, sealants, and joint fillers as recommended by manufacturer for joint type.
- F. Sealants and joint fillers for joints at perimeter of entrance and storefront systems as specified in Division 07, Section "Joint Protection".
- G. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements, except containing no asbestos, formulated for 30-mil thickness per coat.

2.3 COMPONENTS

- A. Storefront Framing System: Provide inside-outside matched resilient flush-glazed storefront framing system with provisions for glass replacement. Shop-fabricate and preassemble frame components in all locations possible. Note to general contractor all masonry openings where dimensional tolerance must be maintained and the required tolerances, the frame shall have depth of 6-1/2", face dimension of not less than 2" and nominal material wall thickness to be .080" min.
 - 1. Thermal-Break Construction: Fabricate storefront framing system with integrally concealed, low conductance thermal barrier, located between exterior materials and exposed interior members to eliminate direct metal-to-metal contact. Use manufacturer's standard construction that has been in use for similar projects for period of not less than 3 years.
 - 2. Aluminum storefront frames to have extruded aluminum sub-sills.
 - 3. Provide extruded aluminum high performance thermal flashing (storefront pan sill) as indicated on drawing or where sill condition does not allow water drain of storefront system to exit the exterior of building. Sill pan should have mechanically fastened end dam.
 - 4. Provide extruded aluminum head and jamb receptors.
- B. Aluminum Door Frames: Fabricate tubular and channel frame assemblies, as indicated, with welded or mechanical joints in accordance with manufacturer's standards; reinforce as necessary to support required loads.

- C. Doors: Provide manufacturer's standard 2-inch- thick glazed doors with minimum 0.1875-inch- thick, extruded tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deep penetration and fillet welded or that incorporate concealed tie-rods.
 - 1. Glazing Stops and Gaskets: Provide manufacturer's standard snap-on extruded-aluminum glazing stops and preformed gaskets.
 - 2. Stile Design: 5-inches width.
 - 3. Manufacturers:
 - a. EFCO Corp., Durastile #518 (Heavy-Duty Doors), Basis of Design,
 - b. Old Castle Glass Engineered Products.
 - c. Kawneer North America; an Alcoa company.
 - d. U.S. Aluminum.
 - e. Tubelite.
 - f. YKK AP America Inc.
 - g. Wausau Window and Wall Systems.
 - h. Traco.
- D. Brackets and Reinforcements: Provide manufacturer's standard brackets and reinforcements that are compatible with adjacent materials. Provide non-staining, nonferrous shims for aligning system components.
- E. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.
 - 1. Reinforce members as required to retain fastener threads.
 - 2. Do not use exposed fasteners, except for hardware application. For hardware application, use countersunk Phillips flat-head machine screws finished to match framing members or hardware being fastened, unless otherwise indicated.
- F. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123 or ASTM A 153 requirements.
- G. Concealed Flashing: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding flashing, compatible with adjacent materials, and of type recommended by manufacturer.
- H. Weather Stripping: Manufacturer's standard replaceable weather stripping as follows:
 - 1. Compression Weather Stripping: Molded neoprene complying with ASTM D 2000 requirements or molded PVC complying with ASTM D 2287 requirements.
 - 2. Sliding Weather Stripping: Wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing complying with AAMA 701 requirements.

2.4 EXTERIOR SUN CONTROL DEVICE

- A. Sun Control system is comprised of outriggers, rowers, fascia, and required accessories anchored directly to curtain wall vertical mullions
- B. Fabricate components true to detail and free from defects impairing appearance, strength or durability. Fabricate custom extrusions as necessary for complete installation.
- C. Fabricate components to allow for accurate and rigid fit of joints and corners. Match components carefully ensuring continuity of line and design. Ensure joints and connections will be flush.
- D. Sun control devices shall be used in conjunction with punched openings, shall have end caps installed on each end, attach to shelf struts.
- E. Shape: As selected from manufacturer's standard configuration.
- F. Color: As selected by Architect from Manufacturer's full range.

2.5 HARDWARE

- A. General: Provide heavy-duty hardware units indicated in sizes, number, and type recommended by manufacturer for entrances indicated. Finish exposed parts to match door finish, unless otherwise indicated.
- B. Continuous Gear Hinges: As specified in Division 08, Section "Door Hardware."
- C. Surface-Mounted Overhead Closers: As specified in Division 08, Section "Door Hardware."
- D. Cylinders: As specified in [Division 08, Section "Door Hardware."
- E. Rim-Mounted Exit Devices: As specified in Division 08, Section "Door Hardware."
- F. Removable Mullions: As specified in Division 08, Section "Door Hardware."
- G. Thresholds: At exterior doors, provide manufacturer's standard threshold with cutouts coordinated for operating hardware, with anchors and jamb clips, and not more than **1/2-inch-** high, with beveled edges providing a floor level change with a slope of not more than 1:2, and in the following material:
 - 1. Material: Aluminum, mill finish.
- H. Weather Sweeps: Manufacturer's standard weather sweep for application to exterior door bottoms and with concealed fasteners on mounting strips.

2.6 FABRICATION

- A. General: Fabricate components that, when assembled, will have accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.
 - 1. Fabricate components for shear-block frame construction.
- B. Forming: Form shapes with sharp profiles, straight and free of defects or deformations, before finishing.
- C. Prepare components to receive concealed fasteners and anchor and connection devices.
- D. Fabricate components to drain water passing joints and condensation and moisture occurring or migrating within the system to the exterior.
- E. Welding: Weld components to comply with referenced AWS standard. Weld before finishing components to greatest extent possible. 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.
- F. Glazing Channels: Provide minimum clearances for thickness and type of glass indicated according to FGMA's "Glazing Manual."
- G. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- H. Storefront: Fabricate framing in profiles indicated for flush glazing (without projecting stops). Provide subframes and reinforcing of types indicated or, if not indicated, as required for a complete system. Factory assemble components to greatest extent possible. Disassemble components only as necessary for shipment and installation.
- I. Entrances: Fabricate door framing in profiles indicated. Reinforce as required to support imposed loads. Factory assemble door and frame units and factory install hardware to greatest extent possible. Reinforce door and frame units as required for installing hardware indicated. Cut, drill, and tap for factory-installed hardware before finishing components.
 - 1. Exterior Doors: Provide compression weather stripping at fixed stops. At other locations, provide sliding weather stripping retained in adjustable strip mortised into door edge.
 - 2. Where door stops are interrupted for installation of rim mounted exit devices provide a snap-in filler with applied weather-stripping to seal perimeter of door frame.

2.7 ALUMINUM FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.
- B. 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.
- C. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.
- D. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: non-specular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
 - 1. Color: Dark bronze.

2.8 STEEL PRIMING

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying primer.
- B. Surface Preparation: Perform manufacturer's standard cleaning operations to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel.
- C. Priming: Apply manufacturer's standard corrosion-resistant primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of entrance and storefront systems. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with manufacturer's written instructions for protecting, handling, and installing entrance and storefront systems. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.

- B. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. 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 and condensation and moisture occurring or migrating within the system to the exterior.
- D. Set continuous sill members and flashing in a full sealant bed to provide weathertight construction, unless otherwise indicated. Comply with requirements of Division 07, Section "Joint Protection."
- E. Install framing components plumb and true in alignment with established lines and grades without warp or rack of framing members.
- F. Install entrances plumb and true in alignment with established lines and grades without warp or rack. Lubricate operating hardware and other moving parts according to hardware manufacturers' written instructions.
 - 1. Install surface-mounted hardware according to manufacturer's written instructions using concealed fasteners to greatest extent possible.
- G. Install glazing to comply with requirements of Division 08, Section "Glazing," unless otherwise indicated.
- H. Install perimeter sealant to comply with requirements of Division 07, Section "Joint Protection," unless otherwise indicated.
- I. Erection Tolerances: Install entrance and storefront systems to comply with the following maximum tolerances:
 - 1. Variation from Plane: Limit variation from plane or location shown to 1/8 inch in 12 feet; 1/4 inch over total length.
 - 2. Alignment: Where surfaces abut in line, limit offset from true alignment to 1/16 inch. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.
 - 3. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch.

3.3 ADJUSTING AND CLEANING

- A. Adjust doors and hardware to provide tight fit at contact points and weather stripping, smooth operation, and weathertight closure.
- B. Remove excess sealant and glazing compounds, and dirt from surfaces.

3.4 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure entrance and storefront systems are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 08 41 13

SECTION 08 71 00 – DOOR HARDWARE (COVER)

See Door Hardware Specification – attached.

SECTION 08 71 00 – DOOR HARDWARE**GENERAL****1.1 SUMMARY**

- A. Section includes:
 1. Mechanical and electrified door hardware
 2. Electronic access control system components
- B. Section excludes:
 1. Windows
 2. Cabinets (casework), including locks in cabinets
 3. Signage
 4. Toilet accessories
 5. Overhead doors
- C. Related Sections:
 1. Division 01 Section "Alternates" for alternates affecting this section.
 2. Division 06 Section "Rough Carpentry"
 3. Division 06 Section "Finish Carpentry"
 4. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
 5. Division 08 Sections:
 - a. "Metal Doors and Frames"
 - b. "Flush Wood Doors"
 - c. "Stile and Rail Wood Doors"
 - d. "Interior Aluminum Doors and Frames"
 - e. "Aluminum-Framed Entrances and Storefronts"
 - f. "Stainless Steel Doors and Frames"
 - g. "Special Function Doors"
 - h. "Entrances"
 6. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
 7. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.

1.2 REFERENCES

- A. UL LLC
 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. Keying Systems and Nomenclature
 4. Installation Guide for Doors and Hardware
- C. NFPA – National Fire Protection Association
 1. NFPA 70 – National Electric Code
 2. NFPA 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives
 3. NFPA 101 – Life Safety Code
 4. NFPA 105 – Smoke and Draft Control Door Assemblies
 5. NFPA 252 – Fire Tests of Door Assemblies
- D. ANSI - American National Standards Institute
 1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
 2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
 3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
 4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
 5. ANSI/SDI A250.8 - Standard Steel Doors and Frames

1.3 SUBMITTALS

- A. General:

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
 2. Prior to forwarding submittal:
 - a. Review drawings and Sections from related trades to verify compatibility with specified hardware.
 - b. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.
- B. Action Submittals:**
1. Product Data: Submit 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 of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.
 - a. Samples will be returned to supplier. 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:
 - a. Submit 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 critical in Project construction schedule.
 - b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
 - c. Indicate complete designations of each item required for each opening, include:
 - 1) Door Index: door number, heading number, and Architect's hardware set number.
 - 2) Quantity, type, style, function, size, and finish of each hardware item.
 - 3) Name and manufacturer of each item.
 - 4) Fastenings and other pertinent information.
 - 5) Location of each hardware set cross-referenced to indications on Drawings.
 - 6) Explanation of all abbreviations, symbols, and codes contained in schedule.
 - 7) Mounting locations for hardware.
 - 8) Door and frame sizes and materials.
 - 9) Degree of door swing and handing.
 - 10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.
 5. Key Schedule:
 - a. After Keying Conference, provide keying schedule that includes levels of keying, explanations 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. 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.
- C. Informational Submittals:**
1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
 2. Provide Product Data:
 - a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
 - b. Include warranties for specified door hardware.
- 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. Final approved hardware schedule edited to reflect conditions as installed.
- d. Final keying schedule
- e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
- f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

E. Inspection and Testing:

1. Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:
 - a. Fire door assemblies, in compliance with NFPA 80.
 - b. Required egress door assemblies, in compliance with NFPA 101.

1.4 QUALITY ASSURANCE

A. Qualifications and Responsibilities:

1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
3. Architectural Hardware Consultant: 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:
 - a. For door hardware: DHI certified AHC or DHC.
 - b. Can provide installation and technical data to Architect and other related subcontractors.
 - c. Can inspect and verify components are in working order upon completion of installation.
 - d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.
4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

B. Certifications:

1. Fire-Rated Door Openings:
 - a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
 - b. Provide only items of door hardware that are listed products tested by UL LLC, 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.
2. Smoke and Draft Control Door Assemblies:
 - a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105
 - b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.
3. Electrified Door Hardware
 - a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.
4. Accessibility Requirements:
 - a. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.

C. Pre-Installation Meetings

1. Keying Conference
 - a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
 - 1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - 2) Preliminary key system schematic diagram.
 - 3) Requirements for key control system.
 - 4) Requirements for access control.

- 5) Address for delivery of keys.
2. Pre-installation Conference
 - a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - b. Inspect and discuss preparatory work performed by other trades.
 - c. Inspect and discuss electrical roughing-in for electrified door hardware.
 - d. Review sequence of operation for each type of electrified door hardware.
 - e. Review required testing, inspecting, and certifying procedures.
 - f. Review questions or concerns related to proper installation and adjustment of door hardware.
3. Electrified Hardware Coordination Conference:
 - a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.
- 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. Deliver each article of hardware in manufacturer's original packaging.
- C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
- D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.
- F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.6 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop 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.

1.7 WARRANTY

- A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.
 1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
 2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.

1.8 MAINTENANCE SERVICE

- A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.
- B. Turn over unused materials to Owner for maintenance purposes.

PRODUCTS

1.9 MANUFACTURERS

- A. The Owner requires use of certain products for their unique characteristics and project suitability to ensure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: "No Substitute."
 1. Where "No Substitute" is noted, submittals and substitution requests for other products will not be considered.
- B. Approval of alternate manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category are only to be considered by official substitution request in accordance with section 01 25 00.
- C. 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.

- D. 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.
- E.

1.10 MATERIALS

- A. Fabrication
 - 1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer's recognized installation standards for application intended.
 - 2. Finish exposed 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 wherever possible for hardware units exposed when door is closed. Coordinate with "Metal Doors and Frames", "Flush Wood Doors", "Stile and Rail Wood Doors" to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.
- 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.
- C. Cable and Connectors:
 - 1. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with number and gage of wires enough to accommodate electric function of specified hardware.
 - 2. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices.
 - 3. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

1.11 HINGES

- A. Manufacturers and Products:
 - 1. Scheduled Manufacturer and Product:
 - a. Ives 5BB series (Owner Preferred)
 - 2. Acceptable Manufacturers and Products:
 - a. Hager BB1279 series
- B. Requirements:
 - 1. Provide hinges conforming to ANSI/BHMA A156.1.
 - 2. Provide five knuckle, ball bearing hinges.
 - 3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
 - a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
 - b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
 - 4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
 - a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
 - 5. 2 inches or thicker doors:
 - a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
 - 6. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
 - 7. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
 - 8. 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
 - 9. Provide hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component. Provide mortar guard for each electrified hinge specified.

1.12 CONTINUOUS HINGES

- A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives (Owner Preferred)
 2. Acceptable Manufacturers:
 - a. Hager
- B. Requirements:
1. Provide pin and barrel continuous hinges conforming to ANSI/BHMA A156.26., Grade 1.
 2. Provide pin and barrel continuous hinges fabricated from 14-gauge, type 304 stainless steel.
 3. Provide twin self-lubricated nylon bearings at each hinge knuckle, with 0.25-inch (6 mm) diameter stainless steel pin.
 4. Provide hinges capable of supporting door weights up to 600 pounds, and successfully tested for 1,500,000 cycles.
 5. On fire-rated doors, provide pin and barrel continuous hinges classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
 6. Provide pin and barrel continuous hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
 7. Install hinges with fasteners supplied by manufacturer.
 8. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

1.13 CONTINUOUS HINGES

- A. Manufacturers:
1. Scheduled Manufacturer:
 - a. Ives (Owner Preferred)
 2. Acceptable Manufacturers:
 - a. Hager
- B. Requirements:
1. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
 2. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
 3. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
 4. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
 5. On fire-rated doors, provide aluminum geared continuous hinges classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
 6. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
 7. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

1.14 ELECTRIC POWER TRANSFER

- A. Manufacturers:
1. Scheduled Manufacturer and Product:
 - a. Von Duprin EPT-10 (Owner Preferred)
 2. Acceptable Manufacturers and Products:
 - a. ABH
- B. Requirements:
1. Provide power transfer with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
 2. Locate electric power transfer per manufacturer's template and UL requirements, unless interference with operation of door or other hardware items.

1.15 MORTISE LOCKS

- A. Manufacturers and Products:
1. Scheduled Manufacturer and Product:
 - a. Schlage L9000 series (Owner Preferred)
 2. Acceptable Manufacturers and Products:
 - a. Sargent 8200 series
- B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3-hour fire doors.
2. Indicators: Where specified, provide indicator window measuring a minimum 2-inch x 1/2 inch with 180-degree visibility. Provide messages color-coded with full text and/or symbols, as scheduled, for easy visibility.
 - a. Outside Occupancy Indicator: Provide indicator above cylinder or emergency release for visibility while operating the lock that identifies an occupied/unoccupied status of the lock or latch.
3. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
4. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to "KEYING" article, herein.
5. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1-inch (25 mm) throw, constructed of stainless steel.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide switches and sensors integrated into the locks and latches.
7. Provide electrified options as schedule in the hardware sets. Where scheduled, provide switches and sensors integrated into the locks and latches.
8. Provide motor based electrified locksets that comply with the following requirements:
 - a. Universal input voltage – single chassis accepts 12 or 24VDC to allow for changes in the field without changing lock chassis.
 - b. Fail Safe/Fail Secure – changing mode between electrically locked (fail safe) and electrically unlocked (fail secure) is field selectable without opening the lock case.
 - c. Low maximum current draw – maximum 0.4 amps to allow for multiple locks on a single power supply.
 - d. Low holding current – maximum 0.01 amps to produce minimal heat, eliminate "hot levers" in electrically locked applications, and to provide reliable operation in wood doors that provide minimal ventilation and air flow.
 - e. Request to Exit Switch (RX)
 - f. Modular Design - provide electrified locks capable of using, adding, or changing a modular RX switch without opening the lock case.
 - g. Monitoring - where scheduled, provide a request to exit (RX) switch that detects rotation of the inside lever.
 - h. Latchbolt Monitor Switch (LX)
 - i. Monitoring - where scheduled, provide a latchbolt monitor (LX) switch that indicates the latchbolt position.
 - j. Door Position Sensor (DPS)
 - k. Monitoring - where scheduled, provide a door position sensor (DPS) switch that detects the position of the door in relation to the frame.
 - l. Connections – provide quick-connect Molex system standard.
9. 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: 03A.
 - b. Tactile Warning (Knurling): Where required by authority having jurisdiction (AHJ). Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.

1.16 EXIT DEVICES

- A. Manufacturers and Products:
 1. Scheduled Manufacturer and Product:
 - a. Von Duprin 99/33A series (Owner Preferred)
 2. Acceptable Manufacturers and Products:
 - a. Dexter 10/40 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.
 2. Cylinders: Refer to "KEYING" article, herein.
 3. Provide grooved touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
 4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
 5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
 6. Provide flush end caps for exit devices.
 7. Provide exit devices with manufacturer's approved strikes.
 8. 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.

9. 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.
10. Provide cylinder or hex-key dogging as specified at non fire-rated openings.
11. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) 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.
12. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
13. Provide electrified options as scheduled. QEL devices only for access controlled openings.
14. Top latch mounting: double- or single-tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.
15. Rim x Rim x Keyed removeable mullion is Owners preference for pairs.
16. Avoid use of concealed vertical rod devices. Surface vertical rod is Owners preference where required.
17. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.
 - a. Tactile Warning (Knurling): Where required by authority having jurisdiction (AHJ). Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.

1.17 ACCESS CONTROL READER

- A. Manufacturers and Products:
 1. Scheduled Manufacturer and Product:
 - a. Schlage MTB11/MTB15 series
 2. Acceptable Manufacturers and Products:
 - a. No Substitute
- B. Requirements:
 1. Provide access control card readers manufactured by a global company who is a recognized leader in the production of access control devices. Card reader manufactured for non-access control applications are not acceptable
 2. Provide multi-technology contactless readers which can read access control data from both 125 kHz and 13.56 MHz contactless smart cards and NFC-compatible. Provide multi-technology contactless reader optimally designed for use in access control applications that require reading both 125 kHz Proximity and 13.56 MHz contactless smart cards by providing:
 - a. Configuration allows reader to be enabled to read smart, proximity or both technologies at the same time.
 - b. A migration platform to upgrade from the most popular 125 kHz proximity technology to MIFARE or MIFARE DESFire EV1 by reading both 125 kHz proximity technology and 13.56 MHz contactless smart card technology.
 - c. Guaranteed compatibility to read all standard data formats ensuring card-to-reader interoperability in multi-location installations and multi-card/reader populations.
 - d. Secure access control data exchange between the smart card and reader utilizing diversified keys and mutual authentication sequences.
 - e. Universal compatibility with most access control systems.
 - f. Ease of installation through industry standard wiring methods.
 - g. Compatibility with legacy 125 KHz proximity access control formats (all standard formats up to 37 bits, including HID Corporate 1000 formats).
 - h. Optimal read range and read speed for increased access control throughput.
 - i. Global availability.
 - j. Product construction suitable for both indoor and outdoor applications.
 - k. Customizable behavior for indicator lights and beeper.
 3. Provide multi-technology contactless readers complying with the following 13.56 MHz related standards to ensure product compatibility and predictability of performance:
 - a. ISO 14443

1.18 POWER SUPPLIES

- A. Manufacturers and Products:
 1. Scheduled Manufacturer and Product:
 - a. Schlage/Von Duprin PS900 Series
 2. Acceptable Manufacturers and Products:
 - a. No Substitute
- B. Requirements:
 1. Provide power supplies approved by manufacturer of supplied electrified hardware.

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. Provide power supplies with the following features:
 - a. 12/24 VDC Output, field selectable.
 - b. Class 2 Rated power limited output.
 - c. Universal 120-240 VAC input.
 - d. Low voltage DC, regulated and filtered.
 - e. Polarized connector for distribution boards.
 - f. Fused primary input.
 - g. AC input and DC output monitoring circuit w/LED indicators.
 - h. Cover mounted AC Input indication.
 - i. Tested and certified to meet UL294.
 - j. NEMA 1 enclosure.
 - k. Hinged cover w/lock down screws.
 - l. High voltage protective cover.

1.19 CYLINDERS

- A. Manufacturers and Products:
 1. Scheduled Manufacturer and Product:
 - a. Schlage Everest 29 FSIC for all interior doors, exterior doors with access control, and all mechanical and sprinkler rooms. All other exterior doors to receive Schlage Everest 29T FSIC.
 2. Acceptable Manufacturers and Products:
 - a. No Substitute
- B. Requirements:
 1. Provide cylinders/cores from the same manufacturer of locksets, compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset; manufacturer's series as indicated. Refer to "KEYING" article, herein.
 2. Provide cylinders in the below-listed configuration(s), distributed throughout the Project as indicated.
 - a. High Security: dual-locking cylinder with permanent core requiring restricted, patented keyway. Dual-locking mechanism with interlocking finger pin(s) to check for patented features on keys.
 3. Patent Protection: Cylinders/cores requiring use of restricted, patented keys, patent protected until the year, 2029.
 4. Nickel silver bottom pins.

1.20 KEYING

- A. Scheduled System:
 1. Existing factory registered system:
 - a. Provide cylinders/cores keyed into Owner's existing factory registered keying system. Comply with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.
- B. Requirements:
 1. Construction Keying:
 - a. Replaceable Construction Cores.
 - 1) Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
 - 2) 3 construction control keys
 - 3) 12 construction change (day) keys.
 - 4) Owner or Owner's Representative will replace temporary construction cores with permanent cores.
 2. Permanent Keying:
 - a. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
 - 1) Master Keying system as directed by the Owner.
 - b. Forward biting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
 - c. Provide keys with the following features:
 - 1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
 - 2) Patent Protection: Keys and blanks protected by one or more utility patent(s) until the year, 2029.
 - d. Identification:

- 1) Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
- 2) Identification stamping provisions must be approved by the Architect and Owner.
- 3) 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.
- 4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
- 5) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
- e. Quantity: Furnish in the following quantities.
 - 1) Change (Day) Keys: 6 per cylinder/core that is keyed differently
 - 2) Permanent Control Keys: 3.
 - 3) Master Keys: 6
 - 4) Key Blanks: Quantity as determined in the keying meeting.

1.21 KEY CONTROL SYSTEM

- A. Manufacturers:
 1. Scheduled Manufacturer:
 - a. Telkee
 2. Acceptable Manufacturers:
 - a. HPC
 - b. Lund
- B. Requirements:
 1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.
 - a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
 - b. Provide hinged-panel type cabinet for wall mounting.

1.22 DOOR CLOSURES

- A. Manufacturers and Products:
 1. Scheduled Manufacturer and Product:
 - a. LCN 4040XP series (Owner Preferred)
 2. Acceptable Manufacturers and Products:
 - a. DC8000 series
- B. Requirements:
 1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
 2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
 3. Cylinder Body: 1-1/2-inch (38 mm) diameter piston with 5/8-inch (16 mm) diameter double heat-treated pinion journal. QR code with a direct link to maintenance instructions.
 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. Provide snap-on cover clip, with plastic covers, that secures cover to spring tube.
 6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck. Provide graphically labelled instructions on the closer body adjacent to each adjustment valve. Provide positive stop on reg valve that prevents reg screw from being backed out.
 7. Provide closers with 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 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.

1.23 PROTECTION PLATES

- A. Manufacturers:
 - 1. Scheduled Manufacturer:
 - a. Ives (Owner Preferred)
 - 2. Acceptable Manufacturers:
 - a. Trimco
 - b. Rockwood
- B. Requirements:
 - 1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
 - 2. Sizes of plates:
 - a. Kick Plates: 10 inches (254 mm) high by 2 inches (51 mm) less width of door.
 - b. Mop Plates: 4 inches (102 mm) high by 1 inch (25 mm) less width of door on pairs.
 - c. Armor Plates: 36 inches (914 mm) high by 2 inches (51 mm) less width of door.
 - 3. At fire rated doors, provide protection plates over 16 inches high with UL label.

1.24 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

- A. Manufacturers:
 - 1. Scheduled Manufacturers:
 - a. Glynn-Johnson (Owner Preferred)
 - 2. Acceptable Manufacturers:
 - a. Rixson
- 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 closers and positive type at doors with closer.

1.25 DOOR STOPS AND HOLDERS

- A. Manufacturers:
 - 1. Scheduled Manufacturer:
 - a. Ives (Owner Preferred)
 - 2. Acceptable Manufacturers:
 - a. Trimco
 - b. 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 lockset 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 stops cannot be used, provide medium duty surface mounted overhead stop.

1.26 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BUTTONS AND GASKETING

- A. Manufacturers:
 - 1. Scheduled Manufacturer:
 - a. Zero International (Owner Preferred)
 - 2. Acceptable Manufacturers:
 - a. Pemko
 - b. National Guard Products
- 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.
 - a. Astragal: For exterior pairs of doors with Active/Inactive Leaf: 43 STST

2. 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.
3. Size of thresholds:
 - a. Saddle Thresholds: 1/2 inch (13 mm) high by jamb width by door width
 - b. Bumper Seal Thresholds: 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width
4. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.

1.27 SILENCERS

- A. Manufacturers:
 1. Scheduled Manufacturer:
 - a. Ives (Owner Preferred)
 2. Acceptable Manufacturers:
 - a. Burns
 - b. Trimco
- B. Requirements:
 1. Provide "push-in" type silencers for hollow metal or wood frames.
 2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
 3. Omit where gasketing is specified.

1.28 DOOR POSITION SWITCHES

- A. Manufacturers:
 1. Scheduled Manufacturer:
 - a. Schlage
 2. Acceptable Manufacturers:
 - a. No Substitute
- 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 (102 mm) between switch and magnetic locking device.

1.29 FINISHES

- A. FINISH: BHMA 626/652 (US26D); EXCEPT:
 1. Hinges at Exterior Doors: BHMA 630 (US32D)
 2. Continuous Hinges: BHMA 630 (US32D)
 3. Aluminum Geared Continuous Hinges: BHMA 628 (US28)
 4. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
 5. Protection Plates: BHMA 630 (US32D)
 6. Overhead Stops and Holders: BHMA 630 (US32D)
 7. Door Closers: Powder Coat to Match
 8. Wall Stops: BHMA 630 (US32D)
 9. Latch Protectors: BHMA 630 (US32D)
 10. Weatherstripping: Clear Anodized Aluminum
 11. Thresholds: Mill Finish Aluminum

EXECUTION

1.30 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. Verify doors, frames, and walls have been properly reinforced for hardware installation.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

1.31 INSTALLATION

- A. 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. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
 - 4. Installation Guide for Doors and Hardware: DHI TDH-007-20
- B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.
- C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.
- I. Lock Cylinders:
 - 1. Install construction cores to secure building and areas during construction period.
 - 2. Replace construction cores with permanent cores as indicated in keying section.
 - 3. Furnish permanent cores to Owner for installation.
- J. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY 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. Connections to panel interface modules, controllers, and gateways.
 - 6. Testing and labeling wires with Architect's opening number.
- K. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- L. Door Closers & Auto Operators: Mount closers/operators on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers/operators so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.
- M. Overhead Stops/holders: Mount overhead stops/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
- N. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.
- O. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
- P. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.
- Q. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- R. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- S. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

1.32 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Spring Hinges: Adjust to achieve positive latching when door can close freely from an open position of 30 degrees.
 - 2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.

- 3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

1.33 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items per manufacturer's instructions 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.

1.34 DOOR HARDWARE SCHEDULE

- A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.
- B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.
- C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.
- D. Hardware Sets:

SECTION CONTINUES

102426 OPT0350532 Version 3

Legend:

 Link to catalog cut sheet












 Electrified Opening

Hardware Group No. ALT_HWS-01 - SINGLE, EXTERIOR, O/S, PANIC, CLOSER, OVERHEAD-STOP, MONITORED

For use on Door #(s):

C01 C02 C02A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112HD		628	IVE
1	EA	PANIC HARDWARE	LD-99-NL		626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	FSIC CORE	23-030 EV29 T		626	SCH
1	EA	OH STOP	100S		689	GLY
1	EA	SURFACE CLOSER	4040XP EDA WMS		689	LCN
1	EA	RAIN DRIP (IF EXPOSED ABOVE)	142AA		AA	ZER
1	EA	DOOR SWEEP	8198AA		AA	ZER
1	EA	THRESHOLD	655A-223		A	ZER
1	EA	DOOR CONTACT	7764	 	628	SCE
1	EA	GASKETING/SEALS	BY DOOR & FRAME MANUFACTURER			










1. OPERATIONAL DESCRIPTION: DOOR CONTACT TIED TO ACCESS CONTROL SYSTEM.
2. CONDUIT, WIRING AND POWER REQUIRMENTS AND INTERFACE BY DIV 26/28.

Hardware Group No. ALT_HWS-02 - PAIR, INTERIOR, DUAL EGRESS, FIRE-RATED, PANIC, MAGNETIC HOLD OPENS

For use on Door #(s):

C01A

Provide each DE door(s) with the following:











QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	600		USP	IVE
1	EA	FIRE EXIT HARDWARE	9927-EO-F-LBR-499F		626	VON
1	EA	FIRE EXIT HARDWARE	9927-EO-F-LBRAFL-499F		626	VON
2	EA	SURFACE CLOSER	4040XP EDA WMS		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
2	EA	MAGNET	SEM7800 SERIES	 	689	LCN
1	EA	GASKETING	488SBK		BK	ZER
2	EA	MEETING STILE	383AA		AA	ZER

1. OPERATIONAL DESCRIPTION: DOORS MAY BE HELD OPEN WITH MAGNETIC HOLDERS TIED INTO THE BUILDING'S FIRE ALARM SYSTEM. UPON ACTIVATION OF FIRE ALARM, MAGNETIC HOLDERS TO RELEASE DOORS, ALLOWING THEM TO CLOSE AND LATCH. FREE EGRESS AT ALL TIMES.
2. CONDUIT, WIRING AND POWER REQUIRMENTS AND INTERFACE BY DIV 26/28.

Hardware Group No. ALT_HWS-03 - UNEQUAL PAIR, INTERIOR, O/S, FIRE-RATED, PANIC, CLOSERS, WALL STOPS

For use on Door #(s):
C02B

Provide each UEP door(s) with the following:



QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	FIRE EXIT HARDWARE	9927-EO-F-LBR-499F		626	VON
			MOUNT EO DEVICE ON NARROW LEAF.			
1	EA	FIRE EXIT HARDWARE	9927-L-F-LBRAFL-03-499F		626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	FSIC CORE	23-030 EV29 T		626	SCH
2	EA	SURFACE CLOSER	4040XP EDA WMS		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
2	EA	WALL STOP	WS406/407CVX		630	IVE
1	EA	GASKETING	488SBK		BK	ZER
2	EA	MEETING STILE	8192AA		AA	ZER

VERIFY EXISTING FRAME DETAIL AND PROVIDE WIDE THROW HINGES AS REQUIRED TO MEET A FULL 180 DEGREES OF SWING FOR BOTH DOORS LEAVES.

Hardware Group No. ALT_HWS-04 - SINGLE, INTERIOR, O/S, FIRE-RATED, MECHANICAL ACCESS DOOR

For use on Door #(s):
C02C

Provide each SGL door(s) with the following:





QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	MORTISE CYLINDER	20-061-ICX		626	SCH
			AS REQUIRED			
1	EA	FSIC CORE	23-030 EV29 T		626	SCH
			AS REQUIRED			
1	EA	BALANCE OF HARDWARE	BY DOOR & FRAME MANUFACTURER			

Hardware Group No. ALT_HWS-05 - PAIR, EXTERIOR, O/S, PANIC, CLOSER, OVER-HEAD STOPS, MONITORED

For use on Door #(s):

C02D C04

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112HD		628	IVE
1	EA	REMOVABLE MULLION	KR4954 STAB		689	VON
1	EA	PANIC HARDWARE	LD-33A-EO		626	VON
1	EA	PANIC HARDWARE	LD-33A-NL		626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	MORTISE CYLINDER	20-061-ICX		626	SCH
			FOR KEYED REMOVABLE MULLION			
2	EA	FSIC CORE	23-030 EV29 T		626	SCH
2	EA	OH STOP	100S		689	GLY
2	EA	SURFACE CLOSER	4040XP EDA WMS		689	LCN
1	EA	RAIN DRIP (IF EXPOSED ABOVE)	142AA		AA	ZER
1	EA	MULLION SEAL	8780NBK PSA		BK	ZER
2	EA	DOOR SWEEP	8198AA		AA	ZER
1	EA	THRESHOLD	655A-223		A	ZER
2	EA	DOOR CONTACT	7764		628	SCE
1	EA	GASKETING/SEALS	BY DOOR & FRAME MANUFACTURER			

1. OPERATIONAL DESCRIPTION: DOOR CONTACTS TIED TO ACCESS CONTROL SYSTEM.
2. 2. CONDUIT, WIRING AND POWER REQUIRMENTS AND INTERFACE BY DIV 26/28.

Hardware Group No. ALT_HWS-06 - PAIR, EXTERIOR, O/S, PANIC, CLOSER, OVERHEAD-STOPS, CARD READER

For use on Door #(s):
C04A

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 CON		✓ 689	VON
1	EA	REMOVABLE MULLION	KR4954 STAB		689	VON
1	EA	ELEC PANIC HARDWARE	HDSI-LXRX-LC-33A-DT-CON		✓ 626	VON
1	EA	ELEC PANIC HARDWARE	LXRX-LC-QEL-33A-NL-CON 24 VDC		✓ 626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	MORTISE CYLINDER	20-061-ICX		626	SCH
			FOR KEYED REMOVABLE MULLION			
2	EA	FSIC CORE	23-030 EV29 T		626	SCH
2	EA	OH STOP	100S		689	GLY
2	EA	SURFACE CLOSER	4040XP EDA WMS		689	LCN
1	EA	RAIN DRIP (IF EXPOSED ABOVE)	142AA		AA	ZER
1	EA	MULLION SEAL	8780NBK PSA		BK	ZER
2	EA	DOOR SWEEP	8198AA		AA	ZER
1	EA	THRESHOLD	655A-223		A	ZER
2	EA	WIRE HARNESS	CON-XXX (LOCK/EXIT TO HINGE FRAME)			VON
2	EA	WIRE HARNESS	CON-XXP (FRAME TO POWER SUPPLY)		✓	SCH
1	EA	MULTITECH READER	MT11 12 VDC		✓ BLK	SCE
2	EA	DOOR CONTACT	7764		✓ 628	SCE
1	EA	POWER SUPPLY	PS902 KL900 120/240 VAC		✓ LGR	SCE
1	EA	GASKETING/SEALS	BY DOOR & FRAME MANUFACTURER			
1		WIRING DIAGRAM	FACTORY POINT TO POINT WIRING DIAGRAM (PER ELECTRIFIED APPLICATION)			

1. OPERATIONAL DESCRIPTION: DOORS NORMALLY CLOSED AND LOCKED. ENTRY BY KEY OR VALID CREDENTIAL. REQUEST TO EXIT SWITCH (RX) BUILT INTO EXIT DEVICE PUSH PADS. PRESENTING VALID CREDENTIAL TO READER MOMNETARILY RETRACTS ONE EXIT DEVICE LATCH BOLT ALLOWING ENTRY. FREE EGRESS AT ALL TIMES.
2. CONDUIT, WIRING, POWER AND ACCESS CONTROL REQUIRMENTS AND INTERACE BY DIV 26/28.

Hardware Group No. ALT_HWS-07 - SINGLE, INTERIOR, O/S, FIRE-RATED, PANIC, CUSH-STOP CLOSER

For use on Door #(s):
C04B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	FIRE EXIT HARDWARE	99-L-F-03		626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	FSIC CORE	23-030 EV29 T		626	SCH
1	EA	SURFACE CLOSER	4040XP CUSH WMS		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	GASKETING	488SBK		BK	ZER

Hardware Group No. ALT_HWS-08 - FIRE-RATED ROLL UP DOOR

For use on Door #(s):
C04C













Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	ALL HARDWARE	BY ROLL-UP DOOR MANUFACTURER			

Hardware Group No. ALT_HWS-09 - PAIR, INTERIOR, O/S, FIRE-RATED, PANIC, SPRING-STOP CLOSER

For use on Door #(s):
C04D






Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	600		USP	IVE
1	EA	FIRE RATED REMOVABLE MULLION	KR9954 STAB		689	VON
1	EA	FIRE EXIT HARDWARE	99-EO-F		626	VON
1	EA	FIRE EXIT HARDWARE	99-L-F-03		626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	MORTISE CYLINDER	20-061-ICX		626	SCH
			FOR KEYED REMOVABLE MULLION			
2	EA	FSIC CORE	23-030 EV29 T		626	SCH
2	EA	SURFACE CLOSER	4040XP SCUSH WMS		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
1	EA	GASKETING	488SBK		BK	ZER
1	EA	MULLION SEAL	8780NBK PSA		BK	ZER
2	EA	MEETING STILE	8192AA		AA	ZER

Hardware Group No. ALT_HWS-10 - SINGLE, INTERIOR, I/S, CLASSROOM SECURITY LOCK, WALL STOP

For use on Door #(s):
C05A






Provide each SGL door(s) 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 03A L283-711		626	SCH
2	EA	FSIC CORE	23-030 EV29 T		626	SCH
1	EA	WALL STOP	WS406/407CVX		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. ALT_HWS-11 - SINGLE, INTERIOR, I/S, STOREROOM LOCK, WALL STOP

For use on Door #(s):
C05A.1

Provide each SGL door(s) 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 03A		626	SCH
1	EA	FSIC CORE	23-030 EV29 T		626	SCH
1	EA	WALL STOP	WS406/407CVX		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. ALT_HWS-12 - SINGLE, INTERIOR, I/S, OFFICE LOCK, WALL STOP

For use on Door #(s):

C05B

Provide each SGL door(s) with the following:











QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050T 03A 09-544		626	SCH
1	EA	FSIC CORE	23-030 EV29 T		626	SCH
1	EA	WALL STOP	WS406/407CVX		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. ALT_HWS-13 - PAIR, INTERIOR, I/S, STOREROOM LOCK X FLUSH BOLTS, KEYED REMOVABLE MULLION, FLOOR STOPS

For use on Door #(s):

C05C

Provide each PR door(s) with the following:







QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	CONST LATCHING BOLT	FB61P		630	IVE
1	EA	DUST PROOF STRIKE	DP2		626	IVE
1	EA	REMOVABLE MULLION	KR4954 STAB		689	VON
1	EA	STOREROOM LOCK	L9080T 03A		626	SCH
1	EA	MORTISE CYLINDER	20-061-ICX		626	SCH
			FOR KEYED REMOVABLE MULLION			
2	EA	FSIC CORE	23-030 EV29 T		626	SCH
2	EA	FLOOR STOP	FS436/FS438 AS REQ		626	IVE
1	EA	MULLION SEAL	8780NBK PSA		BK	ZER
2	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. ALT_HWS-14 - SINGLE, INTERIOR, O/S, STOREROOM LOCK, CLOSER, WALL STOP

For use on Door #(s):

C05D







Provide each SGL door(s) 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 03A		626	SCH
1	EA	FSIC CORE	23-030 EV29 T		626	SCH
1	EA	SURFACE CLOSER	4040XP EDA WMS		689	LCN
1	EA	WALL STOP	WS406/407CVX		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. ALT_HWS-15 - SINGLE, INTERIOR, I/S, STOREROOM LOCK, WALL STOP

For use on Door #(s):
C05E







Provide each SGL door(s) 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 03A		626	SCH
1	EA	FSIC CORE	23-030 EV29 T		626	SCH
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

Hardware Group No. ALT_HWS-16 - SINGLE, INTERIOR, O/S, STOREROOM LOCK, SPRING-STOP & HOLD CLOSER

For use on Door #(s):
C05F






Provide each SGL door(s) 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 03A		626	SCH
1	EA	FSIC CORE	23-030 EV29 T		626	SCH
1	EA	SURFACE CLOSER	4040XP SHCUSH WMS		689	LCN
1	EA	ARMOR PLATE	8400 34" X 1 1/2" LDW B-CS		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. ALT_HWS-17 - SINGLE, INTERIOR, O/S, PANIC, SPRING-STOP & HOLD CLOSER

For use on Door #(s):
C05J C05M

Provide each SGL door(s) with the following:









QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PANIC HARDWARE	99-L-BE-03		626	VON
1	EA	SURFACE CLOSER	4040XP SHCUSH WMS		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. ALT_HWS-18 - SINGLE, INTERIOR, O/S, PANIC W. DOGGING INDICATOR, CLOSER, WALL STOP

For use on Door #(s):

C05K C05L

Provide each SGL door(s) 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	HDSI-99-NL		626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	FSIC CORE	23-030 EV29 T		626	SCH
1	EA	SURFACE CLOSER	4040XP EDA WMS		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

Hardware Group No. ALT_HWS-19 - SINGLE, INTERIOR, O/S, STAFF BATHROOM, CLOSER

For use on Door #(s):

CT3

Provide each SGL door(s) with the following:









QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	FACULTY RESTROOM/HOTEL	L9485T 03A 09-544 L283-722 XL13-439		626	SCH
1	EA	FSIC CORE	23-030 EV29 T		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH WMS		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. HWS-01 - PAIR, INTERIOR, DUAL EGRESS, FIRE-RATED, PANIC, MAGNETIC HOLD OPENS

For use on Door #(s):

500A MZ01A

Provide each DE door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	600		USP	IVE
1	EA	FIRE EXIT HARDWARE	9927-EO-F-LBR-499F		626	VON
1	EA	FIRE EXIT HARDWARE	9927-EO-F-LBRAFL-499F		626	VON
2	EA	SURFACE CLOSER	4040XP EDA WMS		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
2	EA	MAGNET	SEM7800 SERIES	 ↗	689	LCN
1	EA	GASKETING	488SBK		BK	ZER
2	EA	MEETING STILE	383AA		AA	ZER

1. OPERATIONAL DESCRIPTION: DOORS MAY BE HELD OPEN WITH MAGNETIC HOLDERS TIED INTO THE BUILDING'S FIRE ALARM SYSTEM. UPON ACTIVATION OF FIRE ALARM, MAGNETIC HOLDERS TO RELEASE DOORS, ALLOWING THEM TO CLOSE AND LATCH. FREE EGRESS AT ALL TIMES.

2. CONDUIT, WIRING AND POWER REQUIRMENTS AND INTERFACE BY DIV 26/28.

Hardware Group No. HWS-02 - SINGLE, EXTERIOR, O/S, PANIC, CLOSER, OVERHEAD-STOP, MONITORED

For use on Door #(s):

501A	502A	503A	504A	505A	506A
507A	508A	613A	615A	617A	618A
619A	620A	621A			

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112HD		628	IVE
1	EA	PANIC HARDWARE	LD-99-NL		626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	FSIC CORE	23-030 EV29 T		626	SCH
1	EA	OH STOP	100S		689	GLY
1	EA	SURFACE CLOSER	4040XP EDA WMS		689	LCN
1	EA	RAIN DRIP (IF EXPOSED ABOVE)	142AA		AA	ZER
1	EA	DOOR SWEEP	8198AA		AA	ZER
1	EA	THRESHOLD	655A-223		A	ZER
1	EA	DOOR CONTACT	7764		628	SCE
1	EA	GASKETING/SEALS	BY DOOR & FRAME MANUFACTURER			

1. OPERATIONAL DESCRIPTION: DOOR CONTACT TIED TO ACCESS CONTROL SYSTEM.
2. CONDUIT, WIRING AND POWER REQUIRMENTS AND INTERFACE BY DIV 26/28.

Hardware Group No. HWS-03 - SINGLE, INTERIOR, O/S, CLASSROOM SECURITY LOCK, WALL STOP

For use on Door #(s):

501B	502B	503B	504B	505B	506B
507B	508B	513A	517A	519A	520A
521A	522A	613B	617B	618B	619B
620B	621B				

Provide each SGL door(s) with the following:





QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	CLASSROOM SECURITY	L9071T 03A L283-711		626	SCH
2	EA	FSIC CORE	23-030 EV29 T		626	SCH
1	EA	WALL STOP	WS406/407CVX		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. HWS-04 - SINGLE, INTERIOR, O/S, PASSAGE LEVER, OVERHEAD-STOP

For use on Door #(s):

501C 502C 503C 504C 505C 506C
 507C 508C

Provide each SGL door(s) with the following:






QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PASSAGE SET	L9010 03A		626	SCH
1	EA	OH STOP	90S		689	GLY
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. HWS-05 - SINGLE, INTERIOR, I/S, CLASSROOM SECURITY LOCK, WALL STOP

For use on Door #(s):

509A 610A

Provide each SGL door(s) 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 03A L283-711		626	SCH
2	EA	FSIC CORE	23-030 EV29 T		626	SCH
1	EA	WALL STOP	WS406/407CVX		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. HWS-06 - SINGLE, EXTERIOR, O/S, PANIC, SPRING-STOP & HOLD CLOSER, MONITORED

For use on Door #(s):

509AA

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		630	IVE
1	EA	PANIC HARDWARE	99-NL		626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	FSIC CORE	23-030 EV29 T		626	SCH
1	EA	SURFACE CLOSER	4040XP SHCUSH WMS		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	RAIN DRIP (IF EXPOSED ABOVE)	142AA		AA	ZER
1	EA	SEALS	188S		BK	ZER
1	EA	DOOR SWEEP	8198AA		AA	ZER
1	EA	THRESHOLD	655A-223		A	ZER
1	EA	DOOR CONTACT	7764		628	SCE








1. OPERATIONAL DESCRIPTION: DOOR CONTACT TIED TO ACCESS CONTROL SYSTEM.
2. CONDUIT, WIRING AND POWER REQUIRMENTS AND INTERFACE BY DIV 26/28.

Hardware Group No. HWS-07 - SINGLE, INTERIOR, I/S, STOREROOM LOCK, HOLD OPEN CLOSER, WALL STOP

For use on Door #(s):

510A 608A

Provide each SGL door(s) 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 03A		626	SCH
1	EA	FSIC CORE	23-030 EV29 T		626	SCH
1	EA	SURFACE CLOSER	4040XP H WMS		689	LCN
1	EA	ARMOR PLATE	8400 34" X 1 1/2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. HWS-08 - SINGLE, INTERIOR, O/S, STOREROOM LOCK, CLOSER, WALL STOP

For use on Door #(s):

510AA 610BA

Provide each SGL door(s) 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 03A		626	SCH
1	EA	FSIC CORE	23-030 EV29 T		626	SCH
1	EA	SURFACE CLOSER	4040XP EDA WMS		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

Hardware Group No. HWS-09 - SINGLE, INTERIOR, O/S, STOREROOM LOCK, SPRING-STOP CLOSER

For use on Door #(s):

511A 520AA S3-1A

Provide each SGL door(s) 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 03A		626	SCH
1	EA	FSIC CORE	23-030 EV29 T		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH WMS		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. HWS-10 - SINGLE, INTERIOR, O/S, STAFF BATHROOM, SPRING-STOP CLOSER

For use on Door #(s):

512A 610AA

Provide each SGL door(s) with the following:






QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	FACULTY RESTROOM/HOTEL	L9485T 03A 09-544 L283-722 XL13-439		626	SCH
1	EA	FSIC CORE	23-030 EV29 T		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH WMS		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. HWS-11 - SINGLE, INTERIOR, I/S, OFFICE LOCK, WALL STOP

For use on Door #(s):

514A 612A

Provide each SGL door(s) with the following:







QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050T 03A 09-544		626	SCH
1	EA	FSIC CORE	23-030 EV29 T		626	SCH
1	EA	WALL STOP	WS406/407CVX		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. HWS-12 - SINGLE, INTERIOR, O/S, CLASSROOM SECURITY LOCK, SPRING-STOP CLOSER

For use on Door #(s):

515A 615B

Provide each SGL door(s) with the following:





QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	CLASSROOM SECURITY	L9071T 03A L283-711		626	SCH
2	EA	FSIC CORE	23-030 EV29 T		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH WMS		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. HWS-13 - SINGLE, INTERIOR, O/S, STOREROOM LOCK, OVER HEAD STOP & HOLD

For use on Door #(s):

516A 616A

Provide each SGL door(s) with the following:








QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	600		USP	IVE
1	EA	EXIT LOCK WITH CYLINDER	L9026T 03A		626	SCH
1	EA	FSIC CORE	23-030 EV29 T		626	SCH
1	EA	OH STOP & HOLDER	450H		689	GLY
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. HWS-14 - SINGLE, INTERIOR, O/S, PANIC, SPRING-STOP CLOSER

For use on Door #(s):

602A







Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	FIRE EXIT HARDWARE	99-NL-F		626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	FSIC CORE	23-030 EV29 T		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH WMS		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. HWS-15 - SINGLE, INTERIOR, O/S, FIRE-RATED, STOREROOM LOCK, SPRING-STOP CLOSER

For use on Door #(s):
604A









Provide each SGL door(s) 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 03A		626	SCH
1	EA	FSIC CORE	23-030 EV29 T		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH WMS		689	LCN
1	EA	KICK PLATE	8402 10" X 2" LDW B-CS		630	IVE
1	EA	GASKETING	488SBK		BK	ZER

Hardware Group No. HWS-16 - SINGLE, INTERIOR, O/S, FIRE-RATED, PANIC, CLOSER, WALL STOP

For use on Door #(s):
606A M01B M02B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	FIRE EXIT HARDWARE	99-NL-F		626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	FSIC CORE	23-030 EV29 T		626	SCH
1	EA	SURFACE CLOSER	4040XP EDA WMS		689	LCN
1	EA	KICK PLATE	8402 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE
1	EA	GASKETING	488SBK		BK	ZER

Hardware Group No. HWS-17 - PAIR, EXTERIOR, O/S, PANICS, CLOSERS, OVERHEAD-STOPS, CARD READER

For use on Door #(s):
C500A S2-0A

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 CON		✂ 689	VON
1	EA	REMOVABLE MULLION	KR4954 STAB		689	VON
1	EA	ELEC PANIC HARDWARE	HDSI-LXRX-LC-33A-DT-CON		✂ 626	VON
1	EA	ELEC PANIC HARDWARE	LXRX-LC-QEL-33A-NL-CON 24 VDC		✂ 626	VON
2	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	MORTISE CYLINDER	20-061-ICX FOR KEYED REMOVABLE MULLION		626	SCH
3	EA	FSIC CORE	23-030 EV29 T		626	SCH
2	EA	OH STOP	100S		689	GLY
2	EA	SURFACE CLOSER	4040XP EDA WMS		689	LCN
1	EA	RAIN DRIP (IF EXPOSED ABOVE)	142AA		AA	ZER
1	EA	MULLION SEAL	8780NBK PSA		BK	ZER
2	EA	DOOR SWEEP	8198AA		AA	ZER
1	EA	THRESHOLD	655A-223		A	ZER
2	EA	WIRE HARNESS	CON-XXX (LOCK/EXIT TO HINGE FRAME)			VON
2	EA	WIRE HARNESS	CON-XXP (FRAME TO POWER SUPPLY)		✂	SCH
1	EA	MULTITECH READER	MT11 12 VDC		✂ BLK	SCE
2	EA	DOOR CONTACT	7764		✂ 628	SCE
1	EA	POWER SUPPLY	PS902 KL900 120/240 VAC		✂ LGR	SCE
1	EA	GASKETING/SEALS	BY DOOR & FRAME MANUFACTURER			
1	EA	KNOX BOX	MODEL # AS REQUIRED BY LOCAL AUTHORITY			
1		WIRING DIAGRAM	FACTORY POINT TO POINT WIRING DIAGRAM (PER ELECTRIFIED APPLICATION)			

1. OPERATIONAL DESCRIPTION: DOORS NORMALLY CLOSED AND LOCKED. ENTRY BY KEY OR VALID CREDENTIAL. REQUEST TO EXIT SWITCH (RX) BUILT INTO EXIT DEVICE PUSH PADS. PRESENTING VALID CREDENTIAL TO READER MOMNETARILY RETRACTS ONE EXIT DEVICE LATCH BOLT ALLOWING ENTRY. FREE EGRESS AT ALL TIMES.

2. CONDUIT, WIRING, POWER AND ACCESS CONTROL REQUIRMENTS AND INTERACE BY DIV 26/28.

Hardware Group No. HWS-18 - PAIR, EXTERIOR, O/S, PANICS, CLOSERS, OVERHEAD-STOPS, CARD READER

For use on Door #(s):

C500B S1-1A

Provide each PR door(s) with the following:

QTY	EA	DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112HD EPT		628	IVE
2	EA	POWER TRANSFER	EPT10 CON		✓ 689	VON
1	EA	REMOVABLE MULLION	KR4954 STAB		689	VON
1	EA	ELEC PANIC HARDWARE	HDSI-LXRX-LC-33A-DT-CON		✓ 626	VON
1	EA	ELEC PANIC HARDWARE	LXRX-LC-QEL-33A-NL-CON 24 VDC		✓ 626	VON
2	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	MORTISE CYLINDER	20-061-ICX		626	SCH
			FOR KEYED REMOVABLE MULLION			
3	EA	FSIC CORE	23-030 EV29 T		626	SCH
2	EA	OH STOP	100S		689	GLY
2	EA	SURFACE CLOSER	4040XP EDA WMS		689	LCN
1	EA	RAIN DRIP (IF EXPOSED ABOVE)	142AA		AA	ZER
1	EA	MULLION SEAL	8780NBK PSA		BK	ZER
2	EA	DOOR SWEEP	8198AA		AA	ZER
1	EA	THRESHOLD	655A-223		A	ZER
2	EA	WIRE HARNESS	CON-XXX (LOCK/EXIT TO HINGE FRAME)			VON
2	EA	WIRE HARNESS	CON-XXP (FRAME TO POWER SUPPLY)		✓	SCH
1	EA	MULTITECH READER	MT11 12 VDC		✓ BLK	SCE
2	EA	DOOR CONTACT	7764		✓ 628	SCE
1	EA	POWER SUPPLY	PS902 BBK KL900 120/240 VAC		✓ LGR	SCE
1	EA	GASKETING/SEALS	BY DOOR & FRAME MANUFACTURER			
1		WIRING DIAGRAM	FACTORY POINT TO POINT WIRING DIAGRAM (PER ELECTRIFIED APPLICATION)			

1. OPERATIONAL DESCRIPTION: DOORS NORMALLY CLOSED AND LOCKED. ENTRY BY KEY OR VALID CREDENTIAL. REQUEST TO EXIT SWITCH (RX) BUILT INTO EXIT DEVICE PUSH PADS. PRESENTING VALID CREDENTIAL TO READER MOMNETARILY RETRACTS ONE EXIT DEVICE LATCH BOLT ALLOWING ENTRY. FREE EGRESS AT ALL TIMES.
2. 2. CONDUIT, WIRING, POWER AND ACCESS CONTROL REQUIRMENTS AND INTERACE BY DIV 26/28.

Hardware Group No. HWS-19 - SINGLE, EXTERIOR, O/S, PANIC, SPRING-STOP & HOLD CLOSER, MONITORED

For use on Door #(s):

E02A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112HD		628	IVE
1	EA	PANIC HARDWARE	99-NL		626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	FSIC CORE	23-030 EV29 T		626	SCH
1	EA	SURFACE CLOSER	4040XP SHCUSH WMS		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	RAIN DRIP (IF EXPOSED ABOVE)	142AA		AA	ZER
1	EA	DOOR SWEEP	8198AA		AA	ZER
1	EA	THRESHOLD	655A-223		A	ZER
1	EA	DOOR CONTACT	7764		628	SCE
1	EA	GASKETING/SEALS	BY DOOR & FRAME MANUFACTURER			

1. OPERATIONAL DESCRIPTION: DOOR CONTACT TIED TO ACCESS CONTROL SYSTEM.
2. CONDUIT, WIRING AND POWER REQUIRMENTS AND INTERFACE BY DIV 26/28.

Hardware Group No. HWS-20 - PAIR, EXTERIOR, O/S, PANICS, SPRING-STOP & HOLD CLOSERS, MONITORED

For use on Door #(s):

M01A M02A

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112HD		628	IVE
1	EA	REMOVABLE MULLION	KR4954 STAB		689	VON
1	EA	PANIC HARDWARE	99-EO		626	VON
1	EA	PANIC HARDWARE	99-NL		626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	MORTISE CYLINDER	20-061-ICX		626	SCH
			FOR KEYED REMOVABLE MULLION			
2	EA	FSIC CORE	23-030 EV29 T		626	SCH
2	EA	SURFACE CLOSER	4040XP SHCUSH WMS		689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	RAIN DRIP (IF EXPOSED ABOVE)	142AA		AA	ZER
1	EA	MULLION SEAL	8780NBK PSA		BK	ZER
2	EA	MEETING STILE	8195AA		AA	ZER
2	EA	DOOR SWEEP	8198AA		AA	ZER
1	EA	THRESHOLD	655A-223		A	ZER
2	EA	DOOR CONTACT	7764		628	SCE
1	EA	GASKETING/SEALS	BY DOOR & FRAME MANUFACTURER			

1. OPERATIONAL DESCRIPTION: DOOR CONTACTS TIED TO ACCESS CONTROL SYSTEM.
2. CONDUIT, WIRING AND POWER REQUIRMENTS AND INTERFACE BY DIV 26/28.

END OF SECTION

SECTION 08 80 00 – GLAZING**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
1. Windows.
 2. Doors.
 3. Glazed entrances.
 4. Interior borrowed lites.
 5. Storefront framing.

1.2 DEFINITIONS

- A. Manufacturer: A firm that produces primary glass or fabricated glass as defined in referenced glazing publications.
- B. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.
- C. Deterioration of Insulating Glass: Failure of the hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for 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.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- C. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:
1. For insulating-glass units, properties are based on units with lites 6 mm thick and a nominal 1/2-inch- wide interspace.
 2. Center-of-Glass U-Values: NFRC 100 methodology using LBL-15 WINDOW 5.2 computer program, expressed as Btu/ sq. ft. x h x deg F.
 3. Center-of-Glass Solar Heat Gain Coefficient: NFRC 200 methodology using LBL-15 WINDOW 5.2 computer program.
 4. Solar Optical Properties: NFRC 300.

1.4 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Samples: For the following products, in the form of 12-inch- square Samples for glass.
1. Each color of tinted float glass.
 2. Each type of patterned glass.
 3. Coated vision glass.
 4. Ceramic-coated spandrel glass.
- C. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.
- D. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.
- E. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Source Limitations for Clear Glass: Obtain clear float glass from one primary-glass manufacturer.

- C. Source Limitations for Tinted Glass: Obtain tinted, heat-absorbing, and light-reducing float glass from one primary-glass manufacturer for each tint color indicated.
- D. Source Limitations for Coated Glass: Obtain coated glass from one manufacturer for each type of coating and each type and class of float glass indicated.
- E. Source Limitations for Insulating Glass: Obtain insulating-glass units from one manufacturer using the same type of glass and other components for each type of unit indicated.
- F. Source Limitations for Glazing Accessories: Obtain glazing accessories from one source for each product and installation method indicated.
- G. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201 and ANSI Z97.1.
 - 1. Subject to compliance with requirements, permanently mark safety glass with certification label of Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.
- H. 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" and "Laminated Glass Design Guide."
 - 2. IGMA Publications: SIGMA TM-3000 "Glazing Guidelines for Sealed Insulating Glass Units" and SIGMA TB-3001, "Sloped Glazing Guidelines."
- I. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following inspecting and testing agency:
 - 1. Insulating Glass Certification Council.
 - 2. Associated Laboratories, Inc.
 - 3. National Accreditation and Management Institute.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F.

1.8 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. Manufacturer's Special Warranty on Insulating Glass: Written warranty, made out to Owner and signed by insulating-glass manufacturer agreeing to furnish replacements for insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PRIMARY FLOAT GLASS

- A. Float Glass: ASTM C 1036, Type I (transparent glass, flat), Quality q3 (glazing select); class as indicated in schedules at the end of Part 3.

2.2 HEAT-TREATED FLOAT GLASS

- A. Fabrication Process: By vertical (tong-held) or horizontal (roller-hearth) process, at manufacturer's option, except provide horizontal process where indicated as tongless or free of tong marks.
- B. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent glass, flat); Quality q3 (glazing select); class, kind, and condition as indicated in schedules at the end of Part 3.

2.3 COATED FLOAT GLASS

- A. General: Provide coated glass complying with requirements indicated in this Article and in schedules at the end of Part 3.

1. Provide Kind HS (heat-strengthened) coated float glass in place of coated annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in "Performance Requirements" Article. Provide Kind FT (fully tempered) where safety glass is indicated.
2. Provide Kind HS (heat-strengthened) coated float glass, except provide Kind FT (fully tempered) products where coated safety glass is indicated.

2.4 FIRE PROTECTION-RATED GLAZING

- A. Fire Protection-Rated Glazing, General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252 for door assemblies.
- B. Film-Faced Ceramic Glazing: Clear, ceramic flat glass; 3/16-inch nominal thickness; faced on one surface with a clear glazing film; complying with testing requirements in 16 CFR 1201 for Category II materials.

2.5 INSULATING GLASS

- A. Insulating-Glass Units: Preassembled units consisting of sealed lites of glass separated by a dehydrated interspace and complying with ASTM E 2190 and with requirements specified in this Article and in the Insulating-Glass Schedule at the end of Part 3.
 1. Provide Kind HS (heat-strengthened) float glass in place of annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in "Performance Requirements" Article. Provide Kind FT (fully tempered) where safety glass is indicated.
- B. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated in the Insulating-Glass Schedule at the end of Part 3 are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.
- C. Sealing System: Dual seal, with primary and secondary sealants as follows:
 1. Polyisobutylene and silicone.
- D. Spacer Specifications: Manufacturer's standard spacer material and construction.

2.6 ELASTOMERIC GLAZING SEALANTS

- A. General: Provide products of type indicated, complying with the following requirements:
 1. Compatibility: Select 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 for this characteristic.
 4. VOC Content: For sealants used inside of the waterproofing system, not more than 250 g/L when calculated according to 40 CFR 59, Subpart D.
- B. Elastomeric Glazing Sealant Standard: Comply with ASTM C 920 and other requirements indicated for each liquid-applied, chemically curing sealant in the Glazing Sealant Schedule at the end of Part 3, including those referencing ASTM C 920 classifications for type, grade, class, and uses.
 1. Additional Movement Capability: Where additional movement capability is specified in the Glazing Sealant Schedule, provide products with the capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand the specified percentage change in the joint width existing at time of installation and remain in compliance with other requirements in ASTM C 920 for uses indicated.

2.7 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tape: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; 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; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
 1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

2.8 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of material indicated below, complying with standards referenced with name of elastomer indicated below, and of profile and hardness required to maintain watertight seal:
 1. EPDM, ASTM C 864.
 2. Silicone, ASTM C 1115.
 3. Thermoplastic polyolefin rubber, ASTM C 1115.

4. Any material indicated above.
- B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned gaskets of material indicated below; complying with ASTM C 509, Type II, black; and of profile and hardness required to maintain watertight seal:
 1. EPDM.
 2. Silicone.
 3. Thermoplastic polyolefin rubber.
 4. Any material indicated above.

2.9 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 A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer 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.

2.10 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

- A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing standard, to comply with system performance requirements.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with indoor and outdoor faces.
- C. Grind smooth and polish exposed glass edges.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing glazing, with Installer present, for compliance with the following:
 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 2. Presence and functioning of weep system.
 3. Minimum required face or edge clearances.
 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.
- 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 sealant-substrate 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 the length plus width is larger than 50 inches as follows:

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. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
 - K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Where framing joints are vertical, cover these joints by applying tapes to heads and sills first and then to jambs. Where framing joints are horizontal, cover these joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until just before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

- A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with stretch allowance during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Center glass lites in openings on setting blocks and press firmly against soft compression 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. Install gaskets so they protrude past face of glazing stops.

3.6 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.

3.7 PROTECTION AND CLEANING

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.

- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for build-up of dirt, scum, alkaline deposits, or stains; remove as recommended by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way, including natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

3.8 MONOLITHIC FLOAT-GLASS SCHEDULE

- A. Uncoated Clear Float Glass: Where glass as designated below is indicated, provide Type I (transparent glass, flat), Class 1 (clear) glass lites complying with the following:
 1. Uncoated Clear Annealed Float Glass, 6mm: MG
 2. Uncoated Clear Fully Tempered Float Glass, 6mm: Kind FT (fully tempered): MGT.

3.9 FILM FACED FIRE PROTECTION RATED GLAZING SCHEDULE

- A. Film-Faced Ceramic Glazing: Clear, ceramic flat glass; **3/16-inch** nominal thickness; faced on one surface with a clear glazing film; complying with testing requirements in 16 CFR 1201 for Category II materials.
 1. Products: Available products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. Nippon Electric Glass Co., Ltd. (distributed by Technical Glass Products); FireLite NT.
 - b. Safti First; SuperLite C/SP.
 - c. Schott North America, Inc.; (distributed by InterEdge Inc) Pyran Platinum F.
 - d. Vetrotech Saint-Gobain; SGG Keralite FR-F.

3.10 INSULATING-GLASS SCHEDULE

- A. Tinted, low-E Insulating Glass IGE Guardian SN68 + Crystal Gray or approved equal: Where glass of this designation is indicated, provide low-emmissivity insulating-glass units complying with the following:
 1. Overall Unit Thickness and Thickness of Each Lite: 25 and 6 mm.
 2. Interspace Content: Air
 3. Outdoor Lite: Type I (transparent glass, flat), float glass, Class 1 (clear).
 - a. Annealed, Condition A (uncoated surfaces).
 - b. Kind HS (heat strengthened), Condition A (uncoated surfaces), where required.
 - c. Kind FT (fully tempered), Condition A (uncoated surfaces), where indicated, IGTE.
 4. Indoor Lite: Type I (transparent glass, flat), Class 1 (clear) float glass.
 - a. Annealed, condition C (other coated glass), IGE.
 - b. Kind HS (heat strengthened), Condition C (other coated glass). where required.
 - c. Kind FT (fully tempered), Condition C (other coated glass), where indicated, IGTE.
 5. Vision Glass
 - a. Visible Light Transmittance: 34%.
 - b. Winter Nighttime U-value: 0.29.
 - c. Summer Daytime U-value: 0.27.
 - d. Solar Heat Gain Coefficient: 0.25.
 - e. Outdoor Visible Reflectance: 6%.
 6. Spandrel Glass (CSG #1)
 - a. Visible Light Transmittance: 0.
 - b. Winter Nighttime U-value: 0.29.
 - c. Summer Daytime U-value: 0.28.
 - d. Solar Heat Gain Coefficient: 0.21.
 - e. Outdoor Visible Reflectance: 7%.

3.11 GLAZING SEALANT SCHEDULE

- A. Medium-Modulus Neutral-Curing Silicone Glazing Sealant: Where glazing sealants of this designation are indicated, provide products complying with the following:
 1. Products: Provide one of the following:
 - a. 756 H.P.; Dow Corning.
 - b. Silglaze II; GE Silicones.
 - c. 895; Pecora Corporation.
 2. Type and Grade: S (single component) and NS (nonsag).
 3. Class: 25.
 4. Additional Movement Capability: 50 percent movement in extension and 50 percent movement in compression for a total of 100 percent movement.

5. Use Related to Exposure: NT (nontraffic)
6. Uses Related to Glazing Substrates: M, G, A, and, as applicable to glazing substrates indicated, O.
 - a. Use O Glazing Substrates: Coated glass, color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, and wood.
7. Applications: Heel, toe, and cap glazing beads. Metal-to-metal joints.

END OF SECTION 08 80 00

**DIVISION 09
FINISHES**

SECTION 09 21 16 – GYPSUM BOARD ASSEMBLIES**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
 - 1. Interior gypsum wallboard.
 - 2. Tile backing panels.
 - 3. Non-load-bearing steel framing.
 - 4. Sound attenuation batts

1.2 DEFINITIONS

- A. Gypsum Board Terminology: Refer to ASTM C 11 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.3 SUBMITTALS

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

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction. Products used in the assembly shall carry a classification label from a testing company acceptable to the authority having jurisdiction.
 - 1. Fire-Resistance-Rated Assemblies: Indicated by design designations from UL's "Fire Resistance Directory." GA-600, "Fire Resistance Design Manual." ITS's "Directory of Listed Products."
- B. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.
 - 1. STC-Rated Assemblies: Indicated by design designations from GA-600, "Fire Resistance Design Manual."
- C. Gypsum Board Finish Mockups: Before finishing gypsum board assemblies, install mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and qualities of materials and execution.
 - 1. Install mockups for the following applications:
 - a. Surfaces indicated to receive nontextured paint finishes.
 - b. Surfaces indicated to receive textured paint finishes.
 - 2. Simulate finished lighting conditions for review of mockups.
 - 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Gypsum Board Manufacture: Gypsum board manufactured in China will not be permitted. The Contractor shall provide a certification with the shop drawing submittal for this section stating the country of manufacture for each gypsum board product to be provided.

1.5 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, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.
- C. Steel framing and related accessories shall be stored and handled in accordance with AISI "Code of Standard Practice".

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

PART 2 - PRODUCTS**2.1 STEEL PARTITION AND SOFFIT FRAMING**

- A. Components, General: As follows:
 - 1. Comply with ASTM C 754 for conditions indicated.
 - 2. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with ASTM A 653/A 653M, G60, hot-dip galvanized zinc coating.
- B. Steel Studs and Runners: ASTM C 645.
 - 1. Minimum Base Metal Thickness: 0.0179 inch. Provide minimum base metal thickness 20 ga. studs and runners on all walls that are covered with impact resistant wallboard.
 - 2. Depth: 4 inches, unless otherwise indicated.

- C. Deep-Leg Deflection Track: ASTM C 645 top runner with 2-inch- deep flanges.
- D. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 - 1. Minimum Base Metal Thickness: 0.0179 inch.
 - 2. Depth: 7/8 inch, unless otherwise indicated.
- E. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

2.2 INTERIOR GYPSUM WALLBOARD

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
- B. Gypsum Wallboard: ASTM C 1396.
 - 1. Regular Type:
 - a. Thickness: 5/8 inch, unless otherwise indicated.
 - b. Long Edges: Tapered and featured (rounded or beveled) for prefilling.
 - 2. Type X:
 - a. Thickness: 5/8 inch.
 - b. Long Edges: Tapered and featured (rounded or beveled) for prefilling.
 - c. Location: Where required for fire-resistance-rated assembly.
- C. Mold and Moisture Resistant Panels: ASTM C 1396 and as follows. Provide MMR panels that are approved by the manufacturer for horizontal application over the stud spacing indicated.
 - 1. Type: Regular, unless otherwise indicated.
 - 2. Type: Type X where required for fire-resistance-rated assemblies and where indicated.
 - 3. Thickness: 5/8 inch, unless otherwise indicated.

2.3 TILE BACKING PANELS

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
- B. Cementitious Backer Units: ANSI A118.9.
 - 1. Thickness: 1/2 inch.

2.4 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
 - 1. Material: Paper-faced galvanized steel sheet.
 - 2. Shapes:
 - a. Cornerbead: Use at outside corners.
 - b. Bullnose Bead: Use where indicated.
 - c. LC-Bead (J-Bead): Use at exposed panel edges.
 - d. L-Bead: Use where indicated.
 - e. Expansion (Control) Joint: Use where indicated and where recommended by manufacturer of gypsum panels.
- B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fry Reglet Corp.
 - b. Gordon, Inc.
 - c. Pittcon Industries.
 - 2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, alloy 6063-T5.
 - 3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.
 - 4. Drywall reveal trim, 1/2 x 5/8 inch, tapered fin: Use at all intersections of gypsum board and masonry.
 - 5. Drywall Control Joint Trim: H-shaped plastic edge trim to define edge of two abutting gypsum panels at control joints. H-trim to have zip strip front face, caulk reveal per Section 07920 "Sealants".

2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475.
- B. Joint Tape:
 - 1. Interior Gypsum Wallboard: Paper.
 - 2. 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 setting-type taping compound.
 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 3. Fill Coat: For second coat, use setting-type, sandable topping compound.
 4. Finish Coat: For third coat, use setting-type, sandable topping compound.
- D. Joint Compound for Tile Backing Panels:
1. Cementitious Backer Units: As recommended by manufacturer.

2.6 ACOUSTICAL SEALANT

- A. Acoustical Sealant for Exposed and Concealed Joints: 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.

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.
 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Isolation Strip at Exterior Walls:
 1. Asphalt-Saturated Organic Felt: ASTM D 226, 2-1/2 to 3 lb/cf density (No. 15 asphalt felt), nonperforated.
- E. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) 2-1/2 to 3 lb/cf density 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 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. 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 ceilings 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.
- B. Coordination with Sprayed Fire-Resistive Materials:
 1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed-on fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.
 2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of gypsum board assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

3.3 INSTALLING STEEL FRAMING, GENERAL

- A. Installation Standards: ASTM C 754, and ASTM C 840 requirements that apply to framing installation.
- B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with gypsum board manufacturer's written recommendations or, if none available, with United States Gypsum's "Gypsum Construction Handbook."
- C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement.
 1. Isolate ceiling assemblies where they abut or are penetrated by building structure.
 2. Isolate partition framing and wall furring where it abuts structure, except at floor. Install slip-type joints at head of assemblies that avoid axial loading of assembly and laterally support assembly.
 - a. Use deep-leg deflection track where indicated.

- D. Do not bridge building control and expansion joints with steel framing or furring members. Frame both sides of joints independently.

3.4 INSTALLING STEEL SUSPENDED CEILING AND SOFFIT FRAMING

- A. Suspend ceiling 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 ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counter-splaying, or other equally effective means.
 - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
 - 3. Secure wire hangers 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 them to deteriorate or otherwise fail.
 - 4. Do not support ceilings directly from permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 - 5. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - 6. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- B. Installation Tolerances: Install steel framing components for suspended ceilings so members for panel attachment are level to within 1/8 inch in 12 feet measured lengthwise on each member and transversely between parallel members.
- C. Seismic Bracing: Sway-brace suspended steel framing with hangers used for support.
- D. Wire-tie furring channels to supports, as required to comply with requirements for fire-resistance rated assemblies indicated.
- E. Install suspended steel framing components in sizes and spacings indicated, but not less than that required by the referenced steel framing and installation standards.
 - 1. Hangers: 48 inches o.c.
 - 2. Carrying Channels (Main Runners): 48 inches o.c.
 - 3. Furring Channels (Furring Members): 16 inches o.c.
 - 4. Comply with Building Code seismic requirements for sway bracing.

3.5 INSTALLING STEEL PARTITION AND SOFFIT FRAMING

- A. Install tracks (runners) at floors, ceilings, and structural walls and columns where gypsum board assemblies abut other construction.
 - 1. Where studs are installed directly against exterior walls, install asphalt-felt isolation strip between studs and wall.
- B. Installation Tolerance: Install each steel framing and furring member so fastening surfaces vary not more than 1/8 inch from the plane formed by the faces of adjacent framing.
- C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
 - 1. Cut studs 1/2 inch short of full height to provide perimeter relief.
 - 2. For fire-resistance-rated and STC-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid-structure surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed to support gypsum board closures and to make partitions continuous from floor to underside of solid structure.
 - a. Terminate partition framing at suspended ceilings where indicated.
- D. Install steel studs and furring at the following spacings:
 - 1. Single-Layer Construction: 16 inches o.c., unless otherwise indicated.
 - 2. Cementitious Backer Units: 16 inches o.c., unless otherwise indicated.
- E. Install steel studs so flanges point in the same direction and leading edge or end of each panel can be attached to open (unsupported) edges of stud flanges first.
- F. Frame door openings to comply with GA-600 and with gypsum board manufacturer's applicable written recommendations, unless otherwise indicated. 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.
 - 1. Install two studs at each jamb, unless otherwise indicated.
 - 2. 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.
 - 3. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.

- G. 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.

3.6 APPLYING AND FINISHING PANELS, GENERAL

- A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216.
- 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 board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- D. Install gypsum 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. Install wall panels ½-inch off finish floor slab. Provide fire rated sealant to close gap in base of wall to slab on rated walls.
- G. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- H. Attach gypsum panels to framing provided at openings and cutouts.
- I. Form control and expansion joints with space between edges of adjoining gypsum panels from edge with control joint zip strip, caulk zip strip gap. Provide control joints as recommended by the manufacturer for regular gypsum wall board.
- J. Cover both faces of steel stud partition 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 open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists, and other structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- K. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations, and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- L. STC-Rated Assemblies: Seal construction at perimeters, behind control and expansion 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 manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.
- M. 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.
- N. Space fasteners in panels that are tile substrates a maximum of 8 inches o.c.

3.7 PANEL APPLICATION METHODS

- A. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to the 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 board.
 - b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
- B. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill 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.

- D. Mold and Moisture Resistant Panels (MMR): Provide mold and moisture resistant panels in all toilet rooms, kitchens, janitor closets, and within 5 foot of plumbing fixtures in all other spaces, unless another finish material is specifically indicated.
- E. Tile Backing Panels:
 - 1. Cementitious Backer Units: ANSI A108.11, at framed locations indicated to receive tile.
 - 2. Where tile backing panels about other types of panels in the same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.8 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. Install control joints additionally according to ASTM C 840 and in specific locations approved by Architect for visual effect.

3.9 FINISHING GYPSUM BOARD ASSEMBLIES

- 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 1: Embed tape at joints in ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
 - 2. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will be exposed to view, unless otherwise indicated.
 - 3. Level 5 (all other areas): Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fastener, and trim flanges, and apply skim coat of joint compound over entire surface of gypsum panel.
- E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.10 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.

END OF SECTION 09 21 16

SECTION 09 22 00 – SUSPENDED GYPSUM BOARD CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes:
 - 1. Suspension system framing and furring for plaster and gypsum board assemblies.
 - 2. Wire hangers, fasteners, main runners, cross tees, and wall angle moldings.
- B. Related Sections:
 - 1. Division 09, Section “Gypsum Board Assemblies.”
 - 2. Division 09, Section “Acoustical Panel Ceilings.”
 - 3. Division 23 Sections for Mechanical Work.
 - 4. Division 26 Sections for Electrical Work.

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
 - 2. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
 - 3. ASTM A 1008 Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 - 4. ASTM B 117 Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - 5. ASTM C 635 Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
 - 6. ASTM C 636 Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
 - 7. ASTM C 645 Standard Specification for Nonstructural Steel Framing Members.
 - 8. ASTM C 754 Installation of Steel Framing Members to Receive Screw-Attached Gypsum Board.
 - 9. ASTM C 1002 Standard Specification for Steel Drill Screws for the Application of Gypsum board or Metal Plaster Bases.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer’s technical literature.
- B. Samples: 8-inch-long samples of suspension system components, including main runner, cross tees and angle molding.
- C. Certifications: Manufacturer’s certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards.

1.4 QUALITY ASSURANCE

- A. Single-Source Responsibility: To ensure proper interface, all drywall furring components shall be produced or supplied by a single manufacturer.
- B. All accessory components from other manufacturers shall conform to ASTM standards.
- C. Fire Resistance Ratings: As indicated by reference to design designations in UL Fire Resistance Directory, for types of assemblies in which drywall ceilings function as a fire protective membrane and tested per ASTM E 119. Installation in accordance with the UL Design being referenced.
- D. Coordination of Work:
 - 1. Coordinate drywall furring work with installers of related work including, but not limited to acoustical ceilings, building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.
 - 2. All work above the ceiling line should be completed prior to installing the drywall sheet goods. There should be no materials resting against or wrapped around the suspension system, hanger wires or ties.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

1.6 WARRANTY

- A. Suspensions System: Submit a written limited warranty executed by the manufacturer, agreeing to repair or replace grid components that are supplied with a hot-dipped galvanized coating or aluminum base material. Failures include, but are not limited to:

1. The occurrence of 50% red rust as defined by ASTM B 117 test procedures as a result of defects in materials or factory workmanship.
- B. Warranty Period:
 1. Grid: 10 years from date of installation.
- C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the requirements herein, provide products by one of the following:
 1. Armstrong World Industries, Basis of Design.
 2. USG.
 3. Chicago Metallic Corp.
 4. Or Approved Equal.

2.2 SUSPENSION SYSTEMS

- A. Components:
 1. Main Beam: Shall be double-web construction (minimum 0.0179 inch prior to protective coating), hot-dipped galvanized (per ASTM A653).
 - a. 1-1/2 inch web height, prefinished 15/16 inch flange with minimum G40 hot-dipped galvanization.
 - b. 1-11/16-inch web height, 1-1/2 inch flange, available with G40 or G90 hot-dipped galvanization.
 - c. 1-11/16-inch web height with pre-cut facets (8 inches on center) for radius installations, 1-1/2 inch flange.
 2. Primary Cross Tees: Shall be double-web steel construction (minimum 0.0179 inch prior to protective coating), hot-dipped galvanized (minimum G40 or G90 per ASTM A653), web height 1-1/2 inch with rectangular bulb and prefinished 1-1/2" knurled flange.
 3. Secondary Framing Cross Tees: Shall be double web steel construction (minimum 0.0179 inch prior to protective coating), hot-dipped galvanized (minimum G40) web height 1-1/2 inch rectangular bulb and 15/16 inch flange.
 4. Hat Furring Channel: Shall be 48-inch x 1-3/8 inch x 7/8 inch, hot dipped galvanized steel (minimum G40 per ASTM A653); compatible with main beams.
 5. Wall Molding:
 - a. Hot-dipped galvanized (minimum G40), hemmed angle molding, 1-1/4 inch height with 1-1/4 inch flange.
 6. Clips:
 - a. ABAC – Main Beam Adaptor Clip.
 - b. DWCS, DW50, DW58 – Drywall Attachment Clip for transitions to acoustical ceilings.
 - c. Drywall Angle Clips – Available in 30 degree, 45 degree, 60 degree, and 90 degree angles.
 - d. XTAC – Cross Tee Adapter Clip.
 - e. Radius Clip (RC2) – Required to cover all pre-cut facets, including those not being clipped.
 7. Screws for wallboard application shall be bugle head screws in accordance with thickness of material used.
- B. Structural Classification:
 1. Main Beam shall be heavy duty per ASTM C 635.
 2. Classification can require wires to be closer together for additional loading when used to support double layer gypsum, verticals, slopes, domes, half barrels, circles, soffits, canopies, and step conditions which call for loading or unusual designs and shapes in drywall construction. Using cross tees in the construction of circles, barrels, etc. is common in order to hold the radius.
 3. Deflection of fastening suspension system supporting light fixtures, ceiling grilles, access doors, verticals, and horizontal loads shall have a maximum deflection of 1/360 of the span.

PART 3 - EXECUTION

3.1 INSTALLATION – GENERAL

- A. Install suspension system and panels in accordance with the manufacturer's instructions, in compliance with ASTM installation standard, and with applicable codes as required by the authorities having jurisdiction.
- B. To secure to metal clips, concrete inserts, steel bar joist or steel deck, use power actuated fastener, or insert. Coordinate placement for hanger wire spaced as required for expected ceiling loads and layout.
- C. Install hanger wire as required with necessary on center spacing to support expected ceiling load requirements, following applicable building code. Provide additional wires at light fixtures, grilles, and access doors where necessary. A pigtail knot shall be used with three tight wraps at top and bottom fastening locations.

- D. Add additional wire as needed when using compatible clips and accessories.
- E. Control Joints: Roll formed zinc alloy, aluminum or plastic as required for expansion and contraction as shown on drawings.
- F. Expansion Joints: Roll formed zinc alloy, aluminum or plastic as required for expansion and contraction as shown on drawings.
- G. Main beams shall be suspended from the overhead construction with hanger wire, spaced as required for expected ceiling loads, along the length of the main beams.
- H. Install cross tees at on center spacing as specified by the drywall manufacturer. Typical drywall cross tee spacing:
 - 1. 16 inches on center with ½ inch gypsum board.
 - 2. 24 inches on center with 5/8-inch gypsum board.
- I. Other items such as wood, sheet metal, or plastic panels should be screwed to comply with deflection limit equivalent to that of the ceiling installation.
- J. Use channel molding or angle molding to interface with drywall grid system to provide perimeter attachment or to obtain drop soffits, verticals, slopes, etc.
- K. To suspend a second ceiling beneath a new or existing drywall ceiling, without breaching the integrity of the upper ceiling, use the drywall clip. To form a transition from a drywall ceiling to an acoustical ceiling, use the drywall transition clips spaced as required for expected loads.
- L. For light fixtures (Type G, Type F) use secondary framing cross tees as required to frame opening.
- M. Single cross tees in a route hole to be secured by 7/16-inch framing screw or alternative methods.

3.2 INSTALLATION – RADIUS APPLICATIONS

- A. Determine the bow or camber (convex or concave) in a main runner.
- B. Establish a jig or pattern on a flat surface; mark locations to cut main beam; and use four pan head screws to fasten a radius clip (RC2) flat to the web between the bulb and the flange; per the manufacturer's instructions.
- C. Install main beams with on center spacing and wire spacing, as needed, to support expected ceiling load.
- D. Additional bracing may be required by code.
- E. Install cross tees at on center spacing as specified by the manufacturer.

END OF SECTION 09 22 00

SECTION 09 30 00 – TILE**PART 1 - GENERAL****1.1 SUMMARY**

- A. This section includes the following:
 - 1. Porcelain paver tile.
 - 2. Glazed wall tile.
 - 3. Porcelain tile and base.
- B. Related Sections include the following:
 - 1. Division 07, Section "Joint Protection" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
 - 2. Division 09 "Gypsum Board Assemblies" for tile backing panels.

1.2 DEFINITIONS

- A. Facial Dimension: Nominal tile size as defined in ANSI A137.1.

1.3 PERFORMANCE REQUIREMENTS

- A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:
 - 1. Level Surfaces: Minimum 0.6.
- B. Load-Bearing Performance: For ceramic tile installed on walkway surfaces, provide installations rated for the following load-bearing performance level based on testing assemblies according to ASTM C 627 that are representative of those indicated for this Project:
 - 1. Extra Heavy: Passes cycles 1 through 14.

1.4 SUBMITTALS

- A. Product Data: For each type of tile, mortar, grout, and other products specified.
- B. Tile Samples for Initial Selection: Manufacturer's color charts consisting of actual tiles or sections of tiles showing the full range of colors, textures, and patterns available for each type and composition of tile indicated. Include Samples of accessories involving color selection.
- C. Grout Samples for Initial Selection: Manufacturer's color charts consisting of actual sections of grout showing the full range of colors available for each type of grout indicated.
- D. Provide master grade certificates for each type of tile on project.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed tile installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Source Limitations for Tile: Obtain each color, grade, finish, type, composition, and variety of tile from one source with resources to provide products from the same production run for each contiguous area of consistent quality in appearance and physical properties without delaying the Work.
- C. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.

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 requirement of ANSI A137.1 for labeling sealed tile packages.
- B. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is completed and ambient temperature and humidity conditions are being maintained to comply with referenced standards and manufacturer's written instructions.

1.8 EXTRA MATERIALS

- A. Deliver extra materials to Owner. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size indicated.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Products: Subject to compliance with requirements, provide products indicated in the ceramic tile installation schedules at the end of this Section.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Tile-Setting and -Grouting Materials:
 - a. Bonsal American; an Oldcastle Company.
 - b. Custom Building Products.
 - c. DAP, Inc.
 - d. Laticrete International, Inc. (Basis of Design)
 - e. Mapei Corporation.
 - f. Southern Grouts & Mortars, Inc.
 - g. TEC Incorporated.
 - h. Ardex.
2. Tile: (See drawings for 'Basis of Design' product)
 - a. American Olean.
 - b. Crossville.
 - c. Daltile.
 - d. Florida Tile.

2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.
 1. Provide tile complying with Standard Grade requirements, unless otherwise indicated.
 2. For facial dimensions of tile, comply with requirements relating to tile sizes specified in Part 1 "Definitions" Article.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI standards referenced in "Setting Materials" and "Grouting Materials" articles.
- C. Colors, Textures, and Patterns: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:
 1. Provide Architect's selections from manufacturer's full range of colors, textures, and patterns for products of type indicated.
 2. Provide tile trim and accessories that match color and finish of adjoining flat tile.
- D. Factory Blending: For tile exhibiting color variations within the ranges selected during Sample submittals, blend tile in the factory and package so tile units taken from one package show the same range in colors as those taken from other packages and match approved Samples.

2.3 TILE PRODUCTS

- A. Glazed Wall Tile: Provide flat tile complying with the following requirements:
 1. Module Size: 3 x 12 inches. Refer to Finish Schedule on Drawings for manufacturer, style & type.
 2. Thickness: 3/8 inch.
 3. Face: Plain with modified square edges or cushion edges.
- B. Porcelain: Provide flat tile complying with the following requirements:
 1. Composition: Porcelain PFT-1
 2. Facial Dimensions: 12 x 24 inches: Refer to Finish Schedule on Drawings for manufacturer, style & type.
 3. Thickness: Not less than 5/16 inch.
 4. Face: Plain with squares or cushion edges.
 5. For latex-portland cement mortared and grouted paver tile, precoat with temporary protective coating.
- C. Trim Units: Provide tile trim units to match characteristics of adjoining flat tile and to comply with the following requirements:
 1. Size: As indicated, coordinated with sizes and coursing of adjoining flat tile where applicable.
 2. Shapes: As follows, selected from manufacturer's standard shapes:
 - a. Base for Thin-Set Mortar Installations: Straight.
 - b. Wainscot Cap for Thin-Set Mortar Installations.
 - c. External Corners for Thin-Set Mortar Installations: Surface bullnose. Schluter-INDEC.
 - d. Internal Corners: for Thin-Set Mortar Installations: Schluter-INDEC.

2.4 SETTING MATERIALS

- A. Latex-Portland Cement Mortar: ANSI A118.4, composed as follows:
 1. Mixture of Dry-Mortar Mix and Latex Additive: Mixture of prepackaged dry-mortar mix and liquid-latex additive complying with the following requirements:
 - a. Latex Additive: Styrene butadiene rubber.
 - b. Latex Additive: Acrylic resin.
 - c. For wall applications, provide nonsagging, latex-portland cement mortar complying with ANSI A118.4 for mortar of this type defined in Section F-2.1.2.

2.5 GROUTING MATERIALS

- A. Latex-Portland Cement Grout: ANSI A118.6 for materials described in Section H-2.4, composed as follows:
 - 1. Mixture of Dry-Grout Mix and Latex Additive: Mixture of factory-prepared, dry-grout mix and latex additive complying with the following requirements:
 - a. Unsanded Dry-Grout Mix: Dry-set grout complying with ANSI A118.6 for materials described in Section H-2.3, for joints 1/8 inch and narrower.
 - b. Sanded Dry-Grout Mix: Commercial portland cement grout complying with ANSI A118.6 for materials described in Section H-2.1, for joints 1/8 inch and wider.
 - c. Latex Additive: Styrene butadiene rubber.
 - d. Latex Additive: Acrylic resin.
- B. Chemical-Resistant Epoxy Grout: ANSI A118.3, color as selected by Architect from manufacturer's full range of colors.
 - 1. Provide product capable of resisting continuous and intermittent exposure to temperatures of up to 140 deg F and 212 deg F, respectively, as certified by mortar manufacturer for intended use.

2.6 ELASTOMERIC SEALANTS

- A. General: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated that comply with applicable requirements of Division 07, Section "Joint Protection."
 - 1. Use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated.
- C. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and temperature extremes.
- D. Products: Subject to compliance with requirements, provide one of the following:
 - 1. One-Part, Mildew-Resistant Silicone Sealants:
 - a. Dow Corning 786; Dow Corning Corporation.
 - b. Sanitary 1700; GE Silicones.
 - c. Pecora 898 Sanitary Silicone Sealant; Pecora Corp.
 - d. Tremsil 600 White; Tremco, Inc.

2.7 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. Metal Edge Strips: White-zinc-alloy terrazzo strips, 1/8 inch wide at top edge with integral provision for anchorage to mortar bed or substrate, unless otherwise indicated.
 - 1. Wall tile perimeter: Schluter Jolly
 - a. Color: Anodized Aluminum
 - 2. Wall base top: Schluter Schiene
 - a. Color: Anodized Aluminum
 - 3. Exterior wall tile corners: Schluter Jolly
 - a. Color: Anodized Aluminum
 - 4. Interior wall tile corners: Schluter Dilex-Eke
 - a. Color: Anodized Aluminum
- 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.

2.8 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 from oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 series of tile installation standards for installations indicated.
2. 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 before installing tile.
3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust latter in consultation with Architect.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove coatings, including curing compounds, and other substances that contain soap, wax, oil, or silicone and are incompatible with tile-setting materials by using a terrazzo or concrete grinder, a drum sander, or a polishing machine equipped with a heavy-duty wire brush.
- B. Provide concrete substrates for tile floors installed with dry-set or latex-portland cement mortars that comply with flatness tolerances specified in referenced ANSI A108 series of tile installation standards for installations indicated.
 1. Use trowelable leveling and patching compounds per tile-setting material manufacturer's written instructions to fill cracks, holes, and depressions.
 2. Remove protrusions, bumps, and ridges by sanding or grinding.
- C. Blending: For tile exhibiting color variations within the ranges selected during Sample submittals, verify that tile has been blended in the factory and packaged so tile units taken from one package show the same range in colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 INSTALLATION, GENERAL

- A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 series "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.
- B. TCNA Installation Guidelines: TCNA's "Handbook for Ceramic Tile Installation." Comply with TCNA installation methods indicated in ceramic tile installation schedules.
- C. Extend tile work into recesses and under or behind equipment and fixtures to form a complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- E. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are the same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.
 1. For tile mounted in sheets, make joints between tile sheets the same width as joints within tile sheets so joints between sheets are not apparent in finished work.
- F. Lay out tile wainscots to next full tile beyond dimensions indicated.
- G. Grout tile to comply with the requirements of the following tile installation standards:
 1. For ceramic tile grouts (sand-portland cement, dry-set, commercial portland cement, and latex-portland cement grouts), comply with ANSI A108.10.
 2. For chemical-resistant epoxy grouts, comply with ANSI A108.6.
- H. At toilet rooms, install cementitious backer units and treat joints to comply with ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.4 FLOOR TILE INSTALLATION

- A. General: Install tile to comply with requirements in the Ceramic Tile Floor Installation Schedule, including those referencing TCA installation methods and ANSI A108 series of tile installation standards.
- B. Joint Widths: Install tile on floors with the following joint widths:
 1. Glazed Wall Tile: 3/16 inch.
 2. Paver Tile: 3/16 inch.
- C. Back Buttering: For installations indicated below, obtain 100 percent mortar coverage by complying with applicable special requirements for back buttering of tile in referenced ANSI A108 series of tile installation standards:
 1. Tile floors in wet areas, including showers, tub enclosures, laundries, and swimming pools.
 2. Tile floors installed with chemical-resistant mortars and grouts.
 3. Tile floors composed of rib-backed tiles.
- D. Metal Edge Strips: Install at locations indicated or where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.

3.5 WALL TILE INSTALLATION

- A. Install types of tile designated for wall installations to comply with requirements in the Ceramic Tile Wall Installation Schedule, including those referencing TCA installation methods and ANSI setting-bed standards.
- B. Joint Widths: Install tile on walls with the following joint widths:
 - 1. Wall Tile: 3/16 inch for non-lugged tiles; 1/16 inch for lugged tiles.
- C. Back Buttering: For installations indicated, obtain 100 percent mortar coverage by complying with applicable special requirements for back buttering of tile in referenced ANSI A108 series of tile installation standards:
 - 1. Tile installed with chemical-resistant mortars and grouts.

3.6 CLEANING AND PROTECTING

- A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Remove latex-portland cement grout residue from tile as soon as possible.
 - 2. Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.
 - 3. Remove temporary protective coating by method recommended by coating manufacturer that is acceptable to brick and grout manufacturer. Trap and remove coating to prevent it from clogging drains.
- B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, and otherwise defective tile work.
- C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure tile is without damage or deterioration at the time of Substantial Completion.
 - 1. When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.
 - 2. Prohibit foot and wheel traffic from tiled floors for at least 7 days after grouting is completed.
- D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

3.7 FLOOR TILE SCHEDULE

- A. Porcelain Tile PFT-1: Where interior floor installations of this designation are indicated, comply with the following:
 - 1. Installation Method: TCA F115 (thin-set mortar bonded to concrete subfloor, with epoxy grout).
 - 2. Setting Bed and Grout: ANSI A108.1B with the following mortar and grout:
 - a. Latex-portland cement mortar.
 - b. Chemical-resistant epoxy grout. Where epoxy grout is specified for floor tile, provide epoxy grout for base as well.

3.8 WALL TILE SCHEDULE

- A. Ceramic Wall Tile CWT-1 & CWT-2: Comply with the following:
 - 1. Installation Method: TCA W202 (thin-set mortar bed over sound, dimensionally stable masonry or concrete).
 - 2. Setting Bed and Grout: ANSI A108.5 with the following mortar and grout:
 - a. Latex-portland cement mortar.
 - b. Unsanded latex-portland cement grout.

END OF SECTION 09 30 00

SECTION 09 51 13 – ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes ceilings consisting of acoustical panels and exposed suspension systems.

1.2 REFERENCES

- A. Refer to Specification 09, Section 09 21 16 for gypsum board ceilings designated as C-4.
- B. Refer to Specification 09, Section 09 90 00 for ceilings designated as C-11. Refer to reflected ceiling plans for exposed structure to be painted.

1.3 SUBMITTALS

- A. Product Data: For each type of product specified.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed acoustical panel ceilings similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Source Limitations for Ceiling Units: Obtain each acoustical ceiling panel from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
- C. Source Limitations for Suspension System: Obtain each suspension system from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
 - 1. Obtain both acoustical ceiling panels and suspension system from the same manufacturer.
- D. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:
 - 1. Fire-response tests were performed by UL, ITS/Warnock Hersey, or another independent testing and inspecting agency that is acceptable to authorities having jurisdiction and that performs testing and follow-up services.
 - 2. Surface-burning characteristics of acoustical panels comply with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84.
 - 3. Products are identified with appropriate markings of applicable testing and inspecting agency.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels and suspension system components to Project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical 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.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.7 COORDINATION

- A. Coordinate layout and installation of acoustical panels 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.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Acoustical Ceiling Units: Full-size units equal to 2.0 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products indicated for each designation in the Acoustical Panel Ceiling Schedule at the end of Part 3.

2.2 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.
 - 1. Mounting Method for Measuring Noise Reduction Coefficient: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface per ASTM E 795.
- B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

1. Where appearance characteristics of acoustical panels are indicated by referencing ASTM E 1264 pattern designations and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range of products that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.
- C. Provide acoustical panels treated with Bioblock or BioShield paint which contains fungicide that inhibits or retards the growth of mold or mildew on their painted surfaces.

2.3 METAL SUSPENSION SYSTEMS, GENERAL

- A. Seismic Loads: Design and size components to withstand seismic loads in accordance with International Building Code for Seismic Design Category C chosen, select HD grid system and 2" molding.
- B. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable ASTM C 635 requirements.
- C. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
 1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
- D. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung, unless otherwise indicated.
- E. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 1. Zinc-Coated Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, Direct Hung) will be less than yield stress of wire; but provide not less than 0.106-inch- diameter wire.
- F. Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material and finish as that used for exposed flanges of suspension system runners.
 1. For lay-in panels with reveal edge details, provide stepped edge molding that forms a reveal of the same depth and width as that formed between edge of panel and flange at exposed suspension member.
 2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
- G. Hold-Down Clips for Non-Fire-Resistance-Rated Ceilings: For interior ceilings consisting of acoustical panels weighing less than 1 lb/sq. ft., provide hold-down clips spaced 24 inches o.c. on all cross tees.

2.4 ACOUSTICAL SEALANT

- A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), complying with ASTM C 834 and the following requirements:
 1. Product is effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
- B. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 1. Acoustical Sealant for Exposed and Concealed Joints:
 - a. Stop Gap Acoustical Sealant; Auralex Acoustics, Inc.
 - b. AC-20 FTR Acoustical and Insulation Sealant; Pecora Corp.
 - c. SHEETROCK Acoustical Sealant; United States Gypsum Co.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and 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 other conditions affecting performance of acoustical panel ceilings.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordination: Furnish layouts for cast-in-place anchors, clips, and other ceiling anchors whose installation is specified in other Sections.
- B. 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, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

- A. Install acoustical panel ceilings in accordance with the International Building Code and authorities having jurisdiction.

1. Ceiling system installation and components shall conform to seismic requirements for Seismic Design Category C.
- 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, counter-splaying, 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. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
 4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure; that are 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, powder-actuated fasteners, or drilled-in anchors that extend through forms into concrete.
 6. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 7. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; and provide hangers not more than 8 inches from ends of each member.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or post-installed anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical 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, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fitted accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
 1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
 2. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 3. Paint cut panel edges remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 4. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated or required.
 5. Protect lighting fixtures and air ducts according to requirements indicated for fire-resistance-rated assembly.

3.4 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. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

3.5 ACOUSTICAL PANEL CEILING SCHEDULE

- A. Mineral-Base Acoustical Panels for Acoustical Panel Ceiling C-1: Where this designation is indicated, provide acoustical panels, treated with mold/mildew inhibitor, and complying with the following:
 1. Products: Provide product of one of the listed manufacturers corresponding to the Basis of Design product listed:
 - a. Armstrong World Industries, Inc., Fine Fissured Humiguard Plus.
 - b. Rockfon.
 - c. Certainteed, Inc.
 - d. USG Interiors, Inc.

2. Classification: Panels fitting ASTM E 1264 for type and form as follows:
 - a. Type III, mineral base with painted finish; Form 2, water felted.
 3. Pattern: Panels fitting ASTM E 1264 pattern designation (description) C (perforated, small holes). D (fissured).
 4. Color: White.
 5. Light Reflectance Coefficient: Not less than LR 0.84.
 6. Noise Reduction Coefficient: NRC 0.55.
 7. Ceiling Attenuation Class: Not less than CAC 30.
 8. Edge Detail: Square.
 9. Thickness: 5/8- inch.
 10. Size: 24 x 24 inch.
- B. Mineral-Base Acoustical Panels with Membrane-Faced C-3: Where this designation is indicated, provide acoustical panels, treated with mold/mildew inhibitor, and complying with the following:
1. Products: Provide product of one of the listed manufacturers corresponding to the Basis of Design product listed:
 - a. Armstrong World Industries, Inc., Clean Room VL - Nonperforated Humiguard Plus.
 - b. Rockfon.
 - c. Certaineed, Inc.
 - d. USG Interiors, Inc.
 2. Classification: Panels fitting ASTM E 1264 for Type IV, mineral base with membrane-faced overlay; Form 2, water felted, with vinyl-faced membrane overlay on face.
 3. Pattern: Panels fitting ASTM E 1264 pattern designation (description) E (lightly textured).
 4. Color: White.
 5. Light Reflectance Coefficient: Not less than LR 0.83.
 6. Noise Reduction Coefficient: NRC 0.10.
 7. Ceiling Attenuation Class: CAC 40.
 8. Edge Detail: Square.
 9. Thickness: 5/8- inch.
 10. Size: 24 x 24 inch.
- C. Suspended Acoustical Clouds C-5. Where is designation is indicated, provide acoustical panels treated with mold/mildew inhibitor, and complying with the following:
1. Products: Provide product of one of the listed manufacturers corresponding to the Basis of Design product list:
 - a. Armstrong Ceilings, Soundscapes Shapes (Basis of Design).
 - 1) Shape: Rectangle
 - 2) Size 48" x 72"
 - b. CertainTeed Architectural
 - c. Deacoustics
 2. Classification: Panels fitting ASTM E 1264 for Type XII, Form 2, Pattern E; Fire Class A
 3. Color: Custom match Sherwin Williams color. See reflected ceiling plans.
 4. Light: Reflectance Coefficient: Not less than LR 0.90.
- D. Suspension System for Acoustical Panel C-1 and C-3: Where these designations are indicated, provide acoustical panel ceiling suspension system complying with the following:
1. Products:
 - a. Armstrong World Industries, Inc., Prelude XL.
 - b. Rockfon.
 - c. USG Interiors, Inc.
 2. Wide-Face, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet hot-dip galvanized G-30, with prefinished 15/16-inch- wide flanges; other characteristics as follows:
 - a. Structural Classification: Intermediate-duty system.
 - b. Face Finish: Painted white.
 3. Provide 6" straight perimeter trim at ceiling type C-,1, in locations indicated on drawings.
- E. Suspension System for Acoustical Panel C-5: Where these designations are indicated, provide high-humidity rated acoustical panel ceiling suspension system complying with the following:
1. Provide aircraft cable with deck hanging kit for each suspended acoustical ceiling cloud as recommended by the manufacturer.

END OF SECTION 09 51 13

SECTION 09 65 13 – RESILIENT WALL BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the following:
 - 1. Resilient wall base.
 - 2. Resilient stair accessories.
 - 3. Resilient flooring accessories.
- B. Related sections include the following:
 - 1. Division 9 Section "Resilient Tile Flooring."

1.2 SUBMITTALS

- A. Samples for Initial Selection: Manufacturer's standard sample sets consisting of sections of units showing the full range of colors and patterns available for each type of product indicated.
- B. Samples for Verification: In manufacturer's standard sizes, but not less than 12 inches long, of each product color and pattern specified.

1.3 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. Source Limitations: Obtain each type and color of product specified from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
- C. Fire-Test-Response Characteristics: Provide products with the following fire-test-response characteristics as determined by testing identical products per test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Critical Radiant Flux: 0.45 W/sq. cm or greater when tested per ASTM E 648.
 - 2. Smoke Density: Maximum specific optical density of 450 or less when tested per ASTM E 662.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to Project site in manufacturer's original, unopened cartons and containers, each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.
- B. Store products in dry spaces protected from the weather, with ambient temperatures maintained between 50 and 90 deg F.
- C. Move products into spaces where they will be installed at least 48 hours before installation, unless longer conditioning period is recommended in writing by manufacturer.

1.5 PROJECT CONDITIONS

- A. Maintain a temperature of not less than 70 deg F or more than 95 deg F in spaces to receive resilient products for at least 48 hours before installation, during installation, and for at least 48 hours after installation, unless manufacturer's written recommendations specify longer time periods. After post-installation period, maintain a temperature of not less than 55 deg F or more than 95 deg F.
- B. Do not install products until they are at the same temperature as the space where they are to be installed.
- C. For resilient products installed on traffic surfaces, close spaces to traffic during installation and for time period after installation recommended in writing by manufacturer.
- D. Coordinate resilient product installation with other construction to minimize possibility of damage and soiling during remainder of construction period. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products indicated for each designation in the Resilient Wall Base and Accessory Schedule at the end of Part 3.

2.2 RESILIENT WALL BASE

- A. Rubber Wall Base: Products complying with requirements specified in the Resilient Wall Base and Accessory Schedule.

2.3 RESILIENT STAIR ACCESSORIES

- A. Rubber Stair Treads: Products of style suitable for use indicated and complying with FS RR-T-650, Composition A and with requirements specified in the Resilient Wall Base and Accessory Schedule.

- B. Risers: Products of same manufacturer as stair treads and complying with requirements specified in the Resilient Wall Base and Accessory Schedule.

2.4 RESILIENT ACCESSORIES

- A. Rubber Accessories: Products complying with requirements specified in the Resilient Wall Base and Accessory Schedule.

2.5 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by resilient product manufacturer for applications indicated.
- B. Stair-Tread-Nose Filler: Two-part epoxy compound recommended by resilient tread manufacturer to fill nosing substrates that do not conform to tread contours.
- C. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
 - 1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. Cove Base Adhesives: Not more than 50 g/L.
 - b. Rubber Floor Adhesives: Not more than 60 g/L.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where installation of resilient products will occur, with Installer present, for compliance with manufacturer's requirements, including those for maximum moisture content. Verify that substrates and conditions are satisfactory for resilient product installation and comply with requirements specified. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with manufacturer's written installation instructions for preparing substrates indicated to receive resilient products.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
- C. Use stair-tread-nose filler, according to resilient tread manufacturer's written instructions, to fill nosing substrates that do not conform to tread contours.
- D. Remove coatings, including curing compounds, 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.
- E. Broom and vacuum clean substrates to be covered immediately before installing resilient products. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. General: Install resilient products according to manufacturer's written installation instructions.
- B. Apply resilient wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
 - 1. Install wall base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
 - 2. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
 - 3. Do not stretch base during installation.
 - 4. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
 - 5. Install premolded outside corners before installing straight pieces.
 - 6. Form inside corners on job, from straight pieces of maximum lengths possible, by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce a snug fit to substrate.
- C. Place resilient products so they are butted to adjacent materials and bond to substrates with adhesive. Install reducer strips at edges of flooring that would otherwise be exposed.
- D. Apply resilient products to stairs as indicated and according to manufacturer's written installation instructions.

3.4 CLEANING AND PROTECTING

- A. Perform the following operations immediately after installing resilient products:
 - 1. Remove adhesive and other surface blemishes using cleaner recommended by resilient product manufacturers.
 - 2. Sweep or vacuum horizontal surfaces thoroughly.
 - 3. Do not wash resilient products until after time period recommended by resilient product manufacturer.

4. Damp-mop or sponge resilient products to remove marks and soil.
- B. Protect resilient products against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by resilient product manufacturer.
 1. Cover resilient products installed on floors and stairs with undyed, untreated building paper until inspection for Substantial Completion.
- C. Clean resilient products not more than 4 days before dates scheduled for inspections intended to establish date of Substantial Completion in each area of Project. Clean products according to manufacturer's written recommendations.

3.5 RESILIENT WALL BASE AND ACCESSORY SCHEDULE

- A. Rubber Wall Base RWB-1: Provide rubber wall base complying with the following: TS-1 thermoset vulcanized rubber.
 1. Products: As follows:
 - a. Tarkett (Basis of Design)
 - b. Roppe
 - c. Burke
 - d. Flexco
 - e. Mannington
 2. Color and Pattern: Match architect's sample as indicated on interior finish schedule on drawings.
 3. Style: Cove with top-set toe.
 4. Minimum Thickness: 1/8 inch.
 5. Height: 4 inches.
 6. Lengths: Coils in lengths standard with manufacturer, but not less than 96 feet.
 7. Outside Corners: Premoulded.
 8. Inside Corners: Job-formed.
 9. Surface: Smooth.
- B. Accessory Molding: Provide metal accessory trim.
 1. Products: As follows:
 - a. Schluter Systems (Basis of Design)
 - b. Kuberit
 - c. Or approved equal
 2. Color: As selected by Architect from manufacturer's full range of colors produced for rubber accessory molding complying with requirements indicated.
 3. Product Description:
 - a. Schluter Rondec, Color: Anodized Aluminum.
 - b. Reducer strip resilient flooring: Vinpro-U Series
 - c. Tile and resilient flooring joiner: Reno-U Series
 4. Profile and dimensions: As required for specified flooring installation conditions.

3.6 RESILIENT STAIR ACCESSORY SCHEDULE

- A. Rubber Stair Treads and Accessories: Where this designation is indicated, provide rubber stair treads and accessories complying with the following:
 1. Product As Follows:
 - a. Mannington Commercial: Burke Stairway Systems, ColorSpec Stair Treads (Basis of Design)
 - b. Tarkett
 - c. Roppe
 2. Color and Patter: Match Architects's sampleas indicated on interior finish schedule.
 3. Rubber Stair Tread products complying with the following requirements:
 - a. Type 2 Design: Pattern to be selected by Architect
 - b. Nosing Style: Square, 90 degrees.
 - c. Nosing Height: 1-1/2 inches.
 - d. Thickness: 1/8 inch
 - e. Size: Lengths and depths to fit each stair tread in one piece.
- B. Rubber Stair Risers: Where this designation is indicated, provide smooth, flat, coved-toe rubber stair risers complying with the following:
 1. Product As Follows:
 - a. Mannington Commercial: Burke Stairway Systems, Risers (Basis of Design)
 - b. Tarkett
 - c. Roppe
 2. Color and Pattern: Match Architects sample as indicated on interior finish schedule
 3. Thickness: 1/8 inch

4. Height: 7 inches
5. Length: Match to treads

END OF SECTION 09 65 13

SECTION 09 65 20 – RESILIENT VINYL PLANK FLOORING**PART 1 - GENERAL****1.1 SUMMARY**

- A. This section includes the following:
 - 1. Luxury vinyl plank flooring.
- B. Related sections include the following:
 - 1. Division 09 Section "Resilient Base and Accessories" for resilient wall base, reducer strips, and other accessories installed with resilient floor tiles.

1.2 SUBMITTALS

- A. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors and patterns available for each type of product indicated.
- B. Test Reports: Submit test reports confirming substrate moisture vapor emission rate and alkalinity are within limits acceptable to tile and adhesive manufacturers.
- C. Maintenance Data: For resilient flooring to include in the maintenance manuals specified in Division 01.

1.3 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. Source Limitations: Obtain each type, color, and pattern of product specified from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
- C. Fire-Test-Response Characteristics: Provide products with the following fire-test-response characteristics as determined by testing identical products per test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Critical Radiant Flux: 0.45 W/sq. cm or greater when tested per ASTM E 648.
 - 2. Smoke Density: Maximum specific optical density of 450 or less when tested per ASTM E 662.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to Project site in manufacturer's original, unopened cartons and containers, each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.
- B. Store products in dry spaces protected from the weather, with ambient temperatures maintained between 50 and 90 deg F.
- C. Store flooring on flat surfaces.
- D. Move products into spaces where they will be installed at least 48 hours before installation, unless longer conditioning period is recommended in writing by manufacturer.

1.5 PROJECT CONDITIONS

- A. Maintain a temperature of not less than 70 deg F or more than 95 deg F in spaces to receive products for at least 48 hours before installation, during installation, and for at least 48 hours after installation, unless manufacturer's written recommendations specify longer time periods. After post-installation period, maintain a temperature of not less than 55 deg F or more than 95 deg F.
- B. Do not install products until they are at the same temperature as the space where they are to be installed.
- C. Close spaces to traffic during flooring installation and for time period after installation recommended in writing by manufacturer.
- D. Install flooring and accessories after other finishing operations, including painting, have been completed.
- E. Where demountable partitions and other items are indicated for installation on top of resilient flooring, install flooring before these items are installed.
- F. Do not install flooring over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive, as determined by ASTM F 1869, or manufacturer's recommended bond and moisture test.

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Furnish not less than one box for each 50 boxes or fraction thereof, of each type, color, pattern, class, wearing surface, and size of resilient tile flooring installed.
 - 2. Furnish not less than 10 linear feet for each 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient accessory installed.
 - 3. Deliver extra materials to Owner.

1.7 WARRANTY

- A. Defects:
 - 1. One (1) year warranty for material defects plus labor to remedy.
 - 2. Two (2) year warranty for material defects plus 1/2 labor remedy.
- B. 10 Year Warranty: Material defects only.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products indicated for each designation in the Resilient Tile Flooring Schedule at the end of Part 3.

2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by flooring manufacturer for applications indicated.
- B. Adhesives: Non-staining, water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
 - 1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - a. VCT Adhesives: Not more than 50 g/L.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where installation of resilient products will occur, with Installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for resilient product installation and comply with requirements specified.
- B. Concrete Subfloors: Concrete Subfloors: Test subfloors for moisture vapor emission rate recommended by manufacturer of adhesive and tile.
 - 1. Test slabs using ASTM F-1869 (MVR test using Anhydrous Calcium Chloride).
 - 2. Verify concrete slab alkalinity is within tolerances acceptable to tile and adhesive manufacturers.
 - 3. Submit written reports.
- C. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
 - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by flooring manufacturer.
 - 2. Subfloor finishes comply with requirements specified in Division 03 Section "Cast-in-Place Concrete" for slabs receiving resilient flooring.
 - 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- D. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with resilient product manufacturer's written installation instructions for preparing substrates indicated to receive resilient products.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- D. Broom and vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.3 FLOORING INSTALLATION

- A. General: Comply with tile manufacturer's written installation instructions.
- B. Lay out flooring from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half of a tile at perimeter.
 - 1. Lay flooring square with room axis, unless otherwise indicated.
- C. Match flooring for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Cut tiles neatly around all fixtures. Discard broken, cracked, chipped, or deformed tiles.
 - 1. Lay tiles in pattern of colors and sizes indicated on Drawings.

- D. Scribe, cut, and fit flooring to butt neatly and tightly to vertical surfaces and permanent fixtures, including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings.
- E. Extend flooring into toe spaces, door reveals, closets, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other nonpermanent, nonstaining marking device.
- G. Install tiles on covers for telephone and electrical ducts, and similar items in finished floor areas. Maintain overall continuity of color and pattern with pieces of flooring installed on covers. Tightly adhere edges to perimeter of floor around covers and to covers.
- H. Adhere flooring to substrates using a full spread of adhesive applied to substrate to comply with tile manufacturer's written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.
 - 1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- I. Hand roll flooring according to tile manufacturer's written instructions.

3.4 CLEANING AND PROTECTING

- A. Perform the following operations immediately after installing resilient products:
 - 1. Remove adhesive and other surface blemishes using cleaner recommended by resilient product manufacturers.
 - 2. Sweep or vacuum floor thoroughly.
 - 3. Do not wash floor until after time period recommended by flooring manufacturer.
 - a. Allow minimum 5 days following installation, or longer if recommended by manufacturer.
 - 4. Damp-mop floor to remove marks and soil.
- B. Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by flooring manufacturer.
 - 1. Cover products installed on floor surfaces with undyed, untreated building paper until inspection for Final Acceptance.
 - 2. Do not move heavy and sharp objects directly over floor surfaces. Place plywood or hardboard panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.
- C. Clean floor surfaces not more than 4 days before dates scheduled for inspections intended to establish date of Final Acceptance in each area of Project. Clean products according to manufacturer's written recommendations.

3.5 RESILIENT FLOORING SCHEDULE

- A. Luxury Vinyl Plank: LVT-1, LVT-2, LVT-3, & LVT-4 with square edges.
 - 1. Shaw Contract: Joy Squared LVT (Basis of Design)
 - a. Size: 24 x 24 inches
 - b. Finish: ExoGuard+
 - c. Wear Layer Thickness: 20 mil.
 - d. Color: See interior finish schedule on drawings.
 - 2. Equal by Mohawk Group
 - 3. Equal by Mannington Commercial

END OF SECTION 09 65 20

SECTION 09 72 03 – DIGITALLY PRINTED WALL COVERINGS**PART 1 - GENERAL****1.1 SUMMARY**

- A. This section includes the following:
 - 1. Digitally printed vinyl wallcovering.
- B. Related sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 09, Section "Painting" for priming wall surfaces.
 - 2. Division 10, Section "Signage" for custom 3 dimensional acrylic signs that will overlay the digital wall covering.

1.2 SUBMITTALS

- A. Samples color proof for approval prior to manufacture of a full-size miniature mural.
- B. Submit one full size strike-off fro approval prior to manufacture of full-size mural.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed five projects similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Fire-Test-Response Characteristics: Provide wall coverings with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Flame Spread: 25 or less.
 - 2. Smoke Developed: 450 or less.

1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install wall covering until space is enclosed and weathertight, wet-work in space is completed and nominally dry, work above ceilings is complete, and ambient temperature and humidity conditions are and will be continuously maintained at values near those indicated for final occupancy.
- B. Lighting: Do not install wall covering until a lighting level of not less than 15 foot-candles is provided on the surfaces to receive wall covering.
- C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by the wall covering manufacturer for full drying or curing.

1.5 WARRANTY

- A. General Warranty: Special warranty 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 Wall Covering Warranty: Written warranty, signed by wall covering manufacturer agreeing to replace wall covering that does not comply with requirements or that fails within specified warranty period. Warranty does not include deterioration or failure of wall covering due to failure of substrate, vandalism, or abuse. Failures include, but are not limited to, delamination, surface staining due to mildew or bleed through of foreign impurities embedded in the fabric backing. Replacement of wall covering shall include installation costs.
 - 1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Products: Subject to compliance with requirements, provide one of the products specified in each wall covering Product Data sheet at end of this Section.

2.2 ACCESSORIES

- A. Adhesives: Mildew-resistant, non-staining adhesive, for use with specific wall covering and substrate application, as recommended by wall covering manufacturer and with a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPS Method 24).
- B. Substrate primer/sealer: Latex base primer specifically formulated for use with vinyl wallcoverings.
- C. Metal Molding: Extruded Aluminum in long lengths with satin finish designed for use with vinyl wallcoverings.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine substrates for compliance with requirements for moisture content and other conditions affecting performance of Work of this Section. Do not proceed with installation until 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 wall covering's bond, including mold, mildew, oil, grease, incompatible primers, and dirt.
- C. Prepare substrates to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, and defects.
 - 1. Painted Surfaces: Treat areas susceptible to pigment bleeding.
 - 2. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
 - 3. Prime new gypsum board with primer recommended by wall covering manufacturer.
- D. Check painted surfaces for pigment bleeding. Sand gloss, semigloss, and eggshell finishes with fine sandpaper.
- E. Install wall liner, with no gaps or overlaps, where required by wall covering manufacturer. Form smooth wrinkle-free surface for finished installation. Do not begin wall covering installation until wall liner has dried.
- F. Acclimatize wall covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

3.3 INSTALLATION, GENERAL

- A. General: Comply with wall coverings manufacturers' written installation instructions applicable to products and applications indicated, except where more stringent requirements apply.
- B. Cut wall covering strips in roll number sequence. Change roll numbers at partition breaks and corners only.
- C. Install wall covering with no gaps or overlaps, no lifted or curling edges and no visible shrinkage.
- D. Match pattern 72 inches above finish floor.
- E. Install seams vertical and plumb at least 6 inches from outside corners and 3 inches from inside corners. No horizontal seams are permitted.
- F. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.
- G. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams. without any overlap or spacing between strips.

3.4 CLEANING

- A. Remove excess adhesive at finished seams, perimeter edges, and adjacent surfaces.
- B. Use cleaning methods recommended by wall covering manufacturer.
- C. Replace strips that cannot be cleaned.

3.5 VINYL WALL COVERING PRODUCT DATA SHEET

- A. Vinyl Wall Covering Designation: WC-#
- B. Vinyl Wall Covering Standard: FS CCC-W-408D and CFFA-W-101-A.
- C. Total Weight: 19 min. oz/sq. yd.
- D. Width: 54 inches or 60 inches.
- E. Backing Weight: Minimum 3.0 ounces per linear yard.
- F. Digital Image: Architect to provide PDF file of image to be digitally printed with UV inks on manufacturer's PVC Printed wallcovering.

END OF SECTION 09 72 03

SECTION 09 75 19.23 – STONE WINDOWSILLS - QUARTZ

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the following:
 - 1. Quartz windowsills.
- B. Related sections include the following:
 - 1. Division 04, Section "Unit Masonry" for installing masonry inserts for anchoring interior stone facing.
 - 2. Division 07, Section "Joint Protection" for sealing joints with elastomeric sealants in expansion joints of interior stone facing.
 - 3. Division 09 Section "Gypsum Board Assemblies" for light gauge metal stud framing and gypsum board trim and finish accessories.

1.2 SUBMITTALS

- A. Product Data: For each variety of stone, stone accessory, and other manufactured products specified.
 - 1. For stone proposed for use on Project, include data on physical properties required by referenced ASTM standards.
- B. Stone Samples for Verification: Sets for each color, grade, finish, and variety of stone required; not less than 12 inches square. Include 2 or more samples in each set showing the full range of variations in appearance characteristics expected in completed Work.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed interior stone facing similar in material, design, and extent to that indicated for Project that has resulted in construction with a record of successful in-service performance.
- B. Fabricator Qualifications: Engage a firm experienced in producing interior stone facing similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units without delaying the Work.
- C. Source Limitations for Stone: Obtain each variety of stone, regardless of finish, from a single quarry with resources to provide materials of consistent quality in appearance and physical properties and to cut and finish material without delaying the Work.
 - 1. Obtain each variety of stone from a single quarry, whether specified in this Section or in another Section of the Specifications.
- D. Source Limitations for Other Materials: Obtain each type of grout, stone accessory, sealant, and other material from a single manufacturer for each product.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project Site in undamaged condition.
- B. Store and handle stone and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, or other causes.
 - 1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move stone, if required, using dollies with cushioned wood supports.
 - 2. Store stone on wood skids or pallets with nonstaining, waterproof covers. Arrange to distribute weight evenly and to prevent damage to stone. Ventilate under covers to prevent condensation.

1.5 PROJECT CONDITIONS

- A. Do not set stone when air temperature or material temperature is below 50 deg F.
- B. Maintain minimum ambient temperatures of 50 deg F during installation and for 7 days after completion unless higher temperatures are required by fabricator's or supplier's instructions.

PART 2 - PRODUCTS

2.1 STONE SOURCES

- A. Commercial Grade, Level 1.

2.2 MANUFACTURERS

- A. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with ICPA SS-1, except for composition.

1. **Manufacturers:** Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. C&C North America, Inc. (cosentino.com.)
 - b. Cambria.
 - c. E.I. du Pont de Nemours.
 - d. LG Chemical, Ltd.
 - e. Meganite, Inc.
 - f. Technistone USA, Inc.
 - g. Terazzo & Marble Supply.
 - h. Transolid.
 - i. Wilsonart, LLC.
 - j. Approved Equal
2. Colors and Patterns: Refer to Interior Design Drawings for Finish Schedules with Color and Pattern Selections
- B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Water-Cleanable Epoxy Adhesive:
 - a. Bonsal: W. R. Bonsal Co.
 - b. Laticrete International, Inc.
 - c. Mapei Corporation.

2.3 STONE, GENERAL

- A. Provide stone that is free of cracks, seams, and starts impairing structural integrity or function.
- B. Provide stone from a single quarry for each variety of stone required.
- C. Quarry stone in a manner to ensure as-quarried block orientations yield finished stone with required characteristics.

2.4 ADHESIVES AND SEALANTS

- A. General: Use only adhesives formulated for stone and ceramic tile and recommended by their manufacturer for the application indicated.
- B. Water-Cleanable Epoxy Adhesive: ANSI A118.3.

2.5 STONE ACCESSORIES

- A. Setting Shims: Resilient plastic shims, nonstaining to stone, sized to suit joint thicknesses.
- B. Cleaner: Provide stone cleaners specifically formulated for stone varieties, finishes, and applications indicated as recommended by stone producer. Do not use cleaning compounds containing acids, caustics, harsh fillers, or abrasives.

2.6 STONE FABRICATION

- A. General: Fabricate interior stone sills in sizes and shapes required to comply with requirements indicated, including details on Drawings and Shop Drawings.
- B. Cut stone to produce pieces of thickness, size, and shape indicated and to comply with fabrication and construction tolerances recommended by applicable stone association or, if none, by stone source, for faces, edges, beds, and backs.
 1. Thickness of Interior Stone Facing: Provide thickness indicated, but not less than the following:
 - a. Nominal Thickness: 2 cm.
 2. Edges: Round.
 3. Cut stone to produce joints of uniform width and in locations indicated.
 - a. Joint Width: 1/16 inch.
- C. Finish exposed faces and edges of stone to comply with requirements indicated for finish under each type of stone required and to match approved samples and mockups.
- D. Carefully inspect finished stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.
 1. Grade and mark stone for overall uniform appearance when assembled in place. Natural variations in appearance are acceptable if installed stone units match range of colors and other appearance characteristics represented in approved samples and mockups.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive interior stone facing and conditions under which interior stone facing will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of interior stone facing.
 - 1. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean stone surfaces that have become dirty or stained by removing soil, stains, and foreign materials before setting. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

3.3 SETTING STONE, GENERAL

- A. Execute interior stone facing installation by skilled mechanics and employ skilled stone fitters at the site to do necessary field cutting as stone is set.
 - 1. Use power saws to cut stone. Produce lines cut straight and true, with edges eased slightly to prevent snipping.
- B. Set stone to comply with requirements indicated on Drawings and Shop Drawings. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure interior stone facing in place. Shim and adjust anchors, supports, and accessories to set stone accurately in locations indicated with uniform joints of widths indicated and with edges and faces aligned according to established relationships and indicated tolerances.

3.4 CONSTRUCTION TOLERANCES

- A. Variation from Level: For lintels, sills, chair rails, horizontal bands, horizontal grooves, and other conspicuous lines, do not exceed 1/8 inch in 10 feet.
- B. Variation in Joint Width: Do not vary joint thickness more than 1/16 inch or one-fourth of nominal joint width, whichever is less.

3.5 INSTALLING INTERIOR STONE FACING AND TRIM

- A. Erect interior stone facing and trim plumb and true with uniform joint widths and accurately aligned. Use temporary shims to maintain joint width. Remove shims before pointing or grouting.
- B. Stone Window Stools: Set stone window stools on masonry in a full bed of epoxy adhesive.
- C. Point and grout joints after setting. Use mortar or grout type and color indicated. Tool joints uniformly and smoothly with plastic tool.

3.6 ADJUSTING AND CLEANING

- A. Remove and replace interior stone facing of the following description:
 - 1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by Architect.
 - 2. Defective joints and seams.
 - 3. Interior stone facing and joints not matching approved samples and mockups.
 - 4. Interior stone facing not complying with other requirements indicated.
- B. Replace in a manner that results in interior stone facing's matching approved samples and mockups, complying with other requirements, and showing no evidence of replacement.
- C. In-Progress Cleaning: Clean interior stone facing as work progresses. Remove mortar and grout smears before tooling joints.
- D. Clean interior stone facing not less than 6 days after completion of grouting and pointing, using clean water and soft rags or stiff-bristle fiber brushes. Do not use wire brushes, acid-type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials or methods that could damage stone.

3.7 PROTECTION

- A. Protect stone surfaces, edges, and corners from construction damage. Use securely fastened untreated wood, plywood, or heavy cardboard to prevent damage.
- B. Before inspection for Substantial Completion, remove protective covering and clean surfaces.

END OF SECTION 09 75 19.23

SECTION 09 90 00 – PAINTING**PART 1 - GENERAL****1.1 SUMMARY**

- A. This section includes surface preparation and field painting of the following:
 - 1. Exposed exterior items and surfaces.
 - 2. Exposed interior items and surfaces.
 - 3. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
 - 4. Surface repairs associated with existing walls in renovation projects.
- B. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate color or finish, the Architect will select from standard colors and finishes available.
 - 1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.
- C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
 - 1. Prefinished items include the following factory-finished components:
 - a. Architectural woodwork and casework.
 - b. Flush wood doors that have factory finish.
 - c. Metal toilet enclosures.
 - d. Metal lockers.
 - e. Finished mechanical and electrical equipment.
 - f. Light fixtures.
 - g. Distribution cabinets.
 - 2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
 - a. Foundation spaces.
 - b. Furred areas.
 - c. Ceiling plenums.
 - d. Pipe spaces.
 - e. Duct shafts.
 - 3. Finished metal surfaces include the following:
 - a. Anodized aluminum.
 - b. Stainless steel.
 - 4. Operating parts include moving parts of operating equipment and the following:
 - a. Valve and damper operators.
 - b. Linkages.
 - c. Sensing devices.
 - d. Motor and fan shafts.
 - 5. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.
- D. Related sections include the following:
 - 1. Division 05, Section "Structural Steel Framing" for shop priming structural steel.
 - 2. Division 05, Section "Metal Fabrications" for shop priming ferrous metal.
 - 3. Division 08, Section "Hollow Metal Doors and Frames" for shop priming steel doors and frames.
 - 4. Division 09, Section "Gypsum Board Assemblies" for surface preparation for gypsum board.

1.2 DEFINITIONS

- A. General: Standard coating terms defined in ASTM D 16 apply to this Section.
 - 1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
 - 2. Eggshell refers to low-sheen finish with a gloss range between 5 and 20 when measured at a 60-degree meter.
 - 3. Satin refers to low-sheen finish with a gloss range between 15 and 35 when measured at a 60-degree meter.
 - 4. Semi-gloss refers to medium-sheen finish with a gloss range between 30 and 65 when measured at a 60-degree meter.
 - 5. Full gloss refers to high-sheen finish with a gloss range more than 65 when measured at a 60-degree meter.

1.3 SUBMITTALS

- A. Samples for Verification: Of each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.

1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
 2. Provide a list of materials and applications for each coat of each sample. Label each sample for location and application.
- B. Product Data: Submit manufacturer's technical information including paint label analysis and application instructions for each material proposed. Include paint system schedule in the format used in this specification section. Include Material Safety Data Sheet for each paint product use. Include VOC content in grams per liter.
1. Manufacturing Location: Cut sheets or letter from manufacturer stating the location of material manufacturer, and the location of the mining or harvest of raw materials.
 2. Material Cost: Statement of material cost (not including labor and equipment.)
- C. Provide manufacturer's certificates that indicate that paint complies with low VOC limits specified.

1.4 QUALITY ASSURANCE

- A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to that indicated for this Project with a record of successful in-service performance.
- B. Source Limitations: Obtain block fillers, primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.
- C. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample of each type of coating and substrate required on the Project. Comply with procedures specified in PDCA P5. Duplicate finish of approved prepared samples.
1. The Architect will select one room or surface to represent surfaces and conditions for each type of coating and substrate to be painted.
 - a. Wall Surfaces: Provide samples on at least 100 sq. ft. of wall surface.
 2. After permanent lighting and other environmental services have been activated, apply coatings in this room or to each surface according to the Schedule or as specified. Provide required sheen, color, and texture on each surface.
 - a. After finishes are accepted, the Architect will use the room or surface to evaluate coating systems of a similar nature.
 3. Final approval of colors will be from job-applied samples.
 4. Mockups on Existing, Previously Painted Surfaces: Perform surface prep required by Part 3 and/or the manufacturer's surface prep requirements, then provide finish sample mock-up of 100 sq. ft. for each coating type and surface condition. Do not proceed with work until mockups have been reviewed and accepted by Owner and Architect. If existing coating is incompatible with specified coating to be applied inform Architect prior to application.

1.5 PRODUCT SPECIFIC ENVIRONMENTAL REQUIREMENTS

- A. Chemical Component Limitations – VOC: The manufacturer shall demonstrate that the paint does not exceed the VOC concentrations allowed by the EPA's "South Coast Air Quality Management District" VOC regulations.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the Project Site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:
1. Product name or title of material.
 2. Product description (generic classification or binder type.)
 3. Manufacturer's stock number and date of manufacture.
 4. Contents by volume, for pigment and vehicle constituents.
 5. Thinning instructions.
 6. Application instructions.
 7. Color name and number.
 8. VOC content.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain containers used in storage in a clean condition, free of foreign materials and residue.
1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.7 PROJECT CONDITIONS

- A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 and 90 deg F.
- B. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

1.8 EXTRA MATERIALS

- A. Furnish extra paint materials from the same production run as the materials applied in the quantities described below. Package paint materials in unopened, factory-sealed containers for storage and identify with labels describing contents. Deliver extra materials to the Owner.
 1. Quantity: Furnish the Owner with extra paint materials in the quantities indicated below:
 - a. Interior, Low-Luster Acrylic Finish: One case of each color applied.
 - b. Interior, Semi-Gloss Acrylic Enamel: 2 gal. of each color applied.
 2. Quantity: Furnish the Owner with an additional 5 percent, but not less than 1 gal. or 1 case, as appropriate, of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products in the paint schedules.
- B. Manufacturers Names: The following manufacturers are referred to in the paint schedules by use of shortened versions of their names, which are shown in parentheses:
 1. Sherwin-Williams Co. (S-W.)
 2. Benjamin Moore & Co. (Moore.)
 3. PPG Industries (PPG.)

2.2 PAINT MATERIALS, GENERAL

- A. Material Compatibility: Provide block fillers, primers, undercoats, and finish-coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
 1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.
- C. Colors: Match colors indicated by reference to manufacturer's color designations.
- D. Green Seal Requirements: All paints used must meet Green Seal requirements for VOC and chemical component limits, which are as follows:
 1. The VOC concentrations (in grams per liter) of the product shall not exceed those listed below as determined by the US Environmental Protection Agency (EPA) Reference Test Method 24. The calculation of VOC shall exclude water and tinting color added at the point of sale.
 - a. Interior Coatings; Non Flat: 150 g/l.
 - b. Interior Coatings; Flat: 50 g/l.
 - c. Exterior Coatings; Non Flat: 200 g/l.
 - d. Exterior Coatings; Flat: 100 g/l.
 - e. All Anti-Corrosive Coatings: 250 g/l.
 2. Chemical Component Limitations – Aromatic Compounds: The product must contain no more than 0.5% by weight of the sum total of aromatic compounds. Testing for the concentration of these compounds will be performed if they are determined to be present in the product during a materials audit.
 3. Chemical Component Limitations – Other Chemicals: The manufacturer shall demonstrate that the following chemical compounds are not used as ingredients in the manufacturer of the product:
 - a. 1,2-dichlorobenzene.
 - b. Alkylphenol ethoxylates (APEs.)
 - c. Formaldehyde-donors.
 - d. Heavy metals, including lead, mercury, cadmium, hexavalent chromium and antimony in the elemental form or compounds.
 - e. Phthalates.
 - f. Triphenyl tins (TPT) and tributyl tins (TBT.)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with the Applicator present, under which painting will be performed for compliance with paint application requirements.
 1. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.

2. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
 1. Notify the Architect about anticipated problems using the materials specified over substrates primed by others.
 2. On previously painted surfaces, review scheduled paint for compatibility with previous coating system. Inform Architect of incompatibility problems prior to application.

3.2 PREPARATION

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.
 1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- B. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning.
 1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
 1. Provide barrier coats over incompatible primers or remove and re-prime.
 2. Cementitious Materials: Prepare concrete, concrete masonry block, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
 - a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
 - b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's written instructions.
 3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
 - a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
 - b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and backsides of wood, including cabinets, counters, cases, and paneling.
 - c. When transparent finish is required, backprime with spar varnish.
 - d. Backprime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on backside.
 - e. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.
 4. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations.
 - a. Blast steel surfaces clean as recommended by paint system manufacturer and according to requirements of SSPC-SP 10.
 - b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
 - c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.
 5. Galvanized Surfaces: Clean galvanized surfaces with non-petroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
- D. Existing Wall Preparation for Renovation Projects: In addition to all preparation items in 3.2, the Contractor shall include in his Base Bid repair and repointing of masonry block walls to meet the requirements for new masonry block and gypsum walls prior to applying wall finishes.
- E. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
 1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.

- F. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat; but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
 - 1. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 - 2. Provide finish coats that are compatible with primers used.
 - 3. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convactor covers, covers for finned-tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
 - 4. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 5. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
 - 6. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
 - 7. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
 - 8. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
 - 9. Sand lightly between each succeeding enamel or varnish coat.
- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
 - 1. The number of coats and the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 - 2. Omit primer on metal surfaces that have been shop primed and touchup painted.
 - 3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 - 4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.
- C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
 - 1. Brushes: Use brushes best suited for the type of material applied. Use brush of appropriate size for the surface or item being painted.
 - 2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.
 - 3. Spray Equipment: Use airless spray equipment with orifice size as recommended by the manufacturer for the material and texture required.
- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.
- E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and in occupied spaces.
- F. Mechanical items to be painted include, but are not limited to, the following:
 - 1. Piping, pipe hangers, and supports.
 - a. Paint exposed gas piping Safety Yellow.
 - 2. Heat exchangers.
 - 3. Tanks.
 - 4. Ductwork.
 - 5. Insulation.
 - 6. Motors and mechanical equipment.
 - 7. Accessory items.
- G. Electrical items to be painted include, but are not limited to, the following:
 - 1. Conduit and fittings.
 - 2. Switchgear.
 - 3. Panelboards.
- H. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

- I. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.
- J. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- K. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.
- L. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.
- M. Rated Walls: Create stencil and paint wall rating above ceiling at 20'-0" max o.c. and at all wall directional changes. Coordinate text requirements with the requirements of the local building official.

3.4 CLEANING

- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.
 - 1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

3.5 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.
- B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
 - 1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.6 EXTERIOR PAINT SCHEDULE

- A. General: Provide the following paint systems for the various substrates, as indicated.
- B. Zinc-Coated Metal with Semi-Gloss Direct to Metal ("DTM") Acrylic Enamel Finish: 2 topcoats of DTM semi-gloss enamel over acrylic bonding primer, with min. total DFT of 2.5 mils.
 - 1. Prime Coat (Tie-Coat): Lead-free, acrylic base interior/exterior galvanized metal primer, premium grade. Apply over (universal) shop primer.
 - a. Sherwin Williams, Pro Industrial DTM Primer/Finish, B66W11 (Basis of Design.)
 - b. Benjamin Moore, Ultra Spec HP Acrylic Metal Primer HP04.
 - c. PPG, 90-712 Series, Pitt-Tech DTM Primer/Finish.
 - 2. First and Second Coats: DTM Acrylic Gloss Enamel.
 - a. Sherwin Williams, Pro Industrial DTM Acrylic Semi-Gloss B66W1151 (Basis of Design.)
 - b. Benjamin Moore, Ultra Spec HP, DTM Acrylic Semi-Gloss HP29.
 - c. PPG, 90-474 Series, Pitt-Tech DTM Waterborne Acrylic Enamel.

3.7 INTERIOR PAINT SCHEDULE

- A. General: Provide the following paint systems for the various substrates, as indicated. Dry film thickness is noted as "DFT."
- B. Concrete Masonry Units: Low-VOC Acrylic Semi-Gloss Finish. 2 coats over filler, with total DFT not less than 2.5 mils.
 - 1. Prime Coat: Lead-free acrylic Base Primer. Prime Coat not required on items delivered shop primed.
 - a. Sherwin Williams, PrepRite Int/Ext Latex Block Filler/Sealer, B25W25 (Basis of Design.)
 - b. Benjamin Moore, Ultra Spec Masonry Int/Ext 100% Acrylic Sealer Primer (608).
 - c. PPG, Devguard All Purpose Primer.
 - 2. First and Second Coats: DTM Acrylic Semi-Gloss Enamel (30-40 units at 60 deg.)
 - a. Sherwin-Williams, Pro Industrial DTM Acrylic Semi-Gloss Enamel B66W1151 (Basis of Design.)
 - b. Benjamin Moore, Ultra Spec HP D.T.M. Acrylic Semi-Gloss HP29.
 - c. PPG, Speedhide Zero Interior Latex Eggshell, 6-4310X1.
- C. Gypsum Drywall Systems with Satin Acrylic Enamel Finish: Prime coat not required on items delivered shop primed.
 - 1. Prime Coat: Lead-free, acrylic base primer. Prime coat:
 - a. Sherwin-Williams, ProMar 200 Zero-VOC Interior Latex Primer, B28W2600 (Basis of Design.)
 - b. Benjamin Moore, Ultra Spec Masonry Int/Ext 100% Acrylic Sealer Primer (608).
 - c. PPG, Devguard All Purpose Primer.
 - 2. First and Second Finish Coats: DTM Acrylic Semi-Gloss Enamel (30-40 units at 60 deg.)

- a. Sherwin-Williams, Pro Industrial DTM Acrylic Semi-Gloss Enamel. B66W1151 (Basis of Design.)
 - b. Benjamin Moore, Ultra Spec HP D.T.M. Acrylic Semi-Gloss HP29.
 - c. PPG, PPG; 90-1210 Series Pitt Tech DTM Eg-shell Enamel.
- D. Ferrous Metal: Semi-Gloss Direct to Metal (“DTM”) Acrylic Enamel Finish (“AC”): 1 coat over primer, with total DFT not less than 2.5 mils.
- 1. Prime Coat: Lead-free, acrylic Base Primer. Prime coat not required on items delivered shop primed.
 - a. Sherwin-Williams, Pro Industrial Pro-Cryl Universal Primer, B66-310 (Basis of Design.)
 - b. Benjamin Moore, Ultra Spec Masonry Int/Ext 100% Acrylic Sealer Primer (608).
 - c. PPG, Devguard All Purpose Primer.
 - 2. First and Second Finish Coats: DTM Acrylic Semi-Gloss Enamel (30-40 units at 60 deg.)
 - a. Sherwin-Williams, Pro Industrial DTM Acrylic Semi-Gloss Enamel. B66W1151 (Basis of Design.)
 - b. Benjamin Moore, Ultra Spec HP D.T.M. Acrylic Semi Gloss HP29.
 - c. PPG, Speedhide Zero Interior Latex Semi-Gloss.
- E. Ferrous Metal with Latex Dry Fog Flat Finish: One finish coat over primed exposed steel roof construction. (Note: Coordinate with masking and painting accent color exposed ductwork as indicated.)
- 1. Prime Coat (Acrylic or recommended VOC compliant metal primer) 2.0 mils DFT.
 - a. Sherwin-Williams, Pro Industrial Pro-Cryl Universal Primer, B66-310 (Basis of Design.)
 - b. Benjamin Moore, Corotech Prep All Universal Metal Primer V132.
 - c. PPG, Flat or Semi-Gloss Speedhide super Tech Acrylic Latex Dry Fog.
 - 2. Top Coat: All exposed metal structure as scheduled. Acrylic Dry Fog 3.0 mils DFT.
 - a. Sherwin-Williams, Pro Industrial Waterborne Acrylic Dryfall Flat, B42W181 (Basis of Design.)
 - b. Benjamin Moore, Coronado Super Kote 5000 Dry Fall Latex Flat N110 or Semi-Gloss 112.
 - c. PPG, Flat or Semi-Gloss Speedhide super Tech Acrylic Latex Dry Fog.
- F. Ferrous Metal: Semi-Gloss Direct to Metal (“DTM”) Acrylic Enamel Finish (“AC”): 1 coat over primer, with total DFT not less than 2.5 mils.
- 1. Prime Coat: Lead-free, acrylic Base Primer. Prime coat not required on items delivered shop primed.
 - a. Sherwin Williams, Pro Industrial Pro-Cryl Universal Primer, B66-310 (Basis of Design.)
 - b. Moore, Ultra Spec HP D.T.M. Acrylic Semi-Gloss HP29.
 - c. PPG, 9-712 Series Pitt Tech DTM Primer/Finish.
 - 2. First Coat: DTM Acrylic Semi-Gloss Enamel (30-40 units at 60 deg.)
 - a. Sherwin Williams, Pro Industrial DTM Acrylic Semi-Gloss Enamel. B66W1151 (Basis of Design.)
 - b. Benjamin Moore, Ultra Spec HP D.T.M. Acrylic Semi-Gloss HP29.
 - c. PPG, 90474 Series Pitt Tech DTM Waterborne Acrylic Enamel.
- G. Zinc-Coated Metal: Semi-Gloss Direct Acrylic Enamel Finish: 2 coats over primer, with min. total DFT of 2.5 mils.
- 1. Prime Coat:
 - a. Sherwin Williams, Pro Industrial Pro-Cryl Universal Primer, B66-310 (Basis of Design.)
 - b. Benjamin Moore, Ultra Spec HP D.T.M. Acrylic Semi-Gloss HP29.
 - c. PPG, 90-712, Pitt Tech., DTM Industrial Enamel Primer.
 - 2. First and Second Coats:
 - a. Sherwin Williams, Pro Industrial DTM Acrylic Semi-Gloss Enamel. B66W1151 (Basis of Design.)
 - b. Benjamin Moore, P29 Super Spec HP Acrylic D TM Semi-Gloss Enamel.
 - c. PPG, 90-474 Series, DTM Waterborne Acrylic Enamel.

END OF SECTION 09 90 00

SECTION 09 96 00 – HIGH-PERFORMANCE COATINGS**PART 1 - GENERAL****1.1 SUMMARY**

- A. This section includes surface preparation and field application of high-performance coating systems to items and surfaces scheduled, including:
 - 1. Exterior pipe and tube railings.
 - 2. Interior concrete masonry surfaces.
 - 3. Interior pipe and tube railings.
- B. Related sections include the following:
 - 1. Division 05, Section "Structural Steel Framing" for shop priming structural steel.
 - 2. Division 05, Section "Metal Fabrications" for shop priming miscellaneous steel.
 - 3. Division 09, Section "Painting" for general field painting.

1.2 DEFINITIONS

- A. Standard coating terms defined in ASTM D 16 apply to this Section.
- B. Gloss ranges used in this Section include the following:
 - 1. Semigloss refers to medium-sheen finish with a gloss range between 30 and 65 when measured at a 60-degree meter.
 - 2. High gloss refers to high-sheen finish with a gloss range more than 65 when measured at a 60-degree meter.

1.3 SUBMITTALS

- A. Product Data: For each coating system indicated. Include block fillers and primers.
 - 1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference the specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
 - 2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each material specified.
- B. Certification by manufacturer that products supplied comply with requirements indicated that limit the amount of VOCs in coating products.

1.4 QUALITY ASSURANCE

- A. Applicator Qualifications: Engage an experienced applicator who has completed high-performance coating system applications similar in material and extent to those indicated for Project and whose work has a record of successful in-service performance.
- B. Source Limitations: Obtain primers and undercoat materials for each coating system from the same manufacturer as the finish coats.
- C. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample of each type of coating and substrate required. Comply with procedures specified in PDCA P5. Duplicate finish of approved sample Submittals.
 - 1. Architect will select one room, area, or surface to represent surfaces and conditions for application of each type of coating and substrate.
 - a. Wall Surfaces: Provide samples on at least 100 sq. ft. of wall surface.
 - b. Small Areas and Items: Architect will designate items or areas required.
 - 2. After permanent lighting and other environmental services have been activated, apply coatings in this room or to each surface as specified. Provide the required sheen, color, and texture of each surface.
 - a. After finishes are accepted, Architect will use the room or surface to evaluate coating systems of a similar nature.
 - 3. Final approval of colors will be from benchmark samples.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label with the following information:
 - 1. Name or title of material.
 - 2. Product description (generic classification or binder type).
 - 3. Manufacturer's stock number and date of manufacture.
 - 4. Contents by volume, for pigment and vehicle constituents.
 - 5. Thinning instructions.

6. Application instructions.
 7. Color name and number.
 8. Handling instructions and precautions.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain containers used in storage in a clean condition, free of foreign materials and residue.
1. Protect materials from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and applying coatings.

1.6 PROJECT CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 45 and 95 deg F.
- B. Do not apply coatings in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
1. Allow wet surfaces to dry thoroughly and attain temperature and conditions specified before proceeding with or continuing coating operation.
 2. Work may continue during inclement weather only if areas and surfaces to be coated are enclosed and temperature within the area can be maintained within limits specified by manufacturer during application and drying periods.

1.7 EXTRA MATERIALS

- A. Furnish extra high-performance coating materials from the same production run as materials applied and in quantities described below. Package coating materials in unopened, factory-sealed containers for storage and identify with labels describing contents.
1. Quantity: Furnish extra coating materials in quantities indicated below:
 - a. High-Gloss, Aliphatic Polyurethane Enamel: One gal. of each color applied.
 - b. Semigloss, Waterborne Epoxy Coating: 1 case of each color applied.
 - c. High-Gloss, Polyamide Epoxy Coatings: One gal. of each color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products indicated in the coating system descriptions.
- B. Manufacturers' Names: The following manufacturers are referred to in the coating system descriptions by shortened versions of their names shown in parenthesis:
1. Glidden Professional; Devoe Coatings (Glidden Pro).
 2. PPG Industries, Inc. (PPG).
 3. Sherwin Williams; Industrial and Marine Coatings (S-W).
 4. Tnemec Company, Inc. (Tnemec).

2.2 COATINGS MATERIALS, GENERAL

- A. Material Compatibility: Provide primers, undercoats, and finish-coat materials 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.
- B. Material Quality: Provide manufacturer's highest grade of the various high-performance coatings specified. Materials not displaying manufacturer's product identification are not acceptable.
1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.
- C. VOC Classification: Provide high-performance coating materials, including primers, undercoats, and finish-coat materials, that have a VOC classification of 450 g/L or less.

2.3 COLORS

- A. Colors: Match Architect's samples.

2.4 EXTERIOR HIGH-PERFORMANCE COATING SYSTEMS

- A. Ferrous Metal: Provide the following finish systems over exterior ferrous-metal surfaces:
1. Moderate Environment (High-Gloss Finish): One finish coat over an intermediate coat and a primer.

- a. Primer: Epoxy primer applied at spreading rate recommended by manufacturer.
 - 1) Glidden Pro: Devoe Coatings Devran 201H Universal Epoxy Primer.
 - 2) Moore: M36-00/M37 Polyamide Epoxy Clear Sealer/Finish.
 - 3) PPG: 95-245 Series Pitt-Guard DTR Polyamide Epoxy Coating.
 - 4) S-W: Recoatable Epoxy Primer B67 Series/B67V5.
 - 5) Tnemec: Series 27 F. C. Typoxy Polyamide Epoxy.
- b. Intermediate Coat: Epoxy applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 3.0 to 5.0 mils.
 - 1) S-W: Heavy Duty Epoxy B67W300 Series.
 - 2) Tnemec: Series 66 Hi-Build Epoxoline Polamidoamine Epoxy.
- c. Intermediate Coat: Aliphatic polyurethane enamel applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 2.0 to 4.0 mils.
 - 1) Glidden Pro: Devoe Coatings Devthane 319H Aliphatic Urethane Gloss Enamel.
 - 2) Moore: M74/M75 Aliphatic Acrylic Urethane Gloss.
 - 3) PPG: 95-812 Series Pitthane Ultra Acrylic-Aliphatic Urethane Enamel.
 - 4) Tnemec: Series 74 Endura-Shield.
- d. Topcoat: Aliphatic polyurethane enamel applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 2.0 to 4.0 mils.
 - 1) Glidden Pro: Devot Coatings Devthane 379H Aliphatic Urethane Gloss Enamel.
 - 2) Moore: M74/M75 Aliphatic Acrylic Urethane Gloss.
 - 3) PPG: 95-812 Series Pitthane Ultra Acrylic-Aliphatic Urethane Enamel.
 - 4) S-W: Corothane II Gloss B65W400 Series.
 - 5) Tnemec: Series 74 Endura-Shield.

2.5 INTERIOR HIGH-PERFORMANCE COATING SYSTEMS

- A. Concrete Masonry Units: Provide the following finish systems over interior concrete masonry block:
 - 1. Moderate Environment (Semigloss Finish): One finish coat over an intermediate coat and a block filler.
 - a. Use moderate environment coating system for food service areas, toilet rooms, showers and locker rooms, and janitor closets.
 - b. Block Filler: Acrylic or epoxy block filler applied at spreading rate recommended by manufacturer as sufficient to fill pores.
 - 1) Glidden Pro: Devoe Coatings High Performance Waterborne Epoxy Blockfiller 4015 Series.
 - 2) PPG: 95-217 Cementitious Waterproofing Blockfiller.
 - 3) S-W: Epoxy Ester Masonry Filler Sealer B61W2 Series.
 - 4) Tnemec: Series 130 Envirofill Waterborne Cementitious Acrylic.
 - 5) PPG: 16-90 Pitt Glaze Acrylic Blockfiller.
 - c. Intermediate Coat: Epoxy applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 3.0 to 5.0 mils, unless otherwise indicated.
 - 1) Glidden Pro: Devoe Coatings Devran 224 HS High Solids Epoxy Coating.
 - 2) PPG: 97-130 Series Aquapon High Build Semi-Gloss Polyamide Epoxy Coating.
 - 3) S-W: Epolon II Multi-Mil Epoxy Series B62V800.
 - 4) Tnemec: Series 66 Hi-Build Epoxoline Polamidoamine Epoxy.
 - d. Topcoat: Semigloss epoxy applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 3.0 to 5.0 mils, unless otherwise indicated.
 - 1) Glidden Pro: Devoe Coatings Devran 224 HS High Solids Epoxy Coating.
 - 2) PPG: 97-130 Series Aquapon High Build Semi-Gloss Polyamide Epoxy Coating.
 - 3) S-W: Epolon II Multi-Mil Epoxy Series B62V800.
 - 4) Tnemec: Series 66 Hi-Build Epoxoline Polamidoamine Epoxy.
- B. Ferrous Metal: Provide the following finish systems over interior ferrous-metal surfaces:
 - 1. Moderate Environment (High-Gloss Finish): One finish coat over an intermediate coat and a primer.
 - a. Primer: Epoxy primer applied at spreading rate recommended by manufacturer.
 - 1) Glidden Pro: Devoe Coatings Tru-Glaze-WB 4030 Waterborne Epoxy Primer.
 - 2) Moore: M08/M09 Waterborne Epoxy Primer.
 - 3) PPG: 95-245 Pitt-Guard DTR Epoxy Coating.
 - 4) S-W: Recoatable Epoxy Primer B67 Series/B67V5.
 - 5) Tnemec: 27 F. C. Typoxy Polyamide Epoxy.
 - b. Intermediate Coat: Epoxy applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 2.0 to 4.0 mils.
 - 1) Glidden Pro: Devoe Coatings Tru-Glaze-WB 4428 Waterborne Epoxy Gloss Coating (129XX).
 - 2) Moore: M43/M44 Acrylic Epoxy Gloss Coating.
 - 3) PPG: 95-1000 Series Aquapon Polyamide-Epoxy Coating.
 - 4) S-W: Tile Clad II High Solids B62WZ Series/B60VZ70.
 - 5) Tnemec: Series 84 H. S. Epoxy.

- c. Topcoat: High-gloss epoxy applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 2.0 to 4.0 mils, unless otherwise indicated.
 - 1) Glidden Pro: Devoe Coatings Tru-Glaze-WB 4428 Waterborne Epoxy Gloss Coating (129XX).
 - 2) Moore: M43/M44 Acrylic Epoxy Gloss Coating.
 - 3) PPG: 95-1000 Series Aquapon Polyamide-Epoxy Coating.
 - 4) S-W: Tile Clad II High Solids B62WZ Series/B60VZ70.
 - 5) Tnemec: Series 84 H. S. Epoxy.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. With Applicator present, examine substrates and conditions under which high-performance coatings will be applied, for compliance with coating application requirements.
 - 1. Apply coatings only after unsatisfactory conditions have been corrected and surfaces to receive coatings are thoroughly dry.
 - 2. Start of application is construed as Applicator's acceptance of surfaces within that particular area.
- B. Coordination of Work: Review other Sections in which primers or other coatings are provided to ensure compatibility of total systems for various substrates. On request, furnish information on characteristics of specified finish materials to ensure compatible primers.
 - 1. If a potential incompatibility of primers applied by others exists, obtain the following from the primer Applicator before proceeding:
 - a. Confirmation of primer's suitability for expected service conditions.
 - b. Confirmation of primer's ability to be top coated with materials specified.
 - 2. Notify Architect about anticipated problems before using the coatings specified over substrates primed by others.
 - 3. On previously painted surfaces, review scheduled paint for compatibility with previous coating system. Inform Architect of incompatibility problems prior to application.

3.2 PREPARATION

- A. General: Remove plates, machined surfaces, and similar items already in place that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
 - 1. After completing coating operations, reinstall items that were removed; use workers skilled in the trades involved.
- B. Cleaning: Before applying high-performance coatings, clean substrates of substances that could impair bond of coatings. Remove oil and grease before cleaning.
 - 1. Schedule cleaning and coating application so dust and other contaminants from cleaning process will not fall on wet, newly coated surfaces.
- C. Surface Preparation: Clean and prepare surfaces to be coated according to manufacturer's written instructions for each material and substrate condition and as specified.
 - 1. Provide barrier coats over incompatible primers, existing coatings, or remove primers and reprime substrate.
 - 2. Cementitious Substrates: Prepare concrete, brick, concrete masonry block, and cement plaster surfaces to be coated. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods to prepare surfaces.
 - a. Use abrasive blast-cleaning methods if recommended by coating manufacturer.
 - b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not coat surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
 - 3. Ferrous-Metal Substrates: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC recommendations.
 - a. Blast-clean steel surfaces as recommended by coating manufacturer and according to SSPC-SP 10/NACE No. 2.
 - b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
 - c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire brush, solvent clean, and touch up with same primer as the shop coat.
- D. Material Preparation: Carefully mix and prepare coating materials according to manufacturer's written instructions.
 - 1. Maintain containers used in mixing and applying coatings in a clean condition, free of foreign materials and residue.
 - 2. Stir materials before applying to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into the material. Remove film and, if necessary, strain coating material before using.

3. Use only the type of thinners approved by manufacturer and only within recommended limits.
- E. 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.

3.3 APPLICATION

- A. General: Apply high-performance coatings according to manufacturer's written instructions.
 1. Use applicators and techniques best suited for the material being applied.
 2. Do not apply high-performance coatings over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to forming a durable coating film.
 3. Coating colors, surface treatments, and finishes are indicated in the coating system descriptions.
 4. Provide finish coats compatible with primers used.
 5. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, grilles, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
 - a. Coat surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
 - b. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
- B. Scheduling Coating: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for coating as soon as practicable after preparation and before subsequent surface deterioration.
 1. The number of coats and film thickness required is the same regardless of application method.
 - a. Omit primer on metal surfaces that have been shop primed and touchup painted.
 - b. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer.
 - c. Where manufacturer's written instructions require sanding, sand between applications to produce a smooth, even surface.
 - d. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until coating has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and application of another coat does not cause undercoat to lift or lose adhesion.
 2. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance. Give special attention to edges, corners, crevices, welds, exposed fasteners, and similar surfaces to ensure that they receive a dry film thickness equivalent to that of flat surfaces.
- C. Application Procedures: Apply coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
 1. Brush Application: Use brushes best suited for material applied and of appropriate size for the surface or item being coated.
 - a. Apply primers and first coats by brush unless manufacturer's written instructions permit using roller or mechanical applicators.
 - b. Brush out and work brush coats into surfaces in an even film.
 - c. Eliminate cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Neatly draw glass lines and color breaks.
 2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by manufacturer for the material and texture required.
 3. Spray Equipment: Use mechanical methods to apply coating if permitted by manufacturer's written instructions and governing regulations.
 - a. Use spray equipment with orifice size recommended by manufacturer for material and texture required.
 - b. Apply each coat to provide the equivalent hiding of brush-applied coats.
 - c. Do not double back with spray equipment building-up film thickness of two coats in one pass, unless recommended by manufacturer.
- D. Minimum Coating Thickness: Apply each material no thinner than manufacturer's recommended spreading rate. Provide total dry film thickness of the entire system as recommended by manufacturer.
- E. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.
- F. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by manufacturer, to material required to be coated or finished that has not been prime coated by others.
 1. Recoat primed and sealed substrates if there is evidence of suction spots or unsealed areas in first coat, to ensure a finish coat with no burn-through or other defects caused by insufficient sealing.
 2. Where recommended by manufacturer, use of self-priming epoxy systems is allowed.
- G. Completed Work: Match approved Samples for color, texture, and coverage. Remove, refinish, or recoat work that does not comply with specified requirements.

3.4 FIELD QUALITY CONTROL

- A. Contractor shall make available on site a dry film thickness metering device recommended by coating manufacturer for sample testing in presence of Architect. Carry out spot sample checking of coating thickness as directed. Make corrections as necessary to ensure minimum coating requirements are met.

3.5 CLEANING

- A. Cleanup: At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
 - 1. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

3.6 PROTECTION

- A. Protect work of other trades, whether being coated or not, against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.
 - 1. Provide "Wet Paint" signs to protect newly coated finishes. After completing coating operations, remove temporary protective wrappings provided by others to protect their work.
 - 2. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces. Comply with procedures specified in PDCA P1.

END OF SECTION 09 96 00

**DIVISION 10
SPECIALTIES**

SECTION 10 11 00 – VISUAL DISPLAY SURFACES**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
 1. Porcelain enamel markerboards.
 2. Natural-cork tackboards.
 3. Natural cork tackstrip.
- B. Related Sections include the following:
 1. Division 10, Section "Display Cases" for display cases recessed or flush mounted or freestanding.
 2. Division 10, Section "Directories" for individually framed, wall-mounted bulletin boards.

1.2 SUBMITTALS

- A. Product Data: For each type of visual display board indicated.
- B. Shop Drawings: For each type of visual display board required.
 1. Include dimensioned elevations. Show location of joints between individual panels where unit dimensions exceed maximum panel length.
- C. Product Certificates: Signed by manufacturers of tackboards certifying that fabric-faced cork tackboard materials furnished comply with requirements specified for flame-spread ratings.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain visual display boards through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of visual display boards and are based on the products indicated. Other manufacturers' products with equal performance characteristics may be considered. Refer to Division 01 Section "Substitutions."
 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval and only to the extent needed to comply with performance requirements. Where modifications are proposed, submit comprehensive explanatory data to Architect for review.
- C. Fire-Test-Response Characteristics: Provide fabric-faced tackboards with the following surface-burning characteristics as determined by testing assembled materials composed of facings and backings identical to those required in this Section per ASTM E 84 by a testing and inspecting agency acceptable to authorities having jurisdiction. Identify vinyl-fabric-faced tackboards with appropriate markings of applicable testing and inspecting agency.
 1. Flame Spread: 25 or less.
 2. Smoke Developed: 50 or less.

1.4 PROJECT CONDITIONS

- A. Field Measurements: Verify field measurements before preparation of Shop Drawings and before fabrication to ensure proper fitting. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.
 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating markerboards without field measurements. Coordinate wall construction to ensure actual dimensions correspond to established dimensions.

1.5 WARRANTY

- A. General Warranty: The special porcelain enamel markerboard warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Porcelain Enamel Markerboard Warranty: Submit a written warranty executed by manufacturer agreeing to replace porcelain enamel markerboards that do not retain their original writing and erasing qualities, become slick and shiny, or exhibit crazing, cracking, or flaking within the specified warranty period, provided the manufacturer's written instructions for handling, installation, protection, and maintenance have been followed.
 1. Warranty Period: Life of the building.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 - 1. Porcelain Enamel Markerboards:
 - a. Best-Rite Chalkboard Co.
 - b. Claridge Products and Equipment, Inc.
 - c. ASI Visual Display Products.
 - d. Platinum Visual Systems.
 - 2. Tackboards:
 - a. Best-Rite Chalkboard Co.
 - b. Claridge Products and Equipment, Inc.
 - c. American Visual Display Products.
 - d. Platinum Visual Systems.

2.2 MATERIALS

- A. Porcelain Enamel Markerboards: Balanced, high-pressure-laminated, porcelain enamel markerboards of 3-ply construction consisting of face sheet, core material, and backing.
 - 1. Face Sheet: 0.024-inch enameling grade steel especially processed for temperatures used in coating porcelain on steel. Coat exposed face and edges with a 3-coat process consisting of primer, ground coat, and color cover coat. Coat concealed face with a 2-coat process consisting of primer and ground coat. Fuse cover and ground coats to steel at manufacturer's standard firing temperatures, but not less than 1200 deg F.
 - 2. Core: 3/8-inch- thick, particleboard core material complying with requirements of ANSI A208.1, Grade 1-M-1.
 - 3. Backing Sheet: 0.005-inch- thick, aluminum-foil sheet backing.
 - 4. Laminating Adhesive: Manufacturer's standard, moisture-resistant, thermoplastic-type adhesive.
- B. Natural-Cork Tackboards: Single-layer, 1/4-inch- thick, seamless, compressed fine-grain, bulletin board quality, natural-cork sheet; face sanded for natural finish; complying with MS MIL-C-15116, Type II.
- C. Hallway Tack Strip: 1-inch-wide, 3/8-inch-thick cork tackstrip in aluminum frame. Allow 24 lineal feet per classroom for corridor installation, unless otherwise indicated.

2.3 ACCESSORIES

- A. Metal Trim and Accessories: Fabricate frames and trim of not less than 0.062-inch- thick, extruded-aluminum alloy, size and shape as indicated, to suit type of installation. Provide straight, single-length units. Keep joints to a minimum. Miter corners to a neat, hairline closure.
 - 1. 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. Field-Applied Trim: Manufacturer's standard snap-on trim with no visible screws or exposed joints.
 - 3. Chalk-tray: Manufacturer's standard, continuous, solid, extrusion-type, aluminum chalktray with ribbed section and smoothly curved exposed ends for each markerboard.
 - 4. Map Rail: Furnish map rail at top of each unit, complete with the following accessories:
 - a. Display Rail: Provide continuous cork display rail approximately 1 or 2 inches wide, as indicated, integral with map rail.
 - b. End Stops: Provide one end stop at each end of map rail.
 - c. Map Hooks: Provide 2 map hooks with flexible metal clips for every 48 inches of map rail or fraction thereof.
 - d. Flag Holder: Provide one flag holder for each room.

2.4 FABRICATION

- A. Assembly: Provide factory-assembled markerboard and tackboard units, unless field-assembled units are required.
 - 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.

2.5 FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.
- B. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.
- C. 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 611.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine wall surfaces, with Installer present, for compliance with requirements and other conditions affecting installation of visual display boards.
 - 1. Surfaces to receive markerboards shall be free of dirt, scaling paint, and projections or depressions that would affect smooth, finished surfaces of markerboards.
 - 2. Surfaces to receive tackboards shall be dry and free of substances that would impair the bond between tackboards and substrate.
 - 3. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Deliver factory-built visual display boards completely assembled in one piece without joints, where possible. If dimensions exceed panel size, provide 2 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. Use splines at joints to maintain surface alignment.
- B. Install units in locations and at mounting heights indicated and according to manufacturer's written instructions. Keep perimeter lines straight, plumb, and level. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
- C. Coordinate Project-site-assembled units with grounds, trim, and accessories. Join parts with a neat, precision fit.

3.3 ADJUSTING AND CLEANING

- A. Verify that accessories required for each unit have been properly installed and that operating units function properly.
- B. Clean units according to manufacturer's written instructions.

END OF SECTION 10 11 00

SECTION 10 14 00 – SIGNAGE**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following types of signs:
 - 1. Panel signs.
 - 2. Custom printed three-dimensional signage.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 10, Section "Post and Panel Signs" for freestanding exterior signs.
 - 2. Division 32 Section "Exterior Improvements" for roadway signs and traffic signals.

1.2 SUBMITTALS

- A. Product data for each type of sign specified, including details of construction relative to materials, dimensions of individual components, profiles, and finishes.
- B. Shop drawings showing fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components. Show anchors, grounds, layout, reinforcement, accessories, and installation details.
 - 1. Provide message list for each sign required, including large-scale details of wording and lettering layout.
 - 2. For signs supported by or anchored to permanent construction, provide setting drawings, templates, and directions for installation of anchor bolts and other anchors to be installed as a unit of Work in other Sections.
 - 3. Templates: Furnish full-size spacing templates for individually mounted dimensional letters and numbers.
- C. Samples: Provide the following samples of each sign component for initial selection of color, pattern and surface texture as required and for verification of compliance with requirements indicated.
 - 1. Samples for initial selection of color, pattern, and texture:
 - a. Cast Acrylic Sheet and Plastic Laminate: Manufacturer's color charts consisting of actual sections of material including the full range of colors available for each material required.
 - b. Aluminum: Samples of each finish type and color, on 6-inch-long sections of extrusions and not less than 4-inch squares of sheet or plate, showing the full range of colors available.
 - c. Custom printed three-dimensional Signage: provide minimum (1) custom printed acrylic sign sample for review by architect. 12 x 12 inch minimum or similar in size.

1.3 QUALITY ASSURANCE

- A. Sign Fabricator Qualifications: Firm experienced in producing signs similar to those indicated for this Project, with a record of successful in-service performance, and sufficient production capacity to produce sign units required without causing delay in the Work.
- B. Single-Source Responsibility: For each separate sign type required, obtain signs from one source of a single manufacturer.
- C. Design Concept: The Drawings indicate sizes, profiles, and dimensional requirements of signs and are based on the specific types and models indicated. Sign units by other manufacturers may be considered provided deviations in dimensions and profiles do not change the design concept as judged by the Architect. The burden of proof of equality is on the proposer.
- D. Regulatory Requirements: Comply with requirements of NFPA 101 and ANSI N2.1 for graphic symbols, colors, and printed information for panel signs.
 - 1. Comply with requirements of applicable Building Code, most recent edition.
 - 2. Comply with requirements of ICC/ANSI A117.1.

1.4 PROJECT CONDITIONS

- A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication to ensure proper fitting. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following comparable to the basis of design product indicated:
 - 1. Manufacturers of Panel Signs:
 - a. Mohawk Sign Systems, Series 200A
 - b. ACE Sign Systems.
 - c. Andco Industries Corp.
 - d. ASI - Modulex, Inc.
 - e. Best Sign Systems, Inc.
 - f. APCO Sign Systems

- g. InPro Corp.

2.2 MATERIALS

- A. Cast Acrylic Sheet: Provide cast (not extruded or continuous cast) methyl methacrylate monomer plastic sheet, with a minimum flexural strength of 16,000 psi when tested according to ASTM D 790, with a minimum allowable continuous service temperature of 176 deg F, and of the following general types:
 - 1. Transparent Sheet: Where sheet material is indicated as "clear," provide colorless sheet in matte finish, with light transmittance of 92 percent, when tested according to the requirements of ASTM D 1003.
 - 2. Opaque Sheet: Where sheet material is indicated as "opaque," provide colored opaque acrylic sheet in colors and finishes as selected from the manufacturer's standards.
- B. Anchors and Inserts: Use nonferrous metal or hot-dipped galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.
- C. Colored Coatings for Acrylic Plastic Sheet: Use colored coatings, including inks and paints for copy and background colors, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and are nonfading for the application intended.

2.3 PANEL SIGNS- TYPICAL

- A. Panel Signs: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner, complying with the following requirements:
 - 1. Laminated, Sandblasted Polymer: Raised graphics with Braille 1/32 inch above surface with contrasting colors and laminated to acrylic back.
 - 2. Edge Condition: Square cut.
 - 3. Corner Condition: Rounded to radius indicated.
 - 4. Mounting: Unframed.
 - 5. Color: As selected by Architect from manufacturer's full range.
 - 6. Tactile Characteristics: Characters and Grade 2 Braille raised 1/32 inch above surface with contrasting colors.
- B. Changeable Message Inserts: Fabricate signs to allow insertion of changeable messages in the form of transparent covers with paper inserts printed by Owner.

2.4 PANLE SIGNS- MISCELLANEOUS

- A. Stairs.
- B. Elevator.
- C. Exit signage with Braille at all egress doors.

2.5 CUSTOM PRINT ACRYLIC SIGNS

- A. Built-up Signs: Three-dimensional flat cut acrylic sign of a sign as indicated on the drawings. Provide fabricated sign with mounting hardware per manufacturers standard
 - 1. Graphic and logo plate; 25" min. thickness; back-printed on clear acrylic sheet.
 - 2. Background medallion/back panel: 1" min thickness; PVC signage grade. 1/2" inset on back panel (all sides).
 - 3. Custom Graphics to be provided by architect, sign fabricator to coordinate with architect on digital graphic requirements.

2.6 FINISHES

- A. Colors and Surface Textures: For exposed sign material that requires selection of materials with integral or applied colors, surface textures or other characteristics related to appearance, provide color matches indicated, or if not indicated, as selected by the Architect from the manufacturer's standards.

2.7 INSTALLATION

- A. General: Locate sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer's instructions.
 - 1. Install signs level, plumb, and at the height indicated, with sign surfaces free from distortion or other defects in appearance.
 - 2. Install signs at height indicated below, measured from finish floor to centerline of sign panel:
 - a. Elementary Schools: 48 inches.
 - 3. Locate panel signs spaced 6 inches from frame of door, on latch side of door, unless otherwise indicated.
- B. Wall-Mounted Panel Signs: Attach panel signs to wall surfaces using the methods indicated below:
 - 1. Silicone-Adhesive Mounting (at glass mounting locations): Use liquid silicone adhesive recommended by the sign manufacturer to attach sign units to irregular, porous, or vinyl-covered surfaces. Use double-sided vinyl tape where recommended by the sign manufacturer to hold the sign in place until the adhesive has fully cured.
 - 2. Countersunk mechanical fasteners.

2.8 CLEANING AND PROTECTION

- A. After installation, clean soiled sign surfaces according to the manufacturer's instructions. Protect units from damage until acceptance by the Owner.

2.9 INTERIOR PANEL SIGN SCHEDULE (See door schedule for sign schedule, See interior design drawings for custom print acrylic signs for style and locations.)

END OF SECTION 10 14 00

SECTION 10 14 26 – POST AND PANEL SIGNS**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
 - 1. Non-illuminated single-panel-type post and panel signs.
- B. Related Sections include the following:
 - 1. Division 01, Section "Temporary Facilities and Controls" for temporary project identification and temporary information and directional signs.
 - 2. Division 03, Section "Cast-in-Place Concrete" for concrete fill in post holes.
 - 3. Division 10, Section "Signage" for wall-mounted interior signs.

1.2 PERFORMANCE REQUIREMENTS

- A. Design Criteria: Design, fabricate, and install exterior post and panel signs to withstand a wind velocity of 100 mph on the total sign area, in all directions.

1.3 SUBMITTALS

- A. Product Data: For each type of post and panel sign specified. Include details of construction relative to materials, dimensions of individual components, profiles, and finishes. Provide manufacturer's written instructions for maintaining and cleaning sign surfaces.
- B. Shop Drawings: For each type of post and panel sign indicated.
 - 1. Provide plans, elevations, and at least 3/4-inch scale sections of typical members and other components. Show anchors, reinforcement, accessories, layout, and installation details.
 - 2. Provide message list, including details of wording and lettering layout, at least half size. Include full-size details of special graphics.
 - 3. Provide setting drawings, templates, and directions for installing anchor bolts and other anchors to be installed as a unit of Work in other Sections.
- C. Samples for Initial Selection: Manufacturer's color charts consisting of actual units or sections of units showing the full range of colors available for the following:
 - 1. Acrylic and Polycarbonate Sheet: 1-1/2-inch squares of sheet.
 - 2. Die-Cut Vinyl Letters and Graphic Symbols: Provide representative samples of available type styles and graphic symbols.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who is an authorized representative of the sign manufacturer and who has completed installation of post and panel signs similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Source Limitations: Obtain post and panel signs through one source from a single manufacturer.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of post and panel signs and are based on the specific type and model indicated. Other manufacturers' signs may be considered provided deviations are minor and do not change the design concept and are approved by the Architect. Refer to Division 01 Section "Substitutions."
 - 1. Do not modify intended aesthetic effects, as judged solely by the Architect, except with Architect's approval and only to the extent needed to comply with performance requirements. Where modifications are proposed, submit comprehensive explanatory data to Architect for review.

1.5 DELIVERY AND HANDLING

- A. Delivery: Provide protective covering or crating as recommended by the manufacturer to protect sign components and surfaces against damage during transportation and delivery.
 - 1. Coordinate delivery time so signs can be installed within 24 hours of receipt at Project site.
- B. Handle signs carefully to prevent breakage, surface abrasion, denting, soiling, and other defects. Comply with the manufacturer's written handling instructions for unloading components subject to damage.
 - 1. Inspect sign components for damage on delivery.
 - 2. Do not install damaged sign components.
 - 3. Repair minor damage to signs, provided the finished repair is equal in all respects to the original work and is approved by Architect; otherwise, remove and replace damaged sign components.

1.6 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Warranty Period: 5 years.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Andco Industries Corporation.
 2. Apco Graphics Inc.
 3. ASI Sign System, Inc.
 4. Best Manufacturing Company.
 5. Charleston Industries, Inc.
 6. Nelson-Harkins Industries.
 7. Signage Industries.
 8. Supersine Company (The).
 9. Vomar Products, Inc.

2.2 MATERIALS

- A. Aluminum Sheet or Plate: Alloy and temper recommended by the aluminum producer and finisher for the type of use and finish indicated, and with at least the strength and durability properties specified in ASTM B 209 for 5005-H32 alloy.
- B. Aluminum Extrusions: Alloy and temper recommended by the aluminum producer and finisher for the type of use and finish indicated, and with at least the strength and durability properties specified in ASTM B 221 for 6063-T5 alloy.
- C. Uncoated Acrylic Sheet: ASTM D 4802; Category A-1 (cell-cast sheet); Finish 1 (smooth or polished); Type UVA (UV absorbing); 0.177-inch-thick, transparent, colorless, monolithic sheet with a luminous transmittance of 91 percent.
- D. Abrasion-Resistant-Coated Acrylic Sheet: ASTM D 4802; Category A-1 (cell-cast sheet); Finish 3 (abrasion-resistant coated); Type UVA (UV absorbing); 0.177-inch-thick, transparent, monolithic sheet with a luminous transmittance of 91 percent.
1. Abrasion-Resistant Monolithic Polycarbonate Sheet: Of thickness indicated, manufactured by the extrusion process, coated on both surfaces with an abrasion-resistant coating, and with the following minimum physical properties, measured per standard test referenced with each:
 - a. Physical Properties: Minimum values, unless otherwise indicated, measured per standard test referenced with each property:
 - 1) Flexural Strength: 13,500 lbf/sq. in. per ASTM D 790.
 - 2) Impact Resistance: 12 to 16 ft-lbf/in. per ASTM D 256, Method A.
 - 3) Modulus of Elasticity: 340,000 lbf/sq. in. at 110 percent elongation per ASTM D 790.
 - 4) Heat Deflection: 270 deg F at 264 lbf/sq. in. per ASTM D648.
 - 5) Abrasion Resistance: 0.8 to 2.0 percent maximum haze increase for 100 revolutions of a 500 Taber abraser per ASTM D 1044.
 - b. Transparent Sheet: Colorless, with a minimum luminous transmittance of 84 percent for 0.236-inch thickness per ASTM D 1003.
- E. Vinyl Film: Opaque, nonreflective vinyl film, 0.0035-inch minimum thickness, with pressure-sensitive adhesive backing, suitable for exterior applications.
- F. Colored Coatings for Plastic Sheet: Use nonfading colored coatings, including inks and paints for copy and background colors, that are recommended by the manufacturers for optimum adherence to the type of surface used.
- G. Provide 10 signs, with copy on both sides; copy and location to be issued after award of bid by Architect.

2.3 COMPONENTS

- A. Aluminum Posts: Manufacturer's standard 0.125-inch-thick, structural aluminum tubing extruded from 6063-T5 alloy, with vertical slots to engage sign panels. Provide stop blocks in slots to hold panels in position. Include post caps, fillers, spacers, junction boxes, access panels, and related accessories required for a complete installation. Comply with the following requirements for post shape, finish, and mounting method:
1. Post Shape: 4 by 4 inches square.
 2. Post Finish: Match sign panel face.
 3. Sleeve Mounting Method: Provide sign posts of length required for installation over internal reinforcing members embedded in concrete foundations. Provide manufacturer's standard internal post reinforcing members for direct burial in concrete foundations.
- B. Sign Panels: Provide smooth, even, level sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner.
1. Unframed Single-Sheet Panels: Provide unframed single-sheet sign panels with edges mechanically and smoothly finished to conform to the following:

- a. Panel Material: 0.125-inch- thick aluminum plate.
 - 1) Post Finish: Baked enamel.
 - b. Edge Condition: Square cut.
 - c. Corner Condition: Square corners.
- C. Graphic Content and Style: Provide sign copy to comply with requirements indicated for sizes, styles, spacing, content, positions, materials, finishes, and colors of letters, numbers, symbols, and other graphic devices.
- 1. Surface-Applied, Die-Cut Vinyl Copy: Provide die-cut characters from nonreflective vinyl film with pressure-sensitive adhesive backing. Apply copy to both exposed faces of sign panel.

2.4 ACCESSORIES

- A. Fasteners: Use concealed fasteners fabricated from metals that are noncorrosive to sign material and mounting surface.
- B. Anchors and Inserts: Use nonferrous metal or hot-dip galvanized anchors and inserts. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete.

2.5 FABRICATION

- A. General: Provide manufacturer's standard double-post, single-panel-type post and panel signs. The completed sign assembly shall consist of a message panel supported between 2 posts. Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.
 - 1. Allow for thermal movement resulting from a maximum ambient temperature change (range) of 100 deg F. Design, fabricate, and install post and panel sign assemblies to prevent buckling, opening up of joints, and overstressing of welds and fasteners.
 - a. Base design on actual surface temperatures of metals due to both solar heat gain and nighttime-sky heat loss.
 - 2. Welded Connections: Comply with AWS standards for recommended practices in shop welding. Provide welds behind finished surfaces without distortion or discoloration of exposed side. Clean exposed welded surfaces of welding flux and dress on exposed and contact surfaces.
 - 3. Mill joints to a tight, hairline fit. Form joints exposed to the weather to exclude water penetration.
 - 4. Preassemble signs in the shop to the greatest extent possible to minimize field assembly. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in a location not exposed to view after final assembly.
 - 5. Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.
- B. Posts: Fabricate posts to lengths required for mounting method indicated.
 - 1. Sleeves: For removable post installation, provide internal reinforcement recommended by manufacturer, sized for a close fit inside sign posts. For direct embedment of internal reinforcement in concrete foundations, provide lengths 36 inches longer than length needed to attach sign posts securely to internal reinforcement and prevent the sign from overturning when subjected to normal loading conditions prevailing at the Project site.
 - a. Furnish templates as necessary for accurate setting of sleeves in concrete foundations.
- C. Panels: Form panels to required size and shape. Comply with requirements indicated for design, dimensions, finish, color, and details of construction.
 - 1. Increase metal thickness or reinforce with concealed stiffeners or backing materials as required to produce surfaces without distortion, buckles, warp, or other surface deformations.
 - 2. Continuously weld joints and seams, unless other methods are indicated; grind, fill, and dress welds to produce smooth, flush, exposed surfaces with welds invisible after final finishing.
 - 3. Provide finish and copy on both sides of panel.
 - 4. Panel Size: As indicated.

2.6 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.
- B. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.
- C. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Apply baked enamel complying with paint manufacturer's specifications for cleaning, conversion coating, and painting.
 - 1. Organic Coating: Thermosetting, modified-acrylic enamel primer/topcoat system complying with AAMA 2603, except with a minimum dry film thickness of 1.5 mils, medium gloss.
 - 2. Color: As selected by Architect from manufacturer's full range of colors.
- D. Colors and Textures: For exposed sign material that requires selection of materials with integral or applied colors, textures, or other characteristics related to appearance, provide color matches as selected by Architect from manufacturer's standards.

PART 3 - EXECUTION**3.1 PREPARATION**

- A. Furnish templates, anchor bolts, internal reinforcement, and other items required to be set in concrete post foundations at proper time for setting.

3.2 INSTALLATION

- A. General: Locate sign units and accessories where indicated, using mounting methods of type described and complying with manufacturer's written instructions.
- B. Set anchor bolts and other embedded items required for installation. Use templates, setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached.
- C. Install signs level, plumb, and at height indicated, with surfaces free from distortion or other defects in appearance.

3.3 CLEANING AND PROTECTING

- A. At completion of installation, clean soiled surfaces of sign units according to manufacturer's written instructions.
- B. Protect installed sign units from damage until acceptance by Owner.

END OF SECTION 10 14 26

SECTION 10 21 13.17 – SOLID PHENOLIC TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes toilet compartments and screens as follows:
 - 1. Type: Solid-phenolic.
 - 2. Compartment Style: Overhead braced and floor anchored.
 - 3. Screen Style: Overhead braced and floor anchored.
- B. Related Sections include the following:
 - 1. Division 10, Section "Toilet Accessories" for toilet paper holders, grab bars, and similar accessories.

1.2 SUBMITTALS

- A. Product Data: For each type and style of toilet compartment and screen specified. Include details of construction relative to materials, fabrication, and installation. Include details of anchors, hardware, and fastenings.
- B. Shop Drawings: For fabrication and installation of toilet compartment and screen assemblies. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show locations of reinforcement and cutouts for compartment-mounted toilet accessories.
- C. Samples for Initial Selection: Manufacturer's color charts consisting of sections of actual units showing the full range of colors, textures, and patterns available for each type of compartment or screen indicated.

1.3 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions in areas of installation by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating units without field measurements. Coordinate supports, adjacent construction, and fixture locations to ensure actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Bobrick Washroom Equipment, Inc.
 - 2. Bradley Corp.
 - 3. General Partitions Mfg. Corp.
 - 4. Global Partitions.
 - 5. Metpar Corp.
 - 6. Weis/Robart Partitions, Inc.
 - 7. Columbia Partitions.

2.2 MATERIALS

- A. General: Provide materials that have been selected for surface flatness and smoothness. Exposed surfaces that exhibit pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections on finished units are unacceptable.
- B. Solid phenolic with a high-pressure melamine matte finish surface fabricated as part of the core material. Solid phenolic shall meet or exceed all requirements for Class A flame spread rating per ASTM E 84.
 - 1. Doors: 0.75-inch finish thickness.
 - 2. Divider Panels: 0.50-inch finish thickness.
 - 3. Pilasters: 0.75-inch finish thickness.
- C. Color to be selected by Architect from manufacturer's full range of available colors.
- D. Pilaster Shoes and Sleeves (Caps): ASTM A 666, Type 302 or 304 stainless steel, not less than 0.0312 inch thick and 3 inches high, finished to match hardware.
- E. Full-Height (Continuous) Brackets: Manufacturer's standard design for attaching panels and screens to walls and pilasters of the following material:
 - 1. Material: Clear-anodized aluminum.
- F. Hardware and Accessories: Manufacturer's institutional-grade operating hardware and accessories of the following material:
 - 1. Strike and Keeper: Heavy duty cast stainless steel, wall thickness min. 0.125", 2-1/2" high assembly.
- G. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with anti-grip profile in manufacturer's standard finish.

- H. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match hardware, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use hot-dip galvanized or other rust-resistant, protective-coated steel.

2.3 FABRICATION

- A. General: Provide standard doors, panels, screens, and pilasters fabricated for compartment system. Provide units with cutouts and drilled holes to receive compartment-mounted hardware, accessories, and grab bars, as indicated.
- B. Overhead-Braced-and-Floor-Anchored Compartments: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, fasteners, and anchors at pilasters to suit floor conditions. Make provisions for setting and securing continuous head rail at top of each pilaster. Provide shoes at pilasters to conceal supports and leveling mechanism.
- C. Floor-Anchored Head Rail Braced Screens: Provide pilasters and panels of same construction and finish as toilet compartments. Provide manufacturer's standard corrosion-resistant anchoring assemblies complete with threaded rods, lock washers, and leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.
- D. Doors: Unless otherwise indicated, provide 24-inch- wide in-swinging doors for standard toilet compartments and 36-inch- wide out-swinging doors with a minimum 32-inch- wide clear opening for compartments indicated to be handicapped accessible.
 - 1. Hinges: Full height continuous 14 ga. stainless steel hinge with 3" total flange width and ¼" stainless steel pin.
 - 2. Latch and Keeper: Cast stainless steel surface-mounted latch unit with combination rubber-faced door strike and keeper designed for emergency access. Provide units that comply with accessibility requirements of authorities having jurisdiction at compartments indicated to be handicapped accessible.
 - 3. Door Bumper: Manufacturer's standard rubber-tipped bumpers at out-swinging doors or entrance screen doors.
 - 4. Door Pull: Cast stainless steel unit that complies with accessibility requirements of authorities having jurisdiction at out-swinging doors. Provide units on both sides of doors at compartments indicated to be handicapped accessible.
 - 5. Coat Hook: Cast stainless steel combination hook and rubber tipped bumper, sized to prevent door from hitting compartment-mounted accessories.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, plumb, and level. Provide clearances of not more than 1/2 inch between pilasters and panels and not more than 1 inch between panels and walls. Secure units in position with manufacturer's recommended anchoring devices.
- B. Overhead-Braced-and-Floor-Anchored Compartments: Secure pilasters to floor and level, plumb, and tighten. Secure continuous head rail to each pilaster with not less than 2 fasteners. Hang doors and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Screens: Attach with anchoring devices according to manufacturer's written instructions and to suit supporting structure. Set units level and plumb and to resist lateral impact.

3.2 ADJUSTING AND CLEANING

- A. Hardware Adjustment: Adjust and lubricate hardware according to manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and swing doors in entrance screens to return to fully closed position.
- B. Provide final protection and maintain conditions that ensure toilet compartments and screens are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 10 21 13.17

SECTION 10 28 13 – TOILET ACCESSORIES**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
 - 1. Toilet and bath accessories.
 - 2. Grab Bars.
- B. Related Sections include the following:
 - 1. Division 10 Section "Toilet Compartments" for compartments and screens.

1.2 SUBMITTALS

- A. Product Data: Include construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, and finishes for each type of accessory specified.
- B. Setting Drawings: For cutouts required in other work; include templates, substrate preparation instructions, and directions for preparing cutouts and installing anchoring devices.
- C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required. Use designations indicated in the Toilet Accessory Schedule and room designations indicated on Drawings in product schedule.
- D. Maintenance Data: For accessories to include in maintenance manuals specified in Division 01. Provide lists of replacement parts and service recommendations.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise approved by Architect.
- B. Product Options: Accessory requirements, including those for materials, finishes, dimensions, capacities, and performance, are established by specific products indicated in the Toilet Accessory Schedule.
 - 1. Products of other manufacturers listed in Part 2 with equal characteristics, as judged solely by Architect, may be provided.
 - 2. Do not modify aesthetic effects, as judged solely by Architect, except with Architect's approval. Where modifications are proposed, submit comprehensive explanatory data to Architect for review.

1.4 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by disabled persons, 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.

1.5 WARRANTY

- A. General Warranty: Special warranty 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. Manufacturer's Mirror Warranty: Written warranty, executed by mirror manufacturer agreeing to replace mirrors that develop visible silver spoilage defects within minimum warranty period indicated.
 - 1. Minimum Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide accessories by one of the following:
 - 1. Toilet Accessories:
 - a. A & J Washroom Accessories, Inc.
 - b. American Specialties, Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation. Basis of Design.
 - e. GAMCO; div. of Bobrick Washroom Equipment Inc.
 - f. Columbia Accessories.
 - 2. Grab Bars:
 - a. AJW Architectural Products.
 - b. American Specialties, Inc.
 - c. Bobrick Washroom Equipment.
 - d. Bradley Corporation. Basis of Design.
 - e. Brey-Krause Manufacturing.
 - f. GAMCO Specialty Accessories; a division of Bobrick.

- g. Oatey.
 - h. Seachrome Corporation.
 - i. Tubular Specialties Manufacturing.
- B. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, those indicated in the Toilet Accessory Schedule at the end of Part 3.

2.2 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, with No. 4 finish (satin), in 0.0312-inch minimum nominal thickness, unless otherwise indicated.
- B. Brass: ASTM B 19, leaded and unleaded flat products; ASTM B 16, rods, shapes, forgings, and flat products with finished edges; ASTM B 30, castings.
- C. Sheet Steel: ASTM A 1008/A 1008M, cold rolled, commercial quality, 0.0359-inch minimum nominal thickness; surface preparation and metal pretreatment as required for applied finish.
- D. Galvanized Steel Sheet: ASTM A 653/A 653M, G60.
- E. Chromium Plating: ASTM B 456, Service Condition Number SC 2 (moderate service), nickel plus chromium electrodeposited on base metal.
- F. Mirror Glass: ASTM C 1503, mirror glazing quality, clear-glass mirrors, nominal 6.0 mm thick, with silvering, electroplated copper coating, and protective organic coating complying with FS DD-M-411.
- G. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- H. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.

2.3 FABRICATION

- A. General: Names or labels are not permitted on exposed faces of accessories. On interior surface not exposed to view or on back surface of each accessory, provide printed, waterproof label or stamped nameplate indicating manufacturer's name and product model number.
- B. Surface-Mounted Toilet Accessories: Unless otherwise indicated, fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with continuous stainless-steel hinge. Provide concealed anchorage where possible.
- C. Framed Glass-Mirror Units: Fabricate frames for glass-mirror units to accommodate glass edge protection material. Provide mirror backing and support system that permits rigid, tamper-resistant glass installation and prevents moisture accumulation.
 - 1. Provide galvanized steel backing sheet, not less than 0.034 inch and full mirror size, with nonabsorptive filler material. Corrugated cardboard is not an acceptable filler material.
- D. Mirror-Unit Hangers: Provide mirror-unit mounting system that permits rigid, tamper- and theft-resistant installation, as follows:
 - 1. Heavy-duty wall brackets of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
- E. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.
- F. Grab Bar GB:
 - 1. **Manufacturers:** Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. AJW Architectural Products.
 - b. American Specialties, Inc.
 - c. Bobrick Washroom Equipment.
 - d. Bradley Corporation. Basis of Design.
 - e. Brey-Krause Manufacturing.
 - f. GAMCO Specialty Accessories; a division of Bobrick.
 - g. Oatey.
 - h. Seachrome Corporation.
 - i. Tubular Specialties Manufacturing.
 - j. Or Approved Equal.
 - 2. Mounting: Flanges with concealed fasteners.
 - 3. Material: Stainless steel, 0.05 inch thick.
 - a. Finish: Smooth, ASTM A480/A480M No. 4 finish (satin).
 - 4. Outside Diameter: 1-1/2 inches.
 - 5. Configuration and Length: As indicated on Drawings.
- G. Mop and Broom Holder MBH:

1. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf. Bradley 9954 as Basis of Design.
2. Length: 36 inches.
3. Hooks: Three.
4. Mop/Broom Holders: Four, spring-loaded, rubber hat, cam type.
5. 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.

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. Secure mirrors to walls in concealed, tamper-resistant manner with special hangers, toggle bolts, or screws. Set units level, plumb, and square at locations indicated, according to manufacturer's written instructions for substrate indicated.
- C. Install grab bars to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

3.3 TOILET ACCESSORY SCHEDULE

- A. Toilet and Bath Accessories: Catalog numbers given are Bradley:
 1. PTD Paper Towel Dispensers: Surface mounted- owner provided and contractor installed.
 2. PTD2 Paper Towel Dispensers: Surface mounted- owner provided and contractor installed.
 3. TTD Toilet Tissue Dispensers: Owner provided and contractor installed (OPCI).
 4. GB Grab Bars: Concealed mounting, stainless-steel: length indicated: 800-series; See drawings for lengths used.
 5. MBH Mop and Broom Holder; 9954.
 6. SD Soap Dispenser: Surface mounted- owner provided and contractor installed (OPCI).
- B. Mirrors:
 1. MR 1 Stainless-Steel Framed: Channel framed, 24 x 60 inch.
 2. MR 2 Stainless-Steel Framed: Channel framed, 18 x 36 inch.

END OF SECTION 10 28 13

SECTION 10 44 00 – FIRE-PROTECTION SPECIALTIES**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
 - 1. Portable fire extinguishers.
 - 2. Fire-protection cabinets for the following:
 - a. Portable fire extinguishers.
- B. Related Sections include the following:
 - 1. Division 07, Section "Firestopping" for firestopping sealants at fire-rated cabinets.

1.2 SUBMITTALS

- A. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each type of cabinet finish indicated.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain fire extinguishers and cabinets through one source from a single manufacturer.
- B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Standard for Portable Fire Extinguishers."
- C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
 - 1. Provide extinguishers listed and labeled by FM.

1.4 COORDINATION

- A. Coordinate size of cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Portable Fire Extinguishers:
 - a. Ansul Incorporated.
 - b. J.L. Industries, Inc.
 - c. Kidde: Walter Kidde, The Fire Extinguisher Co.
 - d. Larsen's Manufacturing Company.
 - e. Potter-Roemer; Div. of Smith Industries, Inc.
 - f. Watrous; Div. of American Specialties, Inc.
 - 2. Fire-Protection Cabinets:
 - a. J.L. Industries, Inc.
 - b. Larsen's Manufacturing Company.
 - c. Potter-Roemer; Div. of Smith Industries, Inc.
 - d. Watrous; Div. of American Specialties, Inc.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: Carbon steel, complying with ASTM A 366/A 366M, commercial quality, stretcher leveled, temper rolled.
- B. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
 - 1. Sheet: ASTM B 209.

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:80-B:C, 10-lb nominal capacity, in enameled-steel container.

2.4 FIRE-PROTECTION CABINETS

- A. Cabinet Construction: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld joints and grind smooth. Miter and weld perimeter door frames.
 - 1. Fire-Rated Cabinets: Where cabinet located in wall indicated as rated: Listed and labeled to meet requirements of ASTM E 814 for fire-resistance rating of wall where it is installed.
 - a. Construct fire-rated cabinets with double walls fabricated from 0.0478-inch- thick, cold-rolled steel sheet lined with minimum 5/8-inch- thick, fire-barrier material.
 - b. Provide factory-drilled mounting holes.

- 2. Cabinet Metal: Enameled-steel sheet.
- B. Cabinet Type: Suitable for the following:
 - 1. Fire extinguisher.
- C. Cabinet Mounting: Suitable for the following mounting conditions:
 - 1. Semi-recessed: Cabinet box partially recessed in walls of shallow depth to suit style of trim indicated.
- D. Cabinet Trim Style: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.
 - 1. Exposed Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
 - a. Semi-recessed Cabinets: Rolled-Edge Trim: 2-1/2-inch backbend depth.
- E. Cabinet Trim Material: Manufacturer's standard, as follows:
 - 1. Aluminum sheet.
- F. Door Material: Manufacturer's standard, as follows:
 - 1. Aluminum sheet.
- G. Door Glazing: Manufacturer's standard, as follows:
 - 1. Tempered Break Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 1.5 mm.
- H. Door Style: Manufacturer's standard design, as follows:
 - 1. Vertical duo panel with frame.
- I. Door Construction: Fabricate doors according to manufacturer's standards, of materials indicated, and coordinated with cabinet types and trim styles selected.
 - 1. Provide minimum 1/2-inch- thick door frames, fabricated with tubular stiles and rails, and hollow-metal design.
- J. Door Hardware: Provide manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide either lever handle with cam-action latch, or exposed or concealed door pull and friction latch. Provide concealed or continuous-type hinge permitting door to open 180 degrees.

2.5 ACCESSORIES

- A. Mounting Brackets: Manufacturer's standard steel, designed to secure extinguisher, of sizes required for types and capacities of extinguishers indicated, with plated or baked-enamel finish.
 - 1. Provide brackets for extinguishers not located in cabinets.
- B. Identification: Provide lettering to comply with authorities having jurisdiction for letter style, color, size, spacing, and location. Locate as indicated by Architect.
 - 1. Identify bracket-mounted extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to wall surface.
 - 2. Identify fire extinguisher in cabinet with the words "FIRE EXTINGUISHER" applied to door.
 - a. Application Process: Decals.
 - b. Lettering Color: Red.
 - c. Orientation: Vertical.
- C. Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- D. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- E. 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.
- F. Cabinet and Door Finishes: Provide manufacturer's standard baked-enamel paint for the following:
 - 1. Exterior of cabinets and doors, except for those surfaces indicated to receive another finish.
 - 2. Interior of cabinets and doors.

2.6 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Class 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.

2.7 STEEL FINISHES

- A. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond using manufacturer's standard methods.

- B. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked- enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.
 - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for cabinets to verify actual locations of piping connections before cabinet installation.
- B. Examine walls and partitions for suitable framing depth and blocking where semi-recessed cabinets are to be installed.
- C. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged units.
- D. 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.

END OF SECTION 10 44 00

**DIVISION 12
FURNISHINGS**

SECTION 12 24 13 – 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. This section includes:
 - 1. Manually operated roller shades with single rollers.
 - 2. Manually operated roller shades for skylights.
- B. Related requirements:
 - 1. Division 06 Section "Miscellaneous Carpentry" for wood blocking and grounds for mounting roller shades and accessories.
 - 2. Section 07 92 00 "Joint Sealants" for sealing the perimeters of installation accessories for light-blocking shades with a sealant.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, 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.
 - 1. Motor-Operated Shades: Include details of installation and diagrams for power, signal, and control wiring.
- C. Samples: For each exposed product and for each color and texture specified, 10 inches long.
- D. Samples for Initial Selection: For each type and color of shadeband material.
 - 1. Include Samples of accessories involving color selection.
- E. Samples for Verification: For each type of roller shade.
 - 1. Shadeband Material: Not less than 3 inches square. Mark interior face of material if applicable.
 - 2. Roller Shade: Full-size operating unit, not less than 16 inches wide by 36 inches long for each type of roller shade indicated.
 - 3. Installation Accessories: Full-size unit, not less than 10 inches long.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of shadeband material.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Roller Shades: Full-size units equal to 5 percent of quantity installed for each size, color, and shadeband material indicated, but no fewer than two units.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
 - 1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 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.

1.9 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. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

- A. TimberBlindsMetroShade.
- B. Draper, Inc.
- C. Rollease Acmeda Inc.
- D. MechoShade Systems, LLC.
- E. Lutron Electronics Co., Inc.
- F. Levolor Inc.
- G. 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: Manufacturer's standard.
 - a. Loop Length: Full length of roller shade.
 - b. Limit Stops: Provide upper and lower ball stops.
 - c. Chain-Retainer Type: Clip, jamb mount.
- H. 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: Right side of interior face of shade.
 - 2. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
 - 3. Shadeband-to-Roller Attachment: Manufacturer's standard method.
- I. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.
- J. 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.
- K. Shadebands:
 - 1. Shadeband Material: Light-filtering fabric.
 - 2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
 - a. Color and Finish: As selected by Architect from manufacturer's full range.
- L. 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 assembly when shade is fully open, but not less 3 inches.
 - 2. Endcap Covers: To cover exposed endcaps.

2.3 SHADEBAND MATERIALS

- A. Shadeband Material Flame-Resistance Rating: Comply with **[NFPA 701] <Insert requirement>**. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

- B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.
 - 1. Source: Roller shade manufacturer.
 - 2. Type: PVC-coated polyester.
 - 3. Weave: Basketweave.
 - 4. Thickness: 0.22 inches.
 - 5. Weight: 11.9 oz/ sq yd.
 - 6. Openness Factor: 5 percent.
 - 7. Color: As selected by Architect from manufacturer's full range.

2.4 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances 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.
 - 1. Opaque Shadebands: Located so shadeband is not closer than **[2 inches] <Insert dimension>** to interior face of glass. Allow clearances for window operation hardware.
- B. Roller Shade Locations: At all Storefront locations designated as SF-1, SF-2, SF-3, SF-4, and SF-5 on drawings.

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.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

END OF SECTION 12 24 13

SECTION 12 32 16 – MANUFACTURED PLASTIC-LAMINATE-CLAD WOOD CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the following:
 - 1. Plastic-laminate-faced modular wood cabinets of stock design.
 - 2. Plastic-laminate countertops.
 - 3. Solid Surface Tops.
- B. Related sections include the following:
 - 1. Division 06, Section "Miscellaneous Carpentry" for wood blocking for anchoring institutional casework.
 - 2. Division 09, Section "Gypsum Board Assemblies" for reinforcements in gypsum board partitions for anchoring institutional casework.
 - 3. Division 09, Section "Resilient Base and Accessories" for resilient base applied to institutional casework.

1.2 DEFINITIONS

- A. 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.
- B. Semi-exposed 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 semi-exposed.
- C. 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 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for institutional casework. Include plans, elevations, sections, details, and attachments to other Work.
- C. Samples for Initial Selection: For cabinet finishes and for each type of top material indicated.
- D. Samples: Submit one set of each type of hardware item indicated.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative of institutional casework manufacturer for installation and maintenance of units required for this Project.
- B. Source Limitations: Obtain institutional casework through one source from a single prequalified AWI-member manufacturer.
- C. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards," Section 1600.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver institutional 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.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install institutional 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. Field Measurements: Where institutional casework is indicated to fit to other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 COORDINATION

- A. Coordinate layout and installation of metal framing and reinforcements in gypsum board assemblies for support of institutional casework.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of institutional casework that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:
 - 1. Delamination of components or other failures of glue bond.
 - 2. Warping of components.
 - 3. Failure of operating hardware.
 - 4. Deterioration of finishes.
- B. Warranty Period: 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. Plastic-Laminate-Faced Institutional Casework:
 - a. Carolina Casework, Inc.
 - b. Case Systems, Inc.
 - c. Interior Wood Specialties, Inc.
 - d. LSI Corporation of America, Inc.
 - e. Pridgen Cabinet Works, Inc.
 - f. TMI Systems Design Corp.
 - g. Stevens Industries, Inc.
 - h. Basepoint, Inc.
 - 2. Plastic-Laminate Material:
 - a. Formica Corporation.
 - b. Nevamar Company, LLC.
 - c. Wilsonart International. (Basis of Design)
 - d. Pionite.
 - 3. Solid Surface Material:
 - a. Durat USA, (Basis of Design)
 - b. Corian Design
 - c. Avonite Surfaces

2.2 MATERIALS

- A. General:
 - 1. Particleboard: ANSI A208.1, Grade M-2.
 - 2. Medium-Density Fiberboard: ANSI A208.2, Grade MD. Made with binder containing no urea formaldehyde.
 - 3. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.
 - 4. Edge-banding for Plastic Laminate: Rigid PVC extrusions, through color with satin finish, 3 mm thick at doors and drawer fronts, 1 mm thick elsewhere.
- B. Exposed Cabinet Materials:
 - 1. Plastic Laminate: Type VGS.
 - a. Unless otherwise indicated, provide plastic laminate for exposed surfaces.
 - 2. Thermoset decorative overlay at open-faced cabinets.
- C. Semi-exposed Cabinet Materials:
 - 1. Plastic Laminate: Type VGS.
 - 2. Melamine-Faced Particleboard: Particleboard with decorative surface of thermally fused, melamine-impregnated web and complying with LMA SAT-1.
 - a. Provide melamine-faced particleboard for semi-exposed surfaces, unless otherwise indicated.
- D. Concealed Cabinet Materials:
 - 1. Plastic Laminate: Type BKL.

2.3 DESIGN, COLOR, AND FINISH

- A. Design: Provide institutional casework of the following design:
 - 1. Flush overlay with wire pulls.
- B. Melamine-Faced Particleboard Colors, Patterns, and Finishes: As selected by Architect from casework manufacturer's full range.

- C. Plastic-Laminate Colors, Patterns, and Finishes: As selected by Architect from plastic-laminate manufacturer's full range.

2.4 CABINET FABRICATION

- A. Plastic-Laminate-Faced Cabinet Construction:
 - 1. Bottoms and Ends of Cabinets, Shelves, and Tops of Wall Cabinets and Tall Cabinets: 3/4-inch particleboard, plastic-laminate faced on exposed surfaces, melamine faced on semi-exposed surfaces.
 - 2. Backs of Cabinets: 1/2-inch particleboard, plastic-laminate faced on exposed surfaces, melamine faced on semi-exposed surfaces.
 - 3. Drawer Fronts: 3/4-inch particleboard, plastic-laminate faced on both sides.
 - 4. Drawer Sides and Backs: 1/2-inch melamine-faced particleboard, with glued dovetail or multiple-dowel joints.
 - 5. Drawer Bottoms: 1/4-inch melamine-faced particleboard glued and dadoed into front, back, and sides of drawers. Use 1/2-inch material for drawers more than 24 inches wide.
 - 6. Doors: 3/4-inch particleboard or medium-density fiberboard, plastic-laminate faced on both sides.
- B. 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.

2.5 CASEWORK HARDWARE

- A. Hardware, General: Provide manufacturer's standard **[satin-finish] [polished-finish] [powder-coated]**, commercial-quality, heavy-duty hardware complying with requirements indicated.
 - 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: Stainless-steel, semi-concealed, 5-knuckle hinges complying with BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Provide 2 hinges for doors less than 48 inches high and 3 hinges for doors more than 48 inches high.
- C. Pulls: Solid stainless-steel wire pulls, fastened from back with two screws. For sliding doors, provide recessed stainless-steel flush-pulls. Provide 2 pulls for drawers more than 24 inches wide.
- D. Door Catches: Zinc-plated, nylon-roller spring catch or dual, self-aligning, permanent magnet catch. Provide 2 catches on doors more than high.
- E. [Catches: Magnetic Catches, BHMA A156.9, B03141.
- F. Drawer Slides: Powder-coated, metal-channel, self-closing drawer slides, designed to prevent rebound when drawers are closed, with nylon-tired, ball-bearing rollers, and complying with BHMA A156.9, Type B05091, and rated for the following loads:
 - 1. Box Drawer Slides: 100 lbf, dynamic load.
 - 2. File Drawer Slides: 150 lbf, dynamic load.
 - 3. Pencil Drawer Slides: 45 lbf.
 - 4. Keyboard Slide: 75 lbf.
- G. Drawer and Cupboard Locks: Cylindrical (cam) type, 5-pin tumbler, brass with chrome-plated finish, complying with BHMA A156.11, Grade 1.
 - 1. Provide a minimum of two keys per lock and six master keys.
 - 2. Provide locks where indicated.
- H. Adjustable Shelf Supports: 2-pin locking plastic shelf rests complying with BHMA A156.9, Type B04013.
- I. PH Base Cabinet Doors: Equip base cabinet door fronts indicated as handicapped accessible with pocket door hardware as follows:
 - 1. Pocket door hardware, 270E6000 series, Julius Blum, Inc.
 - 2. Hinges, 71M9680, Julius Blum, Inc.
 - 3. Plastic door guides, mounting strips, and fasteners as required.

2.6 COUNTERTOPS

- A. Countertops, General: Provide smooth, clean exposed tops and edges in uniform plane free of defects. Provide front and end overhang of 1 inch over base cabinets.
- B. Plastic-Laminate Tops: Plastic-laminate sheet, shop bonded with waterproof glue to both sides of 3/4-inch plywood or particleboard. Sand surfaces to which plastic laminate is to be bonded.
 - 1. Plastic-Laminate Type for Flat Tops: HGS.
 - 2. Plastic-Laminate Type for Formed Tops: HGP.
 - 3. Plastic-Laminate Type for Backing: BKL.

4. Provide plastic-laminate edgings of the same material as top on front edge of top, on top edges of backsplashes and end splashes, and on ends of tops and splashes.
5. Use exterior plywood or phenolic-resin-bonded particleboard for countertops containing sinks.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of reinforcements, and other conditions affecting performance of institutional casework.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CASEWORK INSTALLATION

- A. Install plumb, level, and true; shim as required, using concealed shims. Where institutional casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.
- B. Base Cabinets: Set cabinets straight, level, and plumb. Adjust subtops within 1/16 inch of a single plane. Fasten cabinets to partition framing, wood blocking, or reinforcements in partitions with fasteners spaced 24 inches o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform. Align similar adjoining doors and drawers to a tolerance of 1/16 inch.
 1. Where base cabinets are not installed adjacent to walls, fasten to floor at toe space with fasteners spaced 24 inches o.c. Secure sides of cabinets to floor, where they do not adjoin other cabinets, with not less than two fasteners.
- C. 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, partition framing, blocking, or reinforcements in partitions. Align similar adjoining doors to a tolerance of 1/16 inch.
 1. Fasten through back, near top and bottom, at ends, and not more than 16 inches o.c. with No. 10 wafer-head screws sized for 1-inch penetration into wood framing, blocking, or hanging strips.
- D. 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.
- E. Adjust casework and hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.3 INSTALLATION OF TOPS

- A. 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.
- B. Secure tops to cabinets with Z-type fasteners or equivalent, using two or more fasteners at each front, end, and back.
- C. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection.
- D. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c. and walls with adhesive.
- E. Seal junctures of top, splash, and walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.4 CLEANING AND PROTECTING

- 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.
- C. Protection: Provide 6-mil plastic or other suitable water-resistant covering over countertop surfaces. Tape to underside of countertop at a minimum of 48 inches o.c. Remove protection at Substantial Completion.

END OF SECTION 12 32 16

DIVISION 14
CONVEYING EQUIPMENT

SECTION 14 21 00 - ELECTRIC TRACTION ELEVATORS**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes: Electric traction elevators.
- B. Related Requirements:
 1. Section 03 30 00 "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
 2. Section 04 20 00 "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry and for grouting elevator entrance frames installed in masonry walls.
 3. Section 05 12 00 "Structural Steel Framing" for the following:
 - a. Attachment plates, angle brackets, and other preparation of structural steel for fastening guide-rail brackets.
 - b. Hoist beams.
 - c. Structural-steel shapes for subsills.
 4. Section 05 50 00 "Metal Fabrications" for the following:
 - a. Attachment plates and angle brackets for supporting guide-rail brackets.
 - b. Pit ladders.
 5. Section 22 14 29 "Sump Pumps" for sump pumps, sumps, and sump covers in elevator pits.]
 6. Section 27 15 13 "Communications Copper Horizontal Cabling" for twisted pair cabling for telephone service for elevators [and for connection to elevator controllers for remote monitoring of elevator performance.
 7. Section 28 46 21.11 "Addressable Fire-Alarm Systems" [Section 28 46 21.13 "Conventional Fire-Alarm Systems"] for smoke detectors in elevator lobbies to initiate emergency recall operation, [for heat detectors in shafts and machine rooms to disconnect power from elevator equipment on or before sprinkler activation,] and for connection to elevator controllers.

1.2 DEFINITIONS

- A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.
- B. Service Elevator: A passenger elevator that is also used to carry freight.

1.3 ACTION SUBMITTALS

- A. Product Data:
 1. Electric traction elevators.
- B. Product Data Submittals: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include Product Data for car enclosures, hoistway entrances, and operation, control, and signal systems.
- C. Shop Drawings:
 1. Include plans, elevations, sections, and large-scale details indicating service at each landing, coordination with building structure, relationships with other construction, and locations of equipment.
 2. Include large-scale layout of car-control station **[and standby power operation control panel]**.
 3. Indicate maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.
- D. Samples for Initial Selection: For finishes involving color selection.
- E. Samples for Verification: For exposed car, hoistway door and frame, and signal equipment finishes; 3-inch- (75-mm-) square Samples of sheet materials; and 4-inch (100-mm) lengths of running trim members.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Seismic Qualification Data: Certificates, for elevator equipment, 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.

- C. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as indicated on Drawings, and electrical service as shown and specified, are adequate for elevator system being provided.
- D. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.
 - 1. Submit manufacturer's or Installer's standard operation and maintenance manual, according to ASME A17.1/CSA B44.
- B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.
- C. Continuing Maintenance Proposal:
 - 1. Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard one-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Elevator manufacturer or an authorized representative who is trained and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

1.8 COORDINATION

- A. Coordinate installation of inserts, sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, inserts, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.
- B. Coordinate locations and dimensions of work specified in other Sections that relates to electric traction elevators including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways, pits, and machine rooms.

1.9 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
 - 2. Warranty Period: One (1) year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain electric traction elevators from single manufacturer.
 - 1. Major elevator components, including driving machines, controllers, signal fixtures, door operators, car frames, cars, and entrances, to be manufactured by single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.
- B. Accessibility Requirements: Comply with requirements for accessible elevators in the United States Access Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.
- C. Seismic Performance: Elevator system to withstand the effects of earthquake motions determined according to ASCE/SEI 7 and to comply with elevator seismic requirements in ASME A17.1/CSA B44.

1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."
2. Project Seismic Design Category: B.
3. Elevator Component Importance Factor: 1.0.
4. Design earthquake spectral response acceleration short period (Sds) for Project is; See Seismic Notes on Structural Sheet S001.
5. Provide earthquake equipment required by ASME A17.1/CSA B44.
6. Provide seismic switch required by ASCE/SEI 7.

2.3 ELECTRIC TRACTION ELEVATORS

A. **Manufacturers:**

1. Schindler Passenger Elevators, 3100 (Basis of Design).
2. Otis Elevator Company.
3. TK Elevator.

B. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturer's standard components to be used, as included in standard elevator systems and as required for complete system.

C. Elevator Description:

1. Machine room-less traction elevator with Jamb mounted microprocessor controller.
2. Machine Type: Gearless traction.
3. Rated Load: 3500 lb. (1589 kg).
4. Freight Loading Class for Service Elevator(s): Class A.
5. Rated Speed: 100 fpm.
6. Operation System: Selective-collective automatic operation.
7. Auxiliary Operations:
 - a. Automatic operation of lights and ventilation fans.
8. Security Features: [Card-reader operation] [Keyswitch operation] [Keypad operation] [Car-to-lobby feature].
9. Car Enclosures:
 - a. Inside Width: Not less than 80 inches (2032 mm) from side wall to side wall.
 - b. Inside Depth: Not less than 66 inches (1676 mm) from back wall to front wall (return panels).
 - c. Inside Height: Not less than 93 inches (2362 mm) to underside of ceiling.
 - d. Front Walls (Return Panels): Satin stainless steel, ASTM A480/A480M, No. 4 finish.
 - e. Car Fixtures: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
 - f. Side and Rear Wall Panels: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
 - g. Reveals: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
 - h. Door Faces (Interior): Satin stainless steel, ASTM A480/A480M, No. 4 finish.
 - i. Door Sills: Aluminum.
 - j. Ceiling: Luminous ceiling.
 - k. Handrails: 1-1/2 inches (38 mm) round and satin stainless steel at sides and rear of car.
 - l. Floor prepared to receive resilient flooring (specified in Section 09 65 16 "Resilient Sheet Flooring").
10. Hoistway Entrances:
 - a. Width: 42 inches (1067 mm)
 - b. Height: 84 inches (2134 mm).
 - c. Type: Single-speed side sliding.
 - d. Frames: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
 - e. Doors and Transoms: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
 - f. Sills: Aluminum.
11. Hall Fixtures: Satin stainless steel, ASTM A480/A480M, No. 4 finish
12. Additional Requirements:
 - a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, ASTM A480/A480M, No. 4 finish.
 - b. Provide hooks for protective pads and one complete set(s) of full-height protective pads.

2.4 TRACTION SYSTEMS

- A. Elevator Machines: Variable-voltage, variable-frequency, ac-type hoisting machines or variable-voltage dc-type hoisting machines and solid-state power converters.
1. Provide nonregenerative system.

- B. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified in another Section.
- C. Machine Beams: Provide steel framing to support elevator hoisting machine and deflector sheaves from the building structure. Comply with Section 05 50 00 "Metal Fabrications" for materials and fabrication.
- D. Car Frame and Platform: Bolted- or welded-steel units.
- E. Guides: Roller guides. Provide guides at top and bottom of car and counterweight frames.

2.5 OPERATION SYSTEMS

- A. Provide manufacturer's standard microprocessor operation systems as required to provide type of operation indicated.
- B. Auxiliary Operations:
 - 1. Automatic Dispatching of Loaded Car: When carload exceeds 80 percent of rated capacity, doors begin closing.
 - 2. Nuisance-Call Cancel: When car calls exceed a preset number while carload is less than a predetermined weight, all car calls are canceled. Preset number of calls and predetermined weight can be adjusted.
 - 3. Independent Service: Keyswitch in car-control station removes car from group operation and allows it to respond only to car calls. Key cannot be removed from keyswitch when car is in independent service. When in independent service, doors close only in response to door close button.
 - 4. Priority Service: Service is initiated by a keyswitch at designated floors. One elevator is removed from group operation and directed to the floor where service was initiated. On arriving at the floor, elevator opens its doors and parks and a lighted sign directs passengers to exit elevator. Car is placed in operation by selecting a floor and pressing door close button or by operating keyswitch to put car in independent service. After responding to floor selected or being removed from independent service, car is returned to group operation. If car is not placed in operation within a preset time after being called, it is returned to group operation.
 - 5. Automatic Operation of Lights and Fan: When elevator is stopped and unoccupied with doors closed, lighting, ventilation fan, and cab displays are de-energized after five minutes and are re-energized before car doors open.
- C. Security features are not to not affect emergency firefighters' service.
 - 1. Keyswitch Operation: Push buttons are activated and deactivated by security keyswitches at hall push-button stations. Key is removable in either position.

2.6 DOOR REOPENING DEVICES

- A. Infrared Array: Provide door reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams causes doors to stop and reopen.
- B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door reopening device, a loud buzzer sounds and doors begin to close at reduced kinetic energy.

2.7 CAR ENCLOSURES

- A. Materials and Finishes: Manufacturer's standards, but not less than the following:
 - 1. Subfloor:
 - a. Exterior, underlayment grade plywood, not less than 5/8-inch (15.9-mm) nominal thickness.
 - 2. Floor Finish:
 - a. Specified in Division 09 Section 09 65 20 "Resilient Vinyl Plank Flooring".
 - b. Elevator manufacturer's standard level-loop nylon carpet; color as selected by Architect from full range of industry colors.
 - 3. Stainless Steel Wall Panels: Flush, formed-metal construction; fabricated from stainless steel sheet.
 - 4. Fabricate car with recesses and cutouts for signal equipment.
 - 5. Fabricate car door frame integrally with front wall of car.
 - 6. Stainless Steel Doors: Flush, hollow-metal construction; fabricated [from stainless steel sheet] [or] [by laminating stainless steel sheet to exposed faces and edges of enameled or powder-coated steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning].
 - 7. Sight Guards: Provide sight guards on car doors.
 - 8. Sills: Extruded or machined metal, with grooved surface, 1/4 inch (6.4 mm) thick.
 - 9. Luminous Ceiling: Fluorescent light fixtures and ceiling panels of translucent acrylic or other permanent rigid plastic.
 - 10. Light Fixture Efficiency: Not less than 35 lumens/W.

11. Ventilation Fan Efficiency: Not less than 3.0 cfm/W (1.4 L/s per W).

2.8 HOISTWAY ENTRANCES

- A. Hoistway Entrance Assemblies: Manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Frame size and profile to accommodate hoistway wall construction.
 1. Where gypsum board wall construction is indicated, frames to be self-supporting with reinforced head sections.
- B. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies to comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, based on testing at as close-to-neutral pressure as possible according to NFPA 252.
 1. Fire-Protection Rating: 1 hour with 30-minute temperature rise of 450 deg F (250 deg C).
- C. Materials and Fabrication: Manufacturer's standards, but not less than the following:
 1. Stainless Steel Frames: Formed from stainless steel sheet.
 2. Stainless Steel Doors and Transoms: Flush, hollow-metal construction; fabricated from stainless steel sheet] [or] [by laminating stainless steel sheet to exposed faces and edges of enameled or powder-coated steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
 3. Sight Guards: Provide sight guards on doors matching door edges.
 4. Sills: Extruded or machined metal, with grooved surface, 1/4 inch (6.4 mm) thick.
 5. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M.

2.9 SIGNAL EQUIPMENT

- A. Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Provide vandal-resistant buttons and lighted elements illuminated with LEDs.
- B. Car-Control Stations: Provide manufacturer's standard recessed car-control stations. Mount in return panel adjacent to car door unless otherwise indicated.
 1. Mark buttons and switches for required use or function. Use both tactile symbols and Braille.
 2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.
- C. Emergency Communication System: Two-way voice communication system, with visible signal, which dials preprogrammed number of monitoring station and does not require handset use. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.
- D. Firefighters' Two-Way Telephone Communication Service: Provide flush-mounted cabinet in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in Section 28 46 21.11 "Addressable Fire-Alarm Systems."
- E. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car-control station. Also, provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served. Include travel direction arrows if not provided in car-control station.
- F. Hall Push-Button Stations: Provide one hall push-button station at each landing.
 1. Provide [manufacturer's standard wall-mounted units] [units with flat faceplate for mounting with body of unit recessed in wall].
 2. Equip units with buttons for calling elevator and for indicating desired direction of travel.
 - a. Provide a means for passengers to indicate that they have disabilities so control system can allow extra room in assigned car.
 3. Provide telephone jack in each unit for firefighters' two-way telephone communication service specified in Section 28 46 21.11 "Addressable Fire-Alarm Systems."
- G. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide **[one of]** the following:
 1. Manufacturer's standard wall-mounted units, for mounting above entrance frames.
 2. Units with flat faceplate for mounting with body of unit recessed in wall and with illuminated elements projecting from faceplate for ease of angular viewing.
 3. Units mounted in both jambs of entrance frame.
- H. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.

1. At manufacturer's option, audible signals may be placed on cars.
- I. Fire-Command-Center Annunciator Panel: Provide panel containing illuminated position indicators for each elevator, clearly labeled with elevator designation; include illuminated signal that indicates when elevator is operational and when it is at the designated emergency return level with doors open. Provide standby power elevator selector switch(es), as required by ASME A17.1/CSA B44, adjacent to position indicators. Provide illuminated signal that indicates when normal power supply has failed.
- J. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire, elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.

2.10 FINISH MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, commercial steel, Type B, exposed, matte finish.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, commercial steel, Type B, pickled.
- C. Stainless Steel Sheet: ASTM A240/A240M, Type 304.
 1. Metal surface is satin polished.
- D. Stainless Steel Bars: ASTM A276/A276M, Type 304.
- E. Stainless Steel Tubing: ASTM A554, Grade MT 304.
- F. Bronze Plate and Sheet: ASTM B36/B36M, Alloy UNS No. C28000 (muntz metal).
- G. Bronze Extrusions: ASTM B455/B455M, Alloy UNS No. C38500 (architectural bronze).
- H. Bronze Tubing: ASTM B135/B135M, Alloy UNS No. C23000 (red brass, 85 percent copper).
- I. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063.
- J. Nickel Silver Extrusions: ASTM B151/B151M, Alloy UNS No. C74500 or UNS No. C77600.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Examine hoistways, hoistway openings, pits, and machine rooms as constructed; verify critical dimensions; and examine supporting structure and other conditions under which elevator work is to be installed.
- B. 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 INSTALLATION OF ELECTRIC TRACTION ELEVATORS

- A. Comply with manufacturer's written instructions.
- B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.
- C. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.
- D. Lubricate operating parts of systems, including ropes, as recommended by manufacturers.
- E. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.
- F. Leveling Tolerance: 1/8 inch (3 mm), up or down, regardless of load and travel direction.
- G. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.
- H. Locate hall signal equipment for elevators as follows unless otherwise indicated:
 1. For groups of elevators, locate hall push-button stations between two elevators at center of group or at location most convenient for approaching passengers.

2. Place hall lanterns either above or beside each hoistway entrance.
3. Mount hall lanterns at a minimum of 72 inches (1829 mm) above finished floor.

3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.
- B. Operating Test: Load elevator rated capacity and operate continuously for 30 minutes over full travel distance, stopping at each level and proceeding immediately to the next. Record temperature rise of elevator machine during 30-minute test period. Record failure to perform as required.
- C. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

3.4 PROTECTION

- A. Temporary Use: Comply with the following requirements for elevator used for construction purposes:
 1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
 2. Provide strippable protective film on entrance and car doors and frames.
 3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
 4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
 5. Do not load elevators beyond their rated weight capacity.
 6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
 7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.5 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service to include twelve (12) months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Parts and supplies to be manufacturer's authorized replacement parts and supplies.
 1. Perform maintenance during normal working hours.
 2. Perform emergency callback service during normal working hours with response time of two hours or less.
 3. Include 24-hour-per-day, 7-day-per-week emergency callback service with response time of four (4) hours or less.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate, adjust, and maintain elevator(s).
- B. Check operation of elevator with Owner's personnel present before date of Substantial Completion and again not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

END OF SECTION 14 21 00

SECTION 14 42 00 – WHEELCHAIR LIFTS**PART 1 - GENERAL****1.1 SUMMARY**

- A. This section includes:
 - 1. Vertical platform lifts.
- B. Related sections:
 - 1. Division 03 Section "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
 - 2. Division 09 painting Sections for field painting of lift equipment.
 - 3. Division 26 Sections for electrical service to lifts, including fused disconnect switches.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, dimensions, electrical characteristics, safety features, controls, and finishes.
- B. Shop Drawings: For each lift. 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. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Initial Selection: For surfaces and components with factory-applied color finishes.
 - 1. Include similar Samples of accessories involving color selection.
- D. Qualification Data: For qualified Installer.
- E. Manufacturer Certificates: Signed by lift manufacturer certifying that runway, ramp or pit, and dimensions as shown on Drawings and that electrical service as shown and specified are adequate for lift being provided.
- F. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted use of lifts.
- G. Operation and Maintenance Data: For each type of lift to include in operation and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Parts list with sources indicated.
 - 2. Recommended parts inventory list.
- H. Warranty: Sample of special warranty.
- I. Continuing maintenance proposal.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
 - 1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
- B. Regulatory Requirements: In addition to requirements of authorities having jurisdiction, comply with ASME A18.1, "Safety Standard for Platform Lifts and Stairway Chairlifts."

1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of lifts that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.

1.5 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of lift Installer. Include quarterly preventive maintenance and repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper lift operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.

PART 2 - PRODUCTS**2.1 MATERIALS**

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Tubing: ASTM A 500.

- C. Steel Pipe: ASTM A 53/A 53M; standard weight (Schedule 40) unless otherwise indicated or required by structural loads.
- D. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel (CS), Type B, exposed, matte finish.
- E. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel (CS), Type B, pickled.
- F. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required:
 - 1. Extruded Aluminum: ASTM B 221, Alloy 6063-T6.
 - 2. Aluminum Sheet: ASTM B 209, Alloy 5005-H15.
- G. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
- H. Stainless-Steel Tubing: ASTM A 554, Grade MT-304.
- I. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing structural members, guide rails, machines, and other lift components where installation of devices is specified in another Section.
- J. Expansion Anchors: Anchor-bolt-and-sleeve assembly of material indicated below with capability to sustain a load equal to 10 times the load imposed as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
 - 2. Material: Group 1, Alloy 304 or Alloy 316, stainless-steel bolts and nuts complying with ASTM F 593 and ASTM F 594.
- K. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107.

2.2 VERTICAL PLATFORM LIFTS

- A. Vertical Platform Lifts: Manufacturer's standard pre-engineered lift systems as indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Butler Mobility Products.
 - b. Garaventa Lift.
 - c. Giant Lift Equipment Mfg. Co. Inc.
 - d. Liftavator, Inc.
 - e. Thyssen Krupp Access.
 - f. Savaria Corporation; Basis of Design – V -1504, 36 x 54 cab with open enclosure & safety gates.
- B. Platform Size: 38 by 54 inches.
- C. Rated Speed: 8 fpm.
- D. Power Supply: 120 V, 60 Hz, 1 phase.
- E. Emergency Operation: Provide emergency manual operation to raise or lower units in case of malfunction or power loss.
- F. Self-Supporting Units: Support vertical loads of units only at base, with lateral support only at landing levels.
- G. Platform Low-Profile Carriage: Fabricate platform floor assembly to total thickness not exceeding 1-1/2 inches.
- H. Platform Enclosure and Door: Rectangular steel-tube frame with flush steel-sheet panels.
- I. Retractable Ramp: Provide ramp matching platform to provide transition from lower floor to lift platform. Ramp lowers to floor automatically when lifts reach lower landing and door opens. Ramp rises automatically when lift control is activated for lift to leave lower landing.
 - 1. Ramp Size: End ramps a minimum of 32 inches wide; length as required for 1:12 slope.
 - 2. Ramp Finish: Finish ramps to match lift platform.

2.3 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.

2.4 FINISHES

- A. Steel Factory Finish:
 - 1. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard 2-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat.
 - 2. Color and Gloss: As selected by Architect from manufacturer's full range.
- B. Aluminum Finishes:
 - 1. Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard, thermosetting polyester or acrylic urethane powder coating with a cured film thickness not less than 1.5 mils.
 - a. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, critical dimensions, and other conditions affecting performance.
- B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Wiring Method: Conceal conductors and cables within housings of units or building construction. Do not install conduit exposed to view in finished spaces. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
- B. Coordinate runway doors with platform travel and positioning, for accurate alignment and minimum clearance between platforms, runway doors, sills, and door frames.
- C. Position sills accurately and fill space under sills solidly with nonshrink, nonmetallic grout.
- D. Coordinate platform doors with platform travel and positioning.
- E. Adjust stops for accurate stopping at each landing, within required tolerances.
- F. Adjust retractable ramps to meet maximum allowable slope and change-in-elevation requirements, and to lie fully against landing surfaces.
- G. Lubricate operating parts of lift, including drive mechanism, guide rails, hinges, safety devices, and hardware.
- H. Test safety devices and verify smoothness of required protective enclosures and fascias

3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of lift installation and before permitting use of lifts, perform acceptance tests as required and recommended by ASME A18.1 and authorities having jurisdiction.
- B. Operating Test: In addition to above testing, load lifts to rated capacity and operate continuously for 30 minutes between lowest and highest landings served. Readjust stops, signal equipment, and other devices for accurate stopping and operation of system.
- C. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times tests are to be performed on lifts.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lifts. Include a review of emergency systems and emergency procedures to be followed at time of operational failure and other building emergencies.
- B. Check operation of lifts with Owner's personnel present and before date of Substantial Completion. Determine that operating systems and devices are functioning properly.
- C. Check operation of lifts with Owner's personnel present not more than one month before end of warranty period. Determine that operating systems and devices are functioning properly.

END OF SECTION 14 42 00

**DIVISION 21
FIRE SUPPRESSION**

SECTION 21 05 00
COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe, fittings, sleeves, escutcheons, seals, and connections for sprinkler systems.
- B. Expansion joints
- C. Expansion loops
- D. Grout
- E. Equipment Installation
- F. Painting and Finishing
- G. Concrete Bases
- H. Supports and Anchorage

1.2 REFERENCE STANDARDS

- A. ASME A112.18.1 - Plumbing Supply Fittings; 2018, with Errata.
- B. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2021.
- C. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
- D. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.
- E. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250; 2021.
- F. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard; 2020.
- G. ASME B16.9 - Factory-Made Wrought Buttwelding Fittings; 2018.
- H. ASME B16.11 - Forged Fittings, Socket-Welding and Threaded; 2021.
- I. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- J. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- K. ASME B16.25 - Buttwelding Ends; 2022.
- L. ASME B36.10M - Welded and Seamless Wrought Steel Pipe; 2022.
- M. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
- N. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- O. ASTM A135/A135M - Standard Specification for Electric-Resistance-Welded Steel Pipe; 2021.

- P. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2023a.
- Q. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2022.
- R. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984, with Editorial Revision (2019).
- S. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use; 2021.
- T. ASTM B32 - Standard Specification for Solder Metal; 2020.
- U. ASTM B75/B75M - Standard Specification for Seamless Copper Tube; 2020.
- V. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2020.
- W. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2022a.
- X. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.
- Y. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2019.
- Z. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2022).
- AA. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2018.
- BB. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2021.
- CC. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2017.
- DD. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2017, with Errata (2018).
- EE. AWWA C606 - Grooved and Shouldered Joints; 2015.
- FF. FM (AG) - FM Approval Guide; Current Edition.
- GG. ITS (DIR) - Directory of Listed Products; Current Edition.
- HH. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- II. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems; 2019, with Amendment.
- JJ. UL (DIR) - Online Certifications Directory; Current Edition.

1.3 SUBMITTALS

- A. Refer to Division 01 Specifications for Submittal Procedures.
- B. Refer to Specification Section 21 13 00 FIRE SUPPRESSION SPRINKLER SYSTEMS for full Submittal Requirements.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section.
 - 1. Minimum five years experience.
- C. Comply with FM (AG), UL (DIR), and ITS (DIR) or Warnock Hersey requirements.
- D. Valves: Bear FM (AG), UL (DIR), and ITS (DIR) or Warnock Hersey product listing label or marking. Provide manufacturer's name and pressure rating marked on valve body.
- E. Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.
- F. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves in shipping containers, with labeling in place.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

1.6 WARRANTY

- A. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.1 FIRE PROTECTION SYSTEMS

- A. Sprinkler Systems: Comply with NFPA 13.
- B. Welding Materials and Procedures: Comply with ASME BPVC-IX.

2.2 ABOVE GROUND PIPING

- A. Steel Pipe: ASTM A53 Schedule 40 or ASTM A795 Schedule 40, black.
 - 1. Steel Fittings: ASME B16.5 steel flanges and fittings.
 - 2. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings and ASME B16.4, threaded fittings.
 - 3. Malleable Iron Fittings: ASME B16.3, threaded fittings and ASTM A47/A47M.
 - 4. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.
 - 5. Mechanical Formed Fittings: Carbon steel housing with integral pipe stop and O-ring pocked and O-ring, uniformly compressed into permanent mechanical engagement onto pipe.

2.3 PIPE SLEEVES

- A. Vertical Piping:
-

1. Sleeve Length: 1 inch above finished floor.
 2. Provide sealant for watertight joint.
 3. Blocked Out Floor Openings: Provide 1-1/2 inch angle set in silicon adhesive around opening.
 4. Drilled Penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.
- B. Plastic, Sheet Metal, or Moisture-Resistant Fiber: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.
- C. Pipe Passing Through Below Grade Exterior Walls:
1. Zinc-coated or cast-iron pipe.
 2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.
- D. Pipe Passing Through Quarry Tile, Terrazzo, or Ceramic Tile Floors:
1. Brass pipe.
 2. Connect sleeve with floor plate.
- E. Clearances:
1. Provide allowance for insulated piping.
 2. Wall, Floor, Floor, Partitions, and Beam Flanges: 1 inch greater than external; pipe diameter.

2.4 ESCUTCHEONS

- A. Manufacturers:
1. Fire Protection Products, Inc
 2. Tyco Fire Protection Products
 3. Viking Group Inc
 4. Victaulic Firelock
- B. Material:
1. Fabricate from nonferrous metal.
 2. Chrome-plated.
 3. Metals and Finish: Comply with ASME A112.18.1.
- C. Construction:
1. One-piece for mounting on chrome-plated tubing or pipe and one-piece type elsewhere.
 2. Internal spring tension devices or setscrews to maintain a fixed position against a surface.

2.5 PIPE HANGERS AND SUPPORTS

- A. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
- B. Hangers for Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.
- C. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- D. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.
- E. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.
- F. Vertical Support: Steel riser clamp.
- G. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

2.6 EXPANSION JOINTS AND LOOPS - HOSE AND BRAID

- A. Manufacturers:
 - 1. The Metraflex Company; FireLoop
 - 2. or approved equal
- B. Provide flexible loops with two flexible sections of hose and braid, two 90-degree elbows, and 180-degree return with support bracket and air release or drain plug.
- C. Provide flexible loops capable of movement in the x, y, and z planes. Flexible loops to impart no thrust loads to the building structure.
- D. Flexible Connectors: Flanged, braided type with wetted components of stainless steel, sized to match piping.
 - 1. Maximum Allowable Working Pressure: 150 psig at 120 degrees F.
 - 2. End Connections: Same as specified for pipe jointing.
 - 3. Provide necessary accessories including, but not limited to, swivel joints.

2.7 MECHANICAL COUPLINGS

- A. Manufacturers:
 - 1. Tyco Fire Protection Products: www.tyco-fire.com/#sle.
 - 2. Victaulic Company; FireLock Style 009H: www.victaulic.com/#sle.
 - 3. Anvil/Gruvlock.
- B. Rigid Mechanical Couplings for Grooved Joints:
 - 1. Dimensions and Testing: Comply with AWWA C606.
 - 2. Minimum Working Pressure: 300 psig.
 - 3. Housing Material: Fabricate of ductile iron complying with ASTM A536.
 - 4. Housing Coating: Factory applied orange enamel.

5. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F to 230 degrees F.
6. Bolts and Nuts: Hot-dipped-galvanized or zinc-electroplated steel.
7. Provide stops for direct stab installation without field assembly.

PART 3 EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

- A. Install sprinkler system and service main piping, hangers, and supports in accordance with NFPA 13.
 - B. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
 - C. Install piping to conserve building space, to not interfere with use of space and other work.
 - D. Group piping whenever practical at common elevations.
 - E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
 - F. Inserts:
 1. Provide inserts for placement in concrete formwork.
 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
 - G. Pipe Hangers and Supports:
 1. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 2. Place hangers within 12 inches of each horizontal elbow.
 3. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 4. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
 5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
-

6. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- H. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- I. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.
- J. Structural Considerations:
 1. Do not penetrate building structural members unless indicated.
 2. Locate flexible expansion loops at or near the building seismic joint.
 3. Contractor is responsible for reviewing complete construction document package and determining, prior to the start of work, which portions of the above grade structural slabs are hard rock concrete and/or lightweight insulating concrete and shall review the structural engineer's requirements for attachment to slabs. UJnistrut or other forms of support required to span multiple joists or beams shall be part of the contractor's bid price. No additional monies will be given for support steel or other members required where piping may not be allowed to be supported by the concrete dec
- K. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
 1. Underground Piping: Caulk pipe sleeve watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.
 2. Aboveground Piping:
 - a. Pack solid using mineral fiber complying with ASTM C592.
 - b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.
 3. All Rated Openings: Caulk tight with firestopping material complying with ASTM E814 in accordance with Section 07 84 00 to prevent the spread of fire, smoke, and gases.
 4. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.
- L. Escutcheons:
 1. Install and firmly attach escutcheons at piping penetrations into finished spaces.
 2. Provide escutcheons on both sides of partitions separating finished areas through which piping passes.
 3. Attach plates at the underside only of suspended ceilings.
 4. Use chrome plated escutcheons in occupied spaces and to conceal openings in construction.
- M. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, unions, and couplings for servicing are consistently provided.
- N. Die-cut threaded joints with full-cut, standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.

3.3 CLEANING

- A. Upon completion of work, clean all parts of the installation.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.
- C. Spray-on Fireproofing overspray shall be removed from all piping, fittings, and all materials provided as part of the fire protection (sprinkler system) contract.

END OF SECTION 21 05 00

**SECTION 21 05 23
GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Two-piece ball valves with indicators.
- B. Bronze butterfly valves with indicators.
- C. Iron butterfly valves with indicators.
- D. Check valves.
- E. Bronze OS&Y gate valves.
- F. Iron OS&Y gate valves.
- G. NRS gate valves.
- H. Indicator posts.
- I. Trim and drain valves.

1.2 RELATED REQUIREMENTS

- A. Section 21 05 00 - Common Work Results for Fire Suppression: Pipe and fittings.
- B. Section 21 05 48 - Vibration and Seismic Controls for Fire Suppression Piping and Equipment.
- C. Section 21 05 53 - Identification for Fire Suppression Piping and Equipment.
- D. Section 21 07 19 - Fire Suppression Piping Insulation.
- E. Section 21 12 00 - Fire-Suppression Standpipes.
- F. Section 21 13 00 - Fire-Suppression Sprinkler Systems.

1.3 ABBREVIATIONS AND ACRONYMS

- A. EPDM: Ethylene-propylene diene monomer.
- B. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- C. NRS: Non-rising stem.
- D. OS&Y: Outside screw and yoke.
- E. PTFE: Polytetrafluoroethylene.
- F. SBR: Styrene-butadiene rubber.

1.4 REFERENCE STANDARDS

- A. ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).

- B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
- C. ASME B31.9 - Building Services Piping; 2020.
- D. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2021.
- E. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service; 2023.
- F. AWWA C606 - Grooved and Shouldered Joints; 2015.
- G. FM (AG) - FM Approval Guide; Current Edition.
- H. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. NFPA 13R - Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies; 2022, with Errata.
- J. UL (DIR) - Online Certifications Directory; Current Edition.
- K. UL 262 - Gate Valves for Fire-Protection Service; Current Edition, Including All Revisions.
- L. UL 312 - Check Valves for Fire-Protection Service; Current Edition, Including All Revisions.
- M. UL 789 - Indicator Posts for Fire-Protection Service; Current Edition, Including All Revisions.
- N. UL 1091 - Standard for Butterfly Valves for Fire-Protection Service; Current Edition, Including All Revisions.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.6 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Obtain valves for each valve type from single manufacturer.
 - 2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.

- B. Where listed products are specified, provide products listed, classified, and labeled by FM (AG), UL (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for the purpose indicated.
- C. Welding Materials and Procedures: Comply with ASME BPVC-IX.
- D. Installer, Maintenance Contractor, and Testing Agency Qualifications:
 - 1. Company specializing in performing the work of this section with minimum five years documented experience.
 - 2. Trained and approved by manufacturer to design, install, test and maintain the equipment specified herein.
 - 3. Complies with manufacturer's certification requirements.
 - 4. Complies with manufacturer's insurance requirements.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, and weld ends.
 - 3. Set valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection and protect flanges and specialties from dirt.
 - a. Provide temporary inlet and outlet caps.
 - b. Maintain caps in place until installation.
 - 2. Store valves in shipping containers and maintain in place until installation.
 - a. Store valves indoors and maintain at higher than ambient dew point temperature.
 - b. If outdoor storage is unavoidable, store valves off the ground in watertight enclosures.
- C. Use the following precautions for handling:
 - 1. Use sling to handle large valves, rigged to avoid damage to exposed parts.
 - 2. Do not use operating handles or stems as lifting or rigging points.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. UL Listed: Provide valves listed in UL (DIR) under following headings and bearing UL mark:
 - 1. Main Level: HAMV - Fire Main Equipment.
 - a. Level 1: HCBZ - Indicator Posts, Gate Valve.

- b. Level 1: HLOT - Valves.
 - c. Level 3: HLOG - Ball Valves, System Control.
 - d. Level 3: HLXS - Butterfly Valves.
 - e. Level 3: HMER - Check Valves.
 - f. Level 3: HMRZ - Gate Valves.
2. Main Level: VDGT - Sprinkler System & Water Spray System Devices.
- a. Level 1: VQGU - Valves, Trim, and Drain.
- B. FM Global Approved: Provide valves listed in FM (AG) Approval Guide under the following headings:
- 1. Automated Sprinkler Systems:
 - a. Indicator posts.
 - b. Valves:
 - 1) Gate valves.
 - 2) Single check valves.
 - 3) Miscellaneous valves.
- C. ASME Compliance:
- 1. ASME B16.1 for flanges on iron valves.
 - 2. ASME B1.20.1 for threads on threaded-end valves.
 - 3. ASME B31.9 for building services piping valves.
- D. Comply with AWWA C606 for grooved-end connections.
- E. Comply with NFPA 20 and NFPA 13R for valves.
- F. Valve Pressure Ratings: Not less than minimum pressure rating indicated or higher as required.
- G. Valve Sizes: Same as upstream piping unless otherwise indicated.
- H. Valve Actuator Types:
- 1. Worm-gear actuator with handwheel for quarter-turn valves, except trim and drain valves.
 - 2. Handwheel: For other than quarter-turn trim and drain valves.
 - 3. Hand-lever: For quarter-turn trim and drain valves 2 NPS and smaller.

2.2 TWO-PIECE BALL VALVES WITH INDICATORS

- A. Manufacturers:
- 1. Victaulic Co. of America

2. Tyco
 3. Nibco
- B. UL 1091, except with ball instead of disc and FM (AG) standard listing for indicating valves (butterfly or ball type), Class Number 1112.
- C. Description:
1. Minimum Pressure Rating: 175 psig.
 2. Body Design: Two piece.
 3. Body Material: Forged brass or bronze.
 4. Port Size: Full or standard.
 5. Seat: PTFE.
 6. Stem: Bronze or stainless steel.
 7. Ball: Chrome-plated brass.
 8. Actuator: Worm gear or traveling nut.
 9. Supervisory Switch: Internal or external.
 10. End Connections for Valves 1 NPS through 2 NPS: Threaded ends or Grooved where available.
 11. End Connections for Valves 2-1/2 NPS: Grooved ends.

2.3 BRONZE BUTTERFLY VALVES WITH INDICATORS

- A. Manufacturers:
1. Victaulic Co. of America.
 2. Tyco.
 3. Nibco
- B. UL 1091 and FM (AG) standard listing for indicating valves, (butterfly or ball type), Class Number 1112.
- C. Minimum Pressure Rating: 175 psig.
- D. Body Material: Bronze.
- E. Seat: EPDM.
- F. Stem: Bronze or stainless steel.
- G. Disc: Bronze with EPDM coating.
- H. Actuator: Worm gear or traveling nut.
- I. Supervisory Switch: Internal or external.

- J. End Connections for Valves 1 NPS through 2 NPS: Threaded ends or Grooved where available.
- K. End Connections for Valves 2-1/2 NPS: Grooved ends.

2.4 IRON BUTTERFLY VALVES WITH INDICATORS

- A. Manufacturers:
 - 1. Victaulic Co. of America.
 - 2. Nibco
 - 3. Tyco
- B. UL 1091 and FM (AG) standard listing for indicating valves (butterfly or ball type), Class Number 112.
- C. Minimum Pressure Rating: 175 psig.
- D. Body Material: Cast or ductile iron with nylon, EPDM, epoxy, polyamide, or approved coating.
- E. Seat: EPDM.
- F. Stem: Stainless steel.
- G. Disc: Ductile iron, nickel plated.
- H. Actuator: Worm gear or traveling nut.
- I. Supervisory Switch: Internal or external.
- J. Body Design: Grooved-end connections.

2.5 CHECK VALVES

- A. Manufacturers:
 - 1. Victaulic Co. of America.
 - 2. Nibco
 - 3. Tyco
- B. UL 312 and FM (AG) standard listing for check valves, Class Number 1045.
- C. Minimum Pressure Rating: 175 psig.
- D. Type: Center guided check valve.
- E. Body Material: Cast iron, ductile iron.
- F. Center guided check with elastomeric seal.
- G. Hinge Spring: Stainless steel.
- H. End Connections: Flanged, grooved, or threaded.

2.6 BRONZE OS&Y GATE VALVES

- A. Manufacturers:
 - 1. Victaulic Co. of America.
 - 2. Tyco.
 - 3. Nibco
- B. UL 262 and FM (AG) standard listing for fire-service water control valves (OS&Y and NRS-type gate valves).
- C. Minimum Pressure Rating: 175 psig.
- D. Body and Bonnet Material: Bronze or brass.
- E. Wedge: One-piece bronze or brass.
- F. Wedge Seat: Bronze.
- G. Stem: Bronze or brass.
- H. Packing: Non-asbestos PTFE.
- I. Supervisory Switch: External.
- J. End Connections: Threaded.

2.7 IRON OS&Y GATE VALVES

- A. Manufacturers:
 - 1. Victaulic Co. of America.
 - 2. Nibco
 - 3. Tyco
- B. Listed and Body Marked: AWWA C509, FM (AG), and UL 262.
- C. Maximum Working Pressure: 175 psi.
- D. Body and Bonnet Material: Cast or ductile iron.
- E. Wedge: Cast or ductile iron, or bronze with elastomeric coating.
- F. Stem: Brass, bronze, or stainless steel.
- G. Packing: Non-asbestos PTFE.
- H. Supervisory Switch: External.

2.8 NRS GATE VALVES

- A. Manufacturers:
 - 1. Victaulic Co. of America.
 - 2. Tyco.

3. Nibco
- B. UL 262 and FM (AG) standard listing for fire-service water control valves (OS&Y and NRS-type gate valves).
- C. Minimum Pressure Rating: 175 psig.
- D. Body and Bonnet Material: Cast or ductile iron.
- E. Wedge: Cast or ductile iron with elastomeric coating.
- F. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
- G. Stem: Brass or bronze.
- H. Packing: Non-asbestos PTFE.
- I. Supervisory Switch: External.
- J. End Connections: Flanged.

2.9 INDICATOR POSTS

- A. Manufacturers:
 1. Victaulic Co. of America.
 2. Tyco.
 3. Nibco
 4. Viking
- B. UL 789 and FM (AG) standard listing for indicator posts.
- C. Type: Underground.
- D. Base Barrel Material: Cast or ductile iron.
- E. Extension Barrel for Adjustable Length Indicator Posts: Cast or ductile iron.
- F. Cap: Cast or ductile iron.
- G. Operation: Wrench.

2.10 TRIM AND DRAIN VALVES

- A. Ball Valves:
 1. Manufacturers:
 - a. Victaulic Co. of America.
 - b. Tyco.
 - c. Viking.
 - d. Nibco

2. Description:

- a. Pressure Rating: 175 psig.
- b. Body Design: Two piece.
- c. Body Material: Forged brass or bronze.
- d. Port Size: Full or standard.
- e. Seat: PTFE.
- f. Stem: Bronze or stainless steel.
- g. Ball: Chrome-plated brass.
- h. Actuator: Hand-lever.
- i. End Connections for Valves 1 NPS through 2-1/2 NPS: Threaded ends or Grooved where available.
- j. End Connections for Valves 1-1/4 NPS and 2-1/2 NPS: Grooved ends.

B. Angle Valves:

1. Manufacturers:

- a. Victaulic Co. of America.
- b. Tyco.
- c. Viking.
- d. Nibco

2. Description:

- a. Pressure Rating: 175 psig.
- b. Body Material: Brass or bronze.
- c. Ends: Threaded.
- d. Stem: Bronze.
- e. Disc: Bronze.
- f. Packing: Asbestos free.
- g. Handwheel: Malleable iron, bronze, or aluminum.

C. Globe Valves:

1. Manufacturers:

- a. Victaulic Co. of America.

- b. Tyco.
 - c. Viking.
 - d. Nibco
2. Description:
- a. Pressure Rating: 175 psig.
 - b. Body Material: Bronze with integral seat and screw-in bonnet.
 - c. Ends: Threaded.
 - d. Stem: Bronze.
 - e. Disc Holder and Nut: Bronze.
 - f. Disc Seat: Nitrile.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Confirm valve interior to be free of foreign matter and corrosion.
- B. Remove packing materials.
- C. Examine guides and seats by operating valves from the fully open position to the fully closed position.
- D. Examine valve threads and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage.
 - 1. Check bolting for proper size, length, and material.
 - 2. Verify gasket for size, defects, damage, and suitable material composition for service.
 - 3. Replace all defective valves with new valves.

3.2 INSTALLATION

- A. Comply with specific valve installation requirements and application in the following Sections:
 - 1. Section 21 12 00 for application of valves in fire-suppression standpipes.
 - 2. Section 21 13 00 for application of valves in wet and dry pipe, fire-suppression sprinkler systems.
 - 3. Section 21 13 39 for application of valves in foam-water, fire-suppression sprinkler systems.
- B. Install listed fire protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections.

SECTION 21 05 23 - GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

1. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in water supply connections and backflow preventer at potable water supply connections.
- D. Valves with threaded connections to have unions at equipment arranged for easy access, service, maintenance, and equipment removal without system shutdown.
- E. Valves in horizontal piping installed with stem at or above the pipe center.
- F. Position valves to allow full stem movement.
- G. Install valve tags. Comply with Section 21 05 53 requirements for valve tags, schedules, and signs on surfaces concealing valves; and the appropriate NFPA standard applying to the piping system in which valves are installed.

END OF SECTION 21 05 23

SECTION 21 05 53
IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Pipe markers.
- D. Ceiling tacks.

1.2 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

1.3 SUBMITTALS

- A. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- B. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Product Data: Provide manufacturers catalog literature for each product required.
- D. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.1 IDENTIFICATION APPLICATIONS

- A. Automatic Controls: Tags.
- B. Control Panels: Nameplates.
- C. Instrumentation: Tags.
- D. Major Control Components: Nameplates.
- E. Piping: Pipe markers.
- F. Pumps: Nameplates.
- G. Relays: Tags.
- H. Small-sized Equipment: Tags.
- I. Thermostats: Nameplates.
- J. Valves: Nameplates and ceiling tacks where above lay-in ceilings. Note: Identification Signs shall be provided at each valve to indicate its function and what it controls. (NFPA 13:8.16.1.1.8)

2.2 NAMEPLATES

- A. Manufacturers:
 - 1. Brimar Industries, Inc
 - 2. Kolbi Pipe Marker Company
 - 3. Seton Identification Products, a Tricor Direct Company
- B. Description: Laminated three-layer plastic with engraved letters.
 - 1. Letter Color: White.
 - 2. Letter Height: 1/4 inch.
 - 3. Background Color: Black.
 - 4. Thickness: 1/8 inch.
 - 5. Plastic: Comply with ASTM D709.

2.3 TAGS

- A. Manufacturers:
 - 1. Advanced Graphic Engraving, LLC
 - 2. Brady Corporation
 - 3. Brimar Industries, Inc
 - 4. Kolbi Pipe Marker Company
 - 5. Seton Identification Products, a Tricor Direct Company
- B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.
- C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.
- D. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.4 PIPE MARKERS

- A. Manufacturers:
 - 1. Brady Corporation
 - 2. Brimar Industries, Inc
 - 3. Kolbi Pipe Marker Company
 - 4. Seton Identification Products, a Tricor Company
- B. Color: Comply with ASME A13.1.

- C. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- D. Underground Plastic Pipe Markers: Bright-colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil, 0.004 inch thick, manufactured for direct burial service.
- E. Color code as follows:
 - 1. Fire Quenching Fluids: Red with white letters.

2.5 CEILING TACKS

- A. Manufacturers:
 - 1. Craftmark Pipe Markers
 - 2. Seton Identification Products, a Tricor Company;.
 - 3. Kolbi Pipe Marker Company;.
- B. Description: Steel with 3/4 inch diameter color coded head.
- C. Color code as follows:
 - 1. Sprinkler Valves: Red.

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 91 23 for stencil painting.

3.2 INSTALLATION

- A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Apply stencil painting in accordance with Section 09 91 23.
- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- F. Use tags on piping 3/4 inch diameter and smaller.
 - 1. Identify service, flow direction, and pressure.
 - 2. Install in clear view and align with axis of piping.
 - 3. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

SECTION 21 05 53 - IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

- G. Locate ceiling tacks to locate valves above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION 21 05 53

**SECTION 21 05 70
FIRE PROTECTION COORDINATION DRAWINGS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The Fire Protection Contractor shall be responsible for providing ¼ scale coordination drawings for the entire project, format shall be as stated below.
- B. The drawings shall cover above ceiling space, mechanical rooms, electrical rooms and service yards.

PART 2 EXECUTION

2.1 COORDINATION (REVIT)

- A. The Fire Protection Contractor shall obtain the architectural, structural, and MEP REVIT models from the Architect. The models will be in REVIT 2018.
- B. The Fire Protection Contractor shall produce drawings that indicate all piping, including underground piping, and equipment on ¼ scale drawings. All items shall be drawn to scale, dimensioned and be easily identified. The drawings shall indicate a bottom of pipe.
- C. The Fire Protection Contractor shall provide the Mechanical Contractor a file compatible with Navisworks that indicates all piping and plumbing equipment.
- D. The overall coordination drawings shall be completed prior to any plumbing, mechanical and electrical work beginning. Start of work, including underground work, without completed Coordination Drawings is at the Contractor's risk.

END OF SECTION 21 05 70 21 05 70

**SECTION 21 07 19
FIRE SUPPRESSION PIPING INSULATION**

PART 2 PRODUCTS

1.1 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

END OF SECTION 21 07 19

**SECTION 21 13 00
FIRE-SUPPRESSION SPRINKLER SYSTEMS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wet-pipe sprinkler system.
- B. System design, installation, and certification.
- C. Fire department connections.

1.2 REFERENCE STANDARDS

- A. FM (AG) - FM Approval Guide; Current Edition.
- B. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2018, with Editorial Revision (2020).
- C. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry; 2018, with Editorial Revision (2020).
- D. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2017, with Editorial Revision (2020).
- E. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2023.
- F. ITS (DIR) - Directory of Listed Products; Current Edition.
- G. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. NFPA 13R - Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies; 2022, with Errata.
- I. NFPA 1963 - Standard for Fire Hose Connections; 2019.
- J. UL (DIR) - Online Certifications Directory; Current Edition.
- K. UL 405 - Standard for Safety Fire Department Connection Devices; Current Edition, Including All Revisions.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene minimum one week before starting work of this section.

1.4 SUBMITTALS

- A. Fire Protection Contractor shall acquire or perform their own Flow Test meeting the requirements of NFPA 291 and submit for review with the Submittals required by this section.
- B. Product Data: Provide data on sprinklers, valves, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

- C. Provide Hydraulic Calculations, including safety factors where applicable, and per NFPA 13, supporting fire protection sprinkler system design illustrated in Shop Drawings
- D. Shop Drawings:
 - 1. Submit preliminary layout of finished ceiling areas indicating only sprinkler locations coordinated with ceiling installation.
 - 2. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, sprinklers, components, and accessories. Indicate system controls.
 - 3. Submit shop drawings to Authorities Having Jurisdiction for approval. Submit proof of approval to Architect. Note: Confirm process with Owner Rep and Architect prior to submittal to AHJ.
- E. Manufacturer's Certificate: Certify that system has been tested and meets or exceeds specified requirements and code requirements.
- F. Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Sprinklers: Type and size matching those installed in quantity required by referenced NFPA design and installation standard.
 - 2. Sprinkler Wrenches: For each sprinkler type.
- H. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.

1.5 QUALITY ASSURANCE

- A. Maintain one copy of referenced design and installation standard on site.
- B. Comply with FM (AG) requirements.
- C. Designer Qualifications: Design system under direct supervision of a minimum Nicet Level III Wet Sprinkler System designer experienced in design of this type of work and licensed in the State in which the Project is located.
- D. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- E. Installer Qualifications: Company specializing in performing the work of this section with minimum five years experience and approved by manufacturer.
- F. Equipment and Components: Provide products that bear FM (AG) label or marking.
- G. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Sprinklers, Valves, and Equipment:
 - 1. Tyco Fire Protection Products
 - 2. Viking Corporation
 - 3. Globe.
 - 4. Reliable

2.2 SPRINKLER SYSTEM

- A. Sprinkler System: Provide coverage for entire building.
- B. Occupancy: Light hazard; comply with NFPA 13.
- C. Water Supply: Determine volume and pressure from water flow test data.
 - 1. Revise design when updated and/or current test data is available prior to submittals.
- D. Provide fire department connections where indicated.
- E. Storage Cabinet for Spare Sprinklers and Tools: Steel, located adjacent to alarm valve.
- F. Pipe Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
 - 1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
 - 2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
 - 3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
 - 4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
 - 5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.

2.3 SPRINKLERS

- A. Suspended Ceiling Type: Concealed pendant type with matching push on cover plate.
 - 1. Response Type: by FP Subcontractor responsible for calculations..
 - 2. Coverage Type: by FP Subcontractor responsible for calculations..
 - 3. Finish: Chrome plated.
 - 4. Cover Plate Finish: Enamel, color white.
 - 5. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- B. Exposed Area Type: Pendent and/or Upright Heads type with guard.
 - 1. Response Type: by FP Subcontractor responsible for calculations..

2. Coverage Type: by FP Subcontractor responsible for calculations..
 3. Finish: Brass.
 4. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- C. Sidewall Type: Semi-recessed horizontal sidewall type with matching push on escutcheon plate.
1. Response Type: by FP Subcontractor responsible for calculations..
 2. Coverage Type: by FP Subcontractor responsible for calculations..
 3. Finish: Chrome plated.
 4. Escutcheon Plate Finish: Chrome plated.
 5. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- D. Dry Sprinklers: Plain barrel pendant type with matching push on escutcheon plate.
1. Response Type: by FP Subcontractor responsible for calculations..
 2. Coverage Type: by FP Subcontractor responsible for calculations..
 3. Finish: Chrome plated.
 4. Cover Plate Finish: Enamel, color white .
 5. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- E. Storage Sprinklers: Pendant type with guard.
1. Response Type: by FP Subcontractor responsible for calculations..
 2. Coverage Type: by FP Subcontractor responsible for calculations..
 3. Finish: Chrome plated.
 4. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- F. Guards: Finish to match sprinkler finish.
- G. Flexible Drop System: Stainless steel, multiple use, open gate type.
1. Application: Use to properly locate sprinkler heads.
 2. Include all supports and bracing.
 3. Provide braided type tube as required for the application.
 4. Manufacturers:
 - a. FlexHead Industries, a brand of Anvil International
 - b. Victaulic Company; Vic-Flex: www.victaulic.com/#sle.

2.4 PIPING SPECIALTIES

- A. Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber-faced clapper to automatically actuate water motor alarm, pressure retard chamber and variable pressure trim with the following additional capabilities and features:
1. Activate electric alarm.
 2. Test and drain valve.
 3. Replaceable internal components without removing valve from installed position.
- B. Test Connections:
1. Inspector's Test Connection:
 - a. Provide test connections approximately 6 ft above floor for each or portion of each sprinkler system equipped with an alarm device, located at the most remote part of each system.
 - b. Route test connection to an open-site drain location, excluding janitor sinks, accepting full flow without negative consequences.
 - c. Supply discharge orifice with same size as corresponding sprinkler orifice.
 2. Backflow Preventer Test Connection:
 - a. Provide downstream of the backflow prevention assembly, listed hose valves with 2.5 inch National Standard male hose threads with cap and chain.
 - b. Furnish one valve for each 250 gpm of system demand or fraction thereof.
 - c. Provide permanent sign reading "Test Valve" in accordance with Section 21 05 53.
- C. Electric Alarm: Electrically operated chrome plated gong with pressure alarm switch.
- D. Water Flow Switch: Vane type switch for mounting horizontal or vertical, with two contacts; rated 10 amp at 125 volt AC and 2.5 amp at 24 volt DC.
- E. Fire Department Connections:
1. Type: Free standing made of corrosion resistant metal complying with UL 405.
 - a. Inlets: Two way, 2-1/2 inch swivel fittings, internal threaded. Thread size and inlets according to NFPA 1963 or Authority Having Jurisdiction. Brass caps with gaskets, chains, and lugs.
 - b. Outlet: Bottom with pipe threads, 4 NPS.
 - c. Rated Working Pressure: 175 psi.
 - d. Finish: Chrome.
 - e. Sleeve: Brass, 18 inches height.
 - f. Signage: Raised or engraved lettering 1 inch minimum indicating system type.
 - g. Manufacturers:
 - 1) Elkhart Brass Manufacturing Company, Inc

2) Fire End & Croker Corporation

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with referenced NFPA design and installation standard.
- B. Install equipment in accordance with manufacturer's instructions.
- C. Locate fire department connection per Civil Drawings with sufficient clearance from walls, obstructions, or adjacent siamese connectors to allow full swing of fire department wrench handle.
- D. Locate outside alarm gong on building wall as indicated.
- E. Place pipe runs to minimize obstruction to other work.
- F. Place piping in concealed spaces above finished ceilings.
- G. Center sprinklers in two directions in ceiling tile and provide piping offsets as required.
- H. Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.
- I. Flush entire piping system of foreign matter.
- J. Install guards on sprinklers where indicated.
- K. Hydrostatically test entire system.
- L. Require test be witnessed by Fire Marshal.

3.2 INTERFACE WITH OTHER PRODUCTS

- A. Ensure required devices are installed and connected as required to fire alarm system.

END OF SECTION 21 13 00

**DIVISION 22
PLUMBING**

**SECTION 22 01 00
PLUMBING GENERAL PROVISIONS**

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. The Contractor shall provide all materials, equipment and labor necessary to install and set into operation a complete plumbing system as shown on the engineering drawings and as specified herein.

1.2 QUALITY ASSURANCE

- A. See the General and Supplementary General Conditions.
- B. All work shall be in accordance with State Code and Underwriter's Regulations. Minimum requirements shall be the State Plumbing Code.
- C. Wherever the words "Approved", "Approval", or "Approved Equal" appear, it is intended that items other than the model numbers specified shall be subject to the approval of the Engineer.
- D. "Provide" as used herein shall mean that the Contractor responsible shall furnish and install said item or equipment. "Furnish" as used herein shall mean that the Contractor responsible shall acquire and make available said item or equipment and that installation shall be by others. "Install" as used herein shall mean that the Contractor responsible shall make installation of items or equipment furnished by others.
- E. Boiler Inspection Certificate (If applicable): It shall be the responsibility of the Contractor to complete the installation of fired or unfired pressure vessels and their safety devices in accordance with the requirements of the latest edition of the North Carolina Department of Labor, "Boiler Inspection Law, Rules and Regulations". The Contractor shall be responsible for notifying the Bureau of Boiler Inspection in writing at least two weeks prior to the date of completion of all equipment requiring inspection. Certificates furnished by the Bureau of Boiler Inspection shall be in a frame having a removable glass cover and posted near the pressure vessel. Certificates shall be installed before requesting final inspection of the completed project. The pressure vessel is NOT to be operated before it is inspected and approved.

1.3 SUBMITTALS

- A. See General and Supplementary General Conditions.
- B. Within ten days after notification of the award of the Contract and written notice to begin work, the Contractor shall submit to the Architect/Engineer for approval a detailed list of equipment and material that he proposes to use. Items requiring submittal data for approval will be noted at this time.
- C. The Contractor shall provide an electronic pdf copy of the submittal data on the products, methods, etc. proposed for use on the project. The submittal shall contain complete submittal data on all products, methods, etc. proposed for use on the project.
- D. Each submittal shall bear the approval of the Contractor indicating that he has reviewed the data and found it to meet the requirements of the specifications as well as space limitations and other project conditions. The submittals shall be clearly identified showing project name, manufacturer's catalog numbers, and all necessary performance and fabrication data.
- E. The Contractor shall submit to the Engineer a set of accurately marked-up plans indicating all changes encountered during the construction. Final payment will be contingent upon receipt of these as-built plans.

- F. The Contractor shall furnish an electronic copy of maintenance and operating instructions as outlined in Paragraph C, Execution, Item #7, of this specification section.
- G. The Contractor shall submit to the Owner all certificates required for operating the system in compliance with the plans and specifications.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. All material and equipment shall be delivered and unloaded by the Contractor within the project site as noted herein or as directed by the Owner.
- B. The Contractor shall protect all material and equipment from breakage, theft, or weather damage. No material or equipment shall be stored on the ground.
- C. The material and equipment shall remain the property of the Contractor until the project has been completed and turned over to the Owner.

1.5 WORK CONDITIONS AND COORDINATION

- A. The Contractor shall review the electrical plans to establish points of connection and the extent of electrical work to be provided in his Contract. All electrical work shall be performed by a licensed electrician.
- B. This Contractor shall be responsible for the final electrical connections to all equipment installed as part of his Contract.
- C. Electrical work shall be in accordance with State codes, and as specified in Division 26 contained herein.
- D. Pipe, conduit and duct chases required for installation of work shall be provided by the General Contractor unless otherwise noted. This Contractor shall be responsible for coordinating the location of all required chases.
- E. All work shall be coordinated with other trades. Cutting of new work and subsequent patching shall be at the Contractor's expense at no extra cost to the Owner.

1.6 GUARANTEE

- A. See the General and Supplementary General Conditions.
- B. Where extended warranties or guarantees are available from the manufacturer, the Contractor shall prepare the necessary Contract Documents to validate these warranties as required by the manufacturer and present them to the Architect/Engineer.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Materials and equipment shall be new, unless noted otherwise, of the highest grade and quality and free from defects or other imperfections. Material and equipment found defective shall be removed and replaced at the Contractor's expense.
- B. The Contractor shall provide nameplates for identification of all equipment, switches, panels, etc. The nameplates shall be laminated phenolic plastic, black front and back with white core, white engraved letters (1/4" minimum) etched into the white core. Nameplates shall be fastened with pan head tapping screws.

PART 3 EXECUTION

3.1 INSPECTION

- A. This Contractor shall examine the areas of completed work and shall insure that no defects or errors are present which would result in the poor application or installation of subsequent work.

3.2 INSTALLATION

- A. All work shall be performed in a manner indicating proficiency in the trade.
- B. All conduit, pipes, ducts, etc. shall be either parallel to building walls or plumb where installed in a vertical position and shall be concealed when located in architecturally finished areas.
- C. Any cutting or patching required for installation of this Contractor's work shall be kept to a minimum. Written approval shall be required by the Architect/Engineer if cutting of primary structure is involved.
- D. All patching shall be done in such a manner as to restore the areas or surfaces to match existing finishes.
- E. The Contractor shall lay out and install his work in advance of pouring concrete floors or walls. He shall furnish all sleeves to the General Contractor for openings through poured masonry floors or walls, above grade, required for passage of all conduits, pipes, or ducts required to support his equipment.
- F. All fixtures shall be accurately roughed in according to the manufacturer's installation dimensions so that no offset adapters, flexible connections or other improvisations are necessary. All incorrect work shall be torn out and corrected and walls and floors patched.
- G. Horizontal drainage and waste pipe shall have a minimum slope or fall of 1/8 inch per foot. All change of horizontal directions in soil waste pipe shall be made with long radius fittings with "Y" branches and 1/8 or 1/16 bends.
- H. All fixtures, floor drains, flush valves and traps shall be set plumb and level.
- I. Connections to cold water, soil and waste lines shall be made at locations shown on the Drawings.
- J. All material and equipment shall be installed following the manufacturer's installation directions.
- K. Spray-on Fireproofing overspray shall be removed from all materials provided as part of the plumbing contract.

3.3 PERFORMANCE

- A. The Contractor shall perform all excavation and backfill operations necessary for installation of his work.
- B. Rock excavation shall be defined in the Supplementary General Conditions, Division 1 or Division 2. A unit price for each rock excavation shall be required in the bid. Plumbing Contractor shall provide the unit price per cubic yard for rock excavation. Construction Manager will establish an allowance for trench rock.

3.4 ERECTION

- A. All support steel, angles, channels, pipes or structural steel stands and anchoring devices that may be required to rigidly support or anchor material and equipment shall be provided by this Contractor.

3.5 FIELD QUALITY CONTROL

- A. The Contractor shall conform to the requirements of Division 03 for concrete testing.
- B. All testing required for compliance with the contract shall be as stated in subsequent sections.

3.6 ADJUST AND CLEAN

- A. All equipment and installed materials shall be thoroughly clean and free of all dirt, oil, grit, grease, etc.
- B. Factory painted equipment shall not be repainted unless damaged areas exist. These areas shall be touched up with a material suitable for intended service. In no event shall nameplates be painted.
- C. At a scheduled meeting, the Contractor shall instruct the Owner or the Owner's representative in the operation and maintenance of all equipment installed under his Contract.

3.7 MAINTENANCE AND OPERATING MANUAL

- A. The Contractor shall prepare an electronic submission of a manual describing the proper maintenance and system operation. This manual shall not consist of standard factory printed data intended for dimension or design purposes (although these may be included), but shall be prepared to describe this particular job. This manual shall include the following:
 - 1. Data on all equipment as listed on the fixture and equipment schedules on the plans, including but not limited to model numbers, input and output capacities, and selected options for each piece of equipment.
 - 2. Manufacturer's operation and maintenance manuals for each piece of equipment furnished as part of this project, and including but not limited to a check list for periodic maintenance of all equipment.
 - 3. A check list for seasonal shutdown.
 - 4. Maintenance and spare parts data for all equipment.
 - 5. As-Built wiring and control diagrams for equipment containing these.
 - 6. Name and address and phone number of at least one service agency for each piece of equipment.
 - 7. A complete narrative of how each system is intended to operate.
 - 8. Name and address of designer of record, contractors, subcontractors, and equipment suppliers.
- B. The manuals shall be dated and signed by the Contractor when completed.
- C. The operating and maintenance manuals shall be submitted to the Engineer for approval. When the manuals are considered complete by the Engineer, they will be turned over to the Owner for their permanent use.

END OF SECTION 22 01 00 22 01 00

SECTION 22 05 17
SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe sleeves.
- B. Pipe sleeve-seals.

1.2 REFERENCE STANDARDS

- A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2022a.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.
- B. Product data: Pipe Sleeve-Seals

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum seven years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified this section.
 - 1. Minimum three years experience.
 - 2. Approved by manufacturer.
- C. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.
- B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

1.6 WARRANTY

- A. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.1 PIPE SLEEVES

- A. Manufacturers:
 - 1. Flexicraft Industries

2. GPT Industries - LinkSeal
 3. Metraflex
 4. EJ Prescott
- B. Vertical Piping:
1. Schedule 40 steel sleeve
 2. Sleeve Length: 2 inches above finished floor.
 3. Provide silicone sealant for watertight joint when not a rated penetration.
 4. Blocked Out Floor Openings: Provide 1-1/2 inch angle set in silicon adhesive around opening.
 5. Drilled Penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.
- C. Pipe passing through interior walls and/or non-rated partitions
1. Schedule 40 steel sleeve. Pack opening with mineral wool.
- D. Pipe Passing Through Below Grade Exterior Walls:
1. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.
- E. Pipe Passing Through Mechanical, Laundry, and Animal Room Floors above Basement:
1. Galvanized steel pipe or black iron pipe with asphalt coating.
 2. Connect sleeve with floor plate except in mechanical rooms.
- F. Clearances:
1. Provide allowance for insulated piping.
 2. Wall, Floor, Floor, Partitions, and Beam Flanges: 1 inch greater than external pipe diameter, including insulation.
 3. All Rated Openings: Caulked tight with fire stopping material complying with ASTM E814 in accordance with Section 07 84 00 to prevent the spread of fire, smoke, and gases.

2.2 PIPE-SLEEVE SEALS

- A. Manufacturers:
1. Flexicraft Industries; PipeSeal: www.flexicraft.com/#sle.
 2. GPT Industries - LinkSeal.
 3. Metraflex.
- B. Modular Mechanical Seal:
1. Synthetic rubber interlocking links continuously fill annular space between pipe and wall/casing opening.

2. Provide watertight seal between pipe and wall/casing opening.
 3. Elastomer element size and material in accordance with manufacturer's recommendations.
 4. Glass reinforced plastic pressure end plates.
- C. Sealing Compounds:
1. Provide packing and sealing compound to fill pipe to sleeve thickness.
 2. Combined packing and sealing compounding to match partition fire-resistance hourly rating.

PART 3 EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and foreign material, from inside and outside, before assembly.

3.2 INSTALLATION

- A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- B. Install piping to conserve building space, to not interfere with use of space and other work.
- C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Pipe Sleeves shall be sized with clearances around pipe based on Code Required Dimensions.
- D. Structural Considerations: Do not penetrate building structural members unless indicated.
- E. Provide sleeves when penetrating all footings, floors, and walls. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
- F. Manufactured Sleeve-Seal Systems:
 1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
 2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
 3. Locate piping in center of sleeve or penetration.
 4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
 5. Tighten bolting for a water-tight seal.
 6. Install in accordance with manufacturer's recommendations.
- G. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.3 CLEANING

SECTION 22 05 17 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

- A. Upon completion of work, clean all parts of the installation.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION 22 05 17

**SECTION 22 05 19
METERS AND GAUGES FOR PLUMBING PIPING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Positive displacement meters.
- B. Flow meters.
- C. Pressure gauges and pressure gauge taps.
- D. Thermometers and thermometer wells.
- E. Static pressure gauges.
- F. Filter gauges.

1.2 REFERENCE STANDARDS

- A. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2013.
- B. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014 (Reapproved 2020).
- C. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014 (Reapproved 2021).
- D. AWWA C700 - Cold-Water Meters -- Displacement Type, Metal Alloy Main Case; 2020.
- E. AWWA C701 - Cold-Water Meters -- Turbine Type, for Customer Service; 2019.
- F. AWWA C702 - Cold-Water Meters -- Compound Type; 2019.
- G. AWWA M6 - Water Meters -- Selection, Installation, Testing, and Maintenance; 2012, with Addendum (2018).
- H. UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service; Current Edition, Including All Revisions.

1.3 SUBMITTALS

- A. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.
- B. Project Record Documents: Record actual locations of components and instrumentation.
- C. Operation and Maintenance Data: For Closeout.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Pressure Gauges: One of each type and size.

1.4 FIELD CONDITIONS

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.1 POSITIVE DISPLACEMENT METERS (LIQUID)

2.2 LIQUID FLOW METERS

A. Manufacturers:

1. E-Mon
2. Onicon Model F-1230
3. SeaMetrics

B. Water Flow Meter shall be Dual Turbine Flow Meter with local mounted display module with digital display, complete with installation of all hardware necessary to enable insertion and removal of the meter without system shutdown.

1. The flow meter shall be hand-insertable without system shutdown.
2. The flow meter shall have dual turbines with jewel bearing systems, electronic impedance-based sensing and an averaging circuit to reduce measurement errors due to swirl and flow profile distortion.
3. Wetted metal components shall be nickel-plated brass.
4. The standard model maximum operating temperature shall be 180°F, 200°F peak, with ambient temperature range of -5°F to 160°F.
5. Maximum operating pressure shall be 400 psi.
6. Pressure drop shall be less than 1 psi at 20 ft/s in 2-1/2" pipe, decreasing in larger pipes and lower velocities.
7. Each flow meter shall be individually wet-calibrated against a primary volumetric standard traceable to NIST. The manufacturer's certificate of calibration shall be provided with each flow meter.
8. Accuracy shall be within $\pm 0.5\%$ of rate at the calibrated velocity, within $\pm 1\%$ of rate over a 10:1 turndown (3.0 to 30 ft/s) and within $\pm 2\%$ of rate over a 50:1 turndown (from 0.4 to 20ft/s).
9. Electrical requirement 120/24, provide with control transformer.
10. The flow meter shall include integral digital output, isolated solid state dry contact, 100mA, 50V divided output.
11. The flow meter shall be covered by the manufacturer's two year warranty.
12. Provide standard electrical connection, 10' of 5-wire cable with 3/4-in. NPT conduit connection.

C. Display Module shall be digital, converting the results of the insertion flow meter to display flow rate and total volume.

1. Housing shall be 6" x 6" x 4" NEMA 4 steel enclosure, wall mount.
2. Electrical requirement shall be 120/1/60.
 - a. Output voltage (nominal): +24 VDC at 200mA.

3. Indicators include multi-functioning LCD(s) with two buttons for mode selection, total reset, and programming, providing 6-digit rate and 8-digit totalization. (Total reset switch can be disabled via programming.)
4. Programming is set at factory for particular flow meter and pipe size. Field programming is possible.
5. Non volatile EEPROM memory retains all programming parameters in the event of power loss.
6. Input is 0-15V pulse output from insertion flow meter.

2.3 PRESSURE GAUGES

A. Manufacturers:

1. Dwyer Instruments, Inc: www.dwyer-inst.com.
2. Moeller Instrument Co., Inc: www.moellerinstrument.com.
3. Omega Engineering, Inc: www.omega.com.

B. Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.

1. Case: Steel with brass bourdon tube.
2. Size: 4-1/2 inch diameter.
3. Mid-Scale Accuracy: One percent.
4. Scale: Psi.

2.4 PRESSURE GAUGE TAPPINGS

- #### **A. Gauge Cock: Tee or lever handle, brass for maximum 150 psi.**

2.5 STEM TYPE THERMOMETERS

A. Manufacturers:

1. Dwyer Instruments, Inc: www.dwyer-inst.com.
2. Omega Engineering, Inc: www.omega.com.
3. Weksler Glass Thermometer Corp: www.wekslerglass.com.

B. Thermometers - Fixed Mounting: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish.

1. Size: 9 inch scale.
2. Window: Clear Lexan.
3. Accuracy: 2 percentper ASTM E77.
4. Calibration: Degrees F.

- C. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
 - 1. Size: 9 inch scale.
 - 2. Window: Clear Lexan.
 - 3. Accuracy: 2 percentper ASTM E77.
 - 4. Calibration: Degrees F.

2.6 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

2.7 TEST PLUGS

- A. Test Plug: 1/4 inch or 1/2 inch stainless steel fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with Nordel core for temperatures up to 350 degrees F.
- B. Test Kit: Carrying case, internally padded and fitted containing one 2-1/2 inch diameter pressure gauges, one gauge adapters with 1/8 inch probes, two 1 inch dial thermometers.

2.8 STATIC PRESSURE GAUGES

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. The Contractor shall set the flow metering system in service to operating conditions as a part of this contract.
- C. Store all components prior to installation in clean, dry place to protect them from construction dirt, water etc. Handle with care to avoid damaging finish or internal components.
- D. Provide one pressure gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gauge.
- E. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
- F. Coil and conceal excess capillary on remote element instruments.
- G. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- H. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- I. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- J. Locate test plugs adjacent thermometers and thermometer sockets.

END OF SECTION 22 05 19

**SECTION 22 05 23
GENERAL-DUTY VALVES FOR PLUMBING PIPING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Applications
- B. General requirements
- C. Angle valves
- D. Ball valves
- E. Butterfly valves
- F. Check valves
- G. Globe valves
- H. Plug valves

1.2 ABBREVIATIONS AND ACRONYMS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Non-rising stem.
- E. OS&Y: Outside screw and yoke.
- F. PTFE: Polytetrafluoroethylene.
- G. RS: Rising stem.
- H. SWP: Steam working pressure.
- I. TFE: Tetrafluoroethylene.
- J. WOG: Water, oil, and gas.

1.3 REFERENCE STANDARDS

- A. ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).
- B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
- C. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard; 2020.
- D. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves; 2022.
- E. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.

- F. ASME B16.34 - Valves — Flanged, Threaded, and Welding End; 2020.
- G. ASME B31.9 - Building Services Piping; 2020.
- H. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2021.
- I. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2022.
- J. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2023).
- K. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984, with Editorial Revision (2019).
- L. ASTM B61 - Standard Specification for Steam or Valve Bronze Castings; 2015 (Reapproved 2021).
- M. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.
- N. AWWA C606 - Grooved and Shouldered Joints; 2015.
- O. MSS SP-45 - Drain and Bypass Connections; 2020.
- P. MSS SP-67 - Butterfly Valves; 2022.
- Q. MSS SP-70 - Gray Iron Gate Valves, Flanged and Threaded Ends; 2011.
- R. MSS SP-71 - Gray Iron Swing Check Valves, Flanged and Threaded Ends; 2018.
- S. MSS SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service; 2010a.
- T. MSS SP-78 - Gray Iron Plug Valves, Flanged and Threaded Ends; 2011.
- U. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves; 2019.
- V. MSS SP-85 - Gray Iron Globe and Angle Valves, Flanged and Threaded Ends; 2011.
- W. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .
- X. NSF 61 - Drinking Water System Components - Health Effects; 2023.
- Y. NSF 372 - Drinking Water System Components - Lead Content; 2022.

1.4 SUBMITTALS

- A. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- B. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- C. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.
- D. Maintenance Materials: Furnish Owner with one wrench for every five plug valves, in each size of square plug valve head.

1.5 QUALITY ASSURANCE

- A. Manufacturer:
 - 1. Obtain valves for each valve type from single manufacturer.
 - 2. Company must specialize in manufacturing products specified in this section, with not less than 10 years of documented experience.
- B. Welding Materials and Procedures: Comply with ASME BPVC-IX.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
 - 2. Protect valve parts exposed to piped medium against rust and corrosion.
 - 3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
 - 4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
 - 5. Secure check valves in either the closed position or open position.
 - 6. Adjust butterfly valves to closed or partially closed position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection and protect flanges and specialties from dirt.
 - a. Provide temporary inlet and outlet caps.
 - b. Maintain caps in place until installation.
 - 2. Store valves in shipping containers and maintain in place until installation.
 - a. Store valves indoors in dry environment.
 - b. Store valves off the ground in watertight enclosures when indoor storage is not an option.

1.7 EXERCISE THE FOLLOWING PRECAUTIONS FOR HANDLING:

- A. Handle large valves with sling, modified to avoid damage to exposed parts.
- B. Avoid the use of operating handles or stems as rigging or lifting points.

PART 2 PRODUCTS

2.1 APPLICATIONS

- A. See drawings for specific valve locations.
- B. NOTE - Gate Valves are not approved for use without specific prior approval from the engineer.
- C. Balancing Valves (circuit setters) shall be Thermostatic Balancing Valves with Service/Shutoff Ball Valves at either end, inline strainer, and T&P Ports on either side of valve such as Circuit Solver by ThermOmegaTech

Model CSUAS or approved equal.

- D. Provide the following valves for the applications if not indicated on drawings:
1. Shutoff: Ball valve required except may be Butterfly on 2-1/2" piping and larger
 2. Dead-End: Single-flange butterfly (lug) type.
 3. Throttling: Provide ball.
 4. Swing Check (Pump Outlet):
 - a. 2 NPS and Smaller: Bronze swing check valves with bronze disc.
 - b. 2-1/2 NPS and Larger for Domestic Water: Iron swing check valves with closure control or center-guided, metal or resilient seat check valves.
 - c. 2-1/2 NPS and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- E. Substitutions of valves with higher CWP classes or SWP ratings for same valve types are permitted when specified CWP ratings or SWP classes are not available.
- F. Required Valve End Connections for Non-Wafer Types:
1. Steel Pipe:
 - a. 2 NPS and Smaller: Threaded ends.
 - b. 2-1/2 NPS to 4 NPS: Grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - c. 5 NPS and Larger: Grooved or flanged ends.
 - d. Grooved-End Copper Tubing and Steel Piping: Grooved.
 2. Copper Tube:
 - a. 2 NPS and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - b. 2-1/2 NPS to 4 NPS: Grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - c. 5 NPS and Larger: Grooved or flanged ends.
- G. Low Pressure, Compressed Air Valves 150 psig or Less:
1. 2 NPS and Smaller:
 - a. Bronze and Brass: Provide with solder-joint, threaded, or press-fitting ends.
 - b. Ball: Two piece, full port, brass or bronze with stainless-steel trim.
 - c. Bronze Lift Check: Class 125, bronze disc.
 - d. Bronze Swing Check: Class 125, bronze disc.
-

- H. High Pressure, Compressed Air Valves 150 psig to 200 psig:
 - 1. 2 NPS and Smaller:
 - a. Bronze and Brass: Provide with solder-joint or threaded ends.
 - b. Ball: Two piece, full port, brass or bronze with stainless-steel trim.
 - c. Bronze Lift Check: Class 125, bronze disc.
 - d. Bronze Swing Check: Class 125, bronze disc.

- I. Domestic, Hot and Cold Water Valves:
 - 1. 2 NPS and Smaller:
 - a. Bronze and Brass: Provide with solder-joint, threaded, or press-fitting ends.
 - b. Bronze Angle: Class 125, bronze disc.
 - c. Ball: Two piece, full port, brass or bronze with stainless-steel trim.
 - d. Bronze Swing Check: Class 125, bronze disc.
 - e. Bronze Gate: Class 125, NRS.
 - f. Bronze Globe: Class 125, bronze disc.
 - 2. 2-1/2 NPS and Larger:
 - a. Iron, 2-1/2 NPS to 4 NPS: Provide with threaded or flanged ends.
 - b. Iron Ball: Class 150.
 - c. Iron Single-Flange Butterfly: 200 CWP, EPDM seat, aluminum-bronze disc.
 - d. Iron Grooved-End Butterfly: 175 CWP.
 - e. Iron Swing Check: Class 125, metal seats.
 - f. Iron Swing Check with Closure Control: Class 125, lever and spring.
 - g. Iron Grooved-End Swing Check: 300 CWP.
 - h. Iron Center-Guided Check: Class 125, compact-wafer, metal seat.
 - i. Iron Plate-Type Check: Class 125; single plate; metal seat.
 - j. Iron Globe: Class 125.

- J. Sanitary Waste, Storm Drainage, and Force-Main Piping Water Valves:
 - 1. 2 NPS and Smaller:
 - a. Bronze and Brass: Provide with solder-joint or threaded.
 - b. Bronze Angle: Class 125, bronze disc.

- c. Ball: One piece, full port, brass or bronze with stainless-steel trim.
 - d. Bronze Swing Check: Class 125, bronze disc.
 - e. Bronze Gate: Class 125, NRS.
 - f. Bronze Globe: Class 125, bronze disc.
2. 2-1/2 NPS and Larger:
- a. Iron, 2-1/2 NPS to 4 NPS: Provide with threaded or flanged ends.
 - b. Iron Ball: Class 150.
 - c. Iron Swing Check: Class 125, metal seats.
 - d. Iron Swing Check with Closure Control: Class 125, lever and spring.
 - e. Iron Grooved-End Swing Check: 300 CWP.
 - f. Iron Gate: Class 125, NRS.
 - g. Iron Globe: Class 125.
 - h. Lubricated Plug: Class 125, regular gland.

2.2 GENERAL REQUIREMENTS

- A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.
- B. Valve Sizes: Match upstream piping unless otherwise indicated.
- C. Valve Actuator Types:
 - 1. Gear Actuator: Quarter-turn valves 8 NPS and larger.
 - 2. Handwheel: Valves other than quarter-turn types.
 - 3. Hand Lever: Quarter-turn valves 6 NPS and smaller except plug valves.
 - 4. Wrench: Plug valves with square heads.
- D. Valves in Insulated Piping: With 2 NPS stem extensions and the following features:
 - 1. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 2. Butterfly Valves: Extended neck.
 - 3. Memory Stops: Fully adjustable after insulation is installed.
- E. Valve-End Connections:
 - 1. Threaded End Valves: ASME B1.20.1.
 - 2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.

3. Pipe Flanges and Flanged Fittings 1/2 NPS through 24 NPS: ASME B16.5.
 4. Solder Joint Connections: ASME B16.18.
 5. Grooved End Connections: AWWA C606.
- F. General ASME Compliance:
1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
 2. Solder-joint Connections: ASME B16.18.
 3. Building Services Piping Valves: ASME B31.9.
- G. Valve Materials for Potable Water: NSF 61 and NSF 372.
- H. Bronze Valves:
1. Fabricate from dezincification resistant material.
 2. Copper alloys containing more than 15 percent zinc are not permitted.
- I. Valve Bypass and Drain Connections: MSS SP-45.
- J. Source Limitations: Obtain each valve type from a single manufacturer.

2.3 BRONZE ANGLE VALVES

- A. Class 125: CWP Rating: 200 psig.:
1. Comply with MSS SP-80, Type 1.
 2. Body: Bronze; ASTM B62, with integral seat and screw in bonnet.
 3. Ends: Threaded
 4. Stem: Bronze
 5. Disc: Bronze
 6. Packing: Asbestos free
 7. Handwheel: Bronze or aluminum

2.4 BRASS BALL VALVES

- A. Two Piece, Full Port with Stainless Steel Trim:
1. Comply with MSS SP-110
 2. SWP Rating: 150 psig.
 3. CWP Rating: 600 psig.
 4. Body: Forged brass.
 5. Ends: Threaded or soldered

6. Seats: PTFE or TFE
7. Stem: Stainless Steel
8. Ball: Chrome-plated brass

2.5 BRONZE BALL VALVES

A. Two Piece, Full Port with Stainless Steel Trim:

1. Comply with MSS SP-110
2. SWP Rating: 150 psig.
3. CWP Rating: 600 psig.
4. Body: Bronze.
5. Ends: Threaded.
6. Seats: PTFE.
7. Stem: Stainless steel
8. Ball: Stainless steel, vented

2.6 STAINLESS STEEL BALL VALVES

A. Two Piece, Full Port with Stainless Steel Trim:

1. Comply with MSS SP-110
2. SWP Rating: 150 psig.
3. CWP Rating: 1000 psig.
4. Body: Stainless steel
5. Seats: PFTE
6. Stem: Stainless steel
7. Ball: Stainless steel

2.7 IRON BALL VALVES

A. Class 125, Full Port, Stainless Steel Trim:

1. Comply with MSS SP-72.
2. CWP Rating: 200 psig.
3. Body: ASTM A536 Grade 65-45-12, ductile iron.
4. Ends: Flanged
5. Seats: PTFE

6. Stem: Stainless steel
7. Ball: Stainless steel
8. Operator: Lever, with locking handle.

2.8 IRON, SINGLE FLANGE BUTTERFLY VALVES

- A. Lug type: Bi-directional dead-end service without use of downstream flange.
1. Comply with MSS SP-67, Type I.
 2. CWP Rating: 200 psig.
 3. Body: ASTM A126, cast iron or ASTM A536, ductile iron.
 4. Stem: One or two-piece stainless steel.
 5. Seat: EPDM
 6. Disc: Stainless steel

2.9 IRON, GROOVED-END BUTTERFLY VALVES

- A. CWP Rating: 175 psig (1200 kPa).
1. Comply with MSS SP-67, Type I.
 2. Body: Coated ductile iron
 3. Stem: Two-piece stainless steel
 4. Disc: Coated ductile iron
 5. Disc Seal: EPDM

2.10 BRONZE LIFT CHECK VALVES

- A. Class 125:
1. Comply with MSS SP-80, Type 1, Metal Disc to Metal Seat and Type 2, Nonmetallic Disc to Metal Seat.
 2. CWP Rating: 200 psig.
 3. Design: Vertical flow
 4. Body: Comply with ASTM B61 or ASTM B62, bronze
 5. Ends: Threaded as indicated
 6. Disc (Type 1): Bronze.

2.11 BRONZE SWING CHECK VALVES

- A. Class 125: CWP Rating: 200 psig (1380 kPa).
1. Comply with MSS SP-80, Type 3

2. Design: Horizontal flow
3. Body: Bronze, ASTM B62
4. Ends: Threaded as indicated
5. Disc: Bronze

2.12 IRON SWING CHECK VALVES

A. Class 125:

1. Comply with MSS SP-71, Type I.
2. CWP Rating: 200 psig.
3. Design: Clear or full waterway.
4. Body: ASTM A126, gray iron with bolted bonnet.
5. Ends: Flanged as indicated.
6. Trim: Composition.
7. Seat Ring and Disc Holder: Bronze.
8. Disc: PTFE or ____.
9. Gasket: Asbestos free.

B. Class 250:

1. Comply with MSS SP-71, Type I.
2. CWP Rating: 500 psig.
3. Design: Clear or full waterway.
4. Body: ASTM A126, gray iron with bolted bonnet.
5. Ends: Flanged as indicated
6. Trim: Bronze
7. Metal Seat
8. Gasket: Asbestos free

2.13 IRON GROOVED-END SWING CHECK VALVES

A. 300 CWP:

1. CWP Rating: 300 psig.
2. Body: ASTM A536, Grade 65-45-12 ductile iron.
3. Seal: EPDM

4. Disc: Stainless steel
5. Coating: Black, non-lead paint

2.14 IRON CENTER-GUIDED CHECK VALVES

- A. Class 125, Compact-Wafer:
 1. Comply with MSS SP-125.
 2. CWP Rating: 200 psig.
 3. Body: 316 stainless steel.
 4. Metal Seat: Stainless steel.
- B. Class 125, Globe:
 1. Comply with MSS SP-125.
 2. CWP Rating: 200 psig.
 3. Body: Stainless steel.
 4. Style: Spring loaded.
 5. Ends: Flanged.
 6. Metal Seat: Stainless steel.
- C. Class 150, Compact-Wafer:
 1. Comply with MSS SP-125.
 2. CW P Rating: 300 psig.
 3. Body: 316 Stainless steel.
 4. Metal Seat: Stainless steel.
- D. Class 150, Globe:
 1. Comply with MSS SP-125.
 2. CWP Rating: 300 psig.
 3. Body: Stainless steel.
 4. Style: Spring loaded.
 5. Ends: Flanged.
 6. Metal Seat: Stainless steel.

2.15 IRON PLATE TYPE CHECK VALVES

- A. Class 125 Single-Plate:
-

1. Comply with API STD 594.
 2. CWP Rating: 200 psig.
 3. Design: Wafer, spring-loaded plate.
 4. Body: ASTM A126, gray iron.
 5. Resilient Seat: EPDM.
- B. Class 125, Dual-Plate:
1. Comply with API STD 594.
 2. CWP Rating: 200 psig.
 3. Design: Wafer, spring-loaded plates.
 4. Body: ASTM A126, gray iron.
 5. Resilient Seat: EPDM.
- C. Class 150, Dual-Plate:
1. Comply with API STD 594.
 2. CWP Rating: 300 psig.
 3. Design: Wafer, spring-loaded plates.
 4. Body: ASTM A395/A395M or ASTM A536, ductile iron.
 5. Resilient Seat: EPDM.
- D. Class 250, Single-Plate:
1. Comply with API STD 594.
 2. CWP Rating: 400 psig.
 3. Design: Wafer, spring-loaded plate.
 4. Body: ASTM A126, gray iron.
 5. Resilient Seat: EPDM.

2.16 BRONZE GLOBE VALVES

- A. Class 125: CWP Rating: 200 psig: and Class 150: CWP Rating: 300 psig:.
1. Comply with MSS SP-80, Type 1.
 2. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
 3. Ends: Threaded or solder joint
 4. Stem: Bronze

5. Disc: Bronze
6. Packing: Asbestos free
7. Handwheel: Bronze or aluminum

2.17 IRON GLOBE VALVES

- A. Class 125: CWP Rating: 200 psig.:
 1. Comply with MSS SP-85, Type I.
 2. Body: Gray iron; ASTM A126, with bolted bonnet
 3. Ends: Flanged
 4. Trim: Bronze
 5. Packing and Gasket: Asbestos free
 6. Operator: Handwheel or chainwheel

2.18 STAINLESS STEEL GLOBE VALVES

- A. Class 150: CWP Rating: 300 psig.:
 1. Comply with ASME B16.34 for pressure-temperature range.
 2. Body: 316L stainless steel, with bolted bonnet.
 3. Ends: Flanged.
 4. Trim: Stainless steel.
 5. Packing and Gasket: Asbestos free.
 6. Operator: Handwheel.

2.19 LUBRICATED PLUG VALVES

- A. Regular Gland and Cylindrical with Threaded Ends:
 1. Comply with MSS SP-78, Type II.
 2. Class 125: CWP Rating: 200 psig.
 3. Class 250: CWP Rating: 400 psig.
 4. Body: ASTM A48/A48M or ASTM A126, cast iron with lubrication sealing system.
 5. Pattern: Regular or short.
 6. Plug: Cast iron or bronze with sealant groove.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.
- B. Verify valve parts to be fully operational in all positions from closed to fully open.
- C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.
- D. Should valve is determined to be defective, replace with new valve.

3.2 INSTALLATION

- A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.
- B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.
- C. Where valve support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- D. Provide the Owner with a valve chart indicating location, valve number, size, manufacturer, purpose, etc. Frame valve chart under glass.
- E. Provide brass or stainless steel valve tags on all valves. Refer to Identification for Plumbing Piping and Equipment Specification for further information.
- F. Provide access panel, minimum 18" square, where valves are located above gypsum board ceiling. Access panel shall have fire rating to match ceiling rating, if ceiling is rated. Access panel shall be painted to match ceiling.
- G. Provide dot on ceiling grid where valves are located above lay-in ceiling. Refer to Identification for Plumbing Piping and Equipment Specification for further information.
- H. The Contractor shall set in service all valves to operating conditions as part of his Contract. Where valves with manual settings are required, valves shall be calibrated by plumbing contractor for a balanced flow.
- I. All valve stems shall be accessible and in no case shall valve stems be installed below horizontal.
- J. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.
- K. In no case shall raised face flanges be bolted to flat face flanges.
- L. All flanged connections shall be gasketed.
- M. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
- N. When soldering valves with TFE or PTFE Seats, contractor shall remove valve body to protect seats.
- O. All elastomers used for seals and seats shall be UL Classified in accordance with NSF-61/NSF-372 for potable water service
- P. Install check valves where necessary to maintain direction of flow as follows:

SECTION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

1. Lift Check: Install with stem plumb and vertical.
2. Swing Check: Install horizontal maintaining hinge pin level.
3. Orient plate-type and center-guided into horizontal or vertical position, between flanges.

END OF SECTION 22 05 23

**SECTION 22 05 29
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Support and attachment components for equipment, piping, and other plumbing work for a completely and properly supported plumbing system.

1.2 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping; 2023.
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
- F. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- G. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023c.
- I. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a, with Editorial Revision (2023).
- J. MFMA-4 - Metal Framing Standards Publication; 2004.
- K. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).
- L. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.

3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
5. Contractor is responsible for reviewing complete construction document package and determining, prior to the start of work, which portions of the above grade structural slabs are hard rock concrete and/or lightweight insulating concrete and shall review the structural engineer's requirements for attachment to slabs. Unistrut or other forms of support required to span multiple joists or beams shall be part of the contractor's bid price. No additional monies will be given for support steel or other members required where piping may not be allowed to be supported by the concrete deck above.

B. Sequencing:

1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 30 00.

1.4 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, non-penetrating rooftop supports, post-installed concrete and masonry anchors, thermal insulated pipe supports, and all devices required for a complete hanger and support system.
- B. Approved Manufacturers: Eaton / Cooper B-Line, Thomas & Betts Corporation, nVent Caddy (Erico), Unistrut, or prior Engineer Approved Equal
- C. Furnish all support materials, associated fittings, accessories, and hardware produced by a single manufacturer.

1.5 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Installer Qualifications for Powder-Actuated Fasteners (when specified): Certified by fastener system manufacturer with current operator's license.
- D. Installer Qualifications for Field-Welding: As specified in Section 05 50 00.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
 1. Comply with MSS SP-58.

2. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
 3. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
 4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
 5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
 6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
 - a. Indoor Dry Locations: Use zinc-plated steel or galvanized steel, or epoxy plated steel unless otherwise indicated.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
 - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Metal Channel (Strut) Framing Systems:
1. Provide factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
 2. Comply with MFMA-4.
 3. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch.
 4. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.
- C. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
1. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2 inch diameter.
 - b. Piping up to 1 inch (27 mm) nominal: 1/4 inch diameter.
 - c. Piping larger than 1 inch (27 mm) nominal: 3/8 inch diameter.
 - d. Trapeze Support for Multiple Pipes: 3/8 inch diameter.
- D. Pipe Supports:
1. Liquid Temperatures Up To 122 degrees F:
 - a. Overhead Support: MSS SP-58 Types 1, 3 through 12.
 - b. Support From Below: MSS SP-58 Types 35 through 38.

SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

- E. Beam Clamps: MSS SP-58 Types 19 through 23, 25 or 27 through 30 based on required load.
 - 1. Material: ASTM A36/A36M carbon steel or ASTM A181/A181M forged steel.
 - 2. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
- F. Riser Clamps:
 - 1. Provide copper plated clamps for copper tubing support.
 - 2. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
- G. Offset Pipe Clamps: Double-leg design two-piece pipe clamp.
- H. Strut Clamps: Two-piece pipe clamp.
- I. Insulation Clamps: Two bolt-type clamps designed for installation under insulation.
- J. Pipe Hangers: For a given pipe run, use hangers of the same type and material.
 - 1. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
 - 2. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.
- K. Intermediate Pipe Guides: Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.
 - 1. Pipe Diameter 6 inches and Smaller: Provide minimum clearance of 0.16 inch.
 - 2. Pipe Diameter 8 inches: Provide U-bolts with double nuts providing minimum clearance of 0.28 inch.
 - 3. Pipe Diameter 8 inches: 0.625 inch U-bolt.
 - 4. Pipe Diameter 10 inches: 0.75 inch U-bolt.
 - 5. Pipe Diameter 12 to 16 inches: 0.875 inch U-bolt.
 - 6. Pipe Diameter 18 to 30 inches: 1 inch U-bolt.
- L. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.
- M. Nonpenetrating Rooftop Supports for Low-Slope Roofs:
 - 1. Provide steel pedestals with thermoplastic or rubber base that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
 - 2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 - 3. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
 - 4. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.
- N. Anchors and Fasteners:

SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

1. Manufacturers - Mechanical Anchors:
 - a. Hilti, Inc
 - b. ITW Red Head, a division of Illinois Tool Works, Inc
 - c. Powers Fasteners, Inc
 - d. Simpson Strong-Tie Company Inc
 - e. nVent CADDY (Erico).
2. Manufacturers - Powder-Actuated Fastening Systems:
 - a. Hilti, Inc
 - b. ITW Ramset, a division of Illinois Tool Works, Inc
 - c. Powers Fasteners, Inc
 - d. Simpson Strong-Tie Company Inc
3. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
4. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
5. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
6. Hollow Masonry: Use toggle bolts.
7. Hollow Stud Walls: Use toggle bolts.
8. Steel: Use beam clamps, machine bolts, or welded threaded studs.
9. Sheet Metal: Use sheet metal screws.
10. Wood: Use wood screws.
11. Plastic and lead anchors are not permitted.
12. Powder-actuated fasteners are permitted only as follows:
 - a. Where approved by Architect.
 - b. Use only threaded studs; do not use pins.
13. Hammer-driven anchors and fasteners are permitted only as follows: Wood Frame Construction
14. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - a. Comply with MFMA-4.
 - b. Channel Material: Use galvanized steel.
 - c. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch minimum base metal thickness.

- d. Manufacturer: Same as manufacturer of metal channel (strut) framing system.
- 15. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Equipment Support and Attachment:
 - 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
 - 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 - 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 - 4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 4 inch high concrete pad constructed in accordance with Section 03 30 00.
 - 5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- H. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.
- I. Secure fasteners according to manufacturer's recommended torque settings.
- J. Remove temporary supports.

- K. The actual arrangement of the piping shall follow the general locations shown on the Drawings, such that clearances, line drainage, etc. shall be maintained.
- L. In no case shall this Contractor be allowed to cut or reduce the specified covering to allow the application of a smaller hanger than required.
- M. Hangers supporting vertical and horizontal copper piping, sized 1 ½" in diameter and larger, shall be spaced on not more than 10-foot centers and 30" of each change or direction.
- N. Hangers supporting vertical and horizontal copper piping, sized 1 ¼" in diameter and smaller, shall be spaced on not more than 6-foot centers and 30" of each change of direction.
- O. Hangers supporting vertical and horizontal PVC piping of any size shall be spaced on not more than 4-foot centers and 30" of each change of direction.
- P. Hangers supporting vertical and horizontal CPVC piping 1 ¼" in diameter and larger shall be spaced on not more than 4-foot centers and 30" of each change of direction.
- Q. Hangers supporting vertical and horizontal CPVC piping 1" in diameter and smaller shall be spaced on not more than 3-foot centers and 30" of each direction.
- R. Hangers supporting horizontal cast iron piping of any size shall be spaced not more than 5-foot centers and 30" of each change of direction, with a minimum of two hangers per section.
- S. Hangers supporting vertical cast iron piping of any size shall be spaced on not more than 10-foot centers and 30" of each change of direction, with a minimum of two hangers per section.
- T. Rigid support sway bracing shall be provided at changes in direction greater than 45 degrees for all pipe sizes 4" and larger.
- U. Vertical risers shall be supported at each floor, 5-feet on center, and/or at changes in direction of pipe.
- V. Sleeves shall be provided wherever pipes pass through walls, floors and ceilings. Sleeves shall be Schedule 40, black steel, ½" in diameter larger than the pipe or insulation on the pipe. Sleeves through walls and ceilings shall be flush. Sleeves through floors shall extend one inch above finished floor. Sleeves in exterior walls shall be caulked and made water-tight.

3.3 FIELD QUALITY CONTROL

- A. Inspect support and attachment components for damage and defects.
- B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- C. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 22 05 29

**SECTION 22 05 53
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Pipe markers.
- D. Ceiling tacks.
- E. Valve Tags

1.2 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

1.3 SUBMITTALS

- A. List: Submit list of wording, symbols, letter size, and color coding for plumbing identification.
- B. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Product Data: Provide manufacturers catalog literature for each product required.
- D. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- E. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.1 IDENTIFICATION APPLICATIONS

- A. Control Panels: Nameplates.
- B. Heat Transfer Equipment: Nameplates.
- C. Major Control Components: Nameplates.
- D. Piping: Tags.
- E. Pumps: Nameplates.
- F. Small-sized Equipment: Tags.
- G. Tanks: Nameplates.
- H. Valves: Tags and ceiling tacks where located above lay-in ceiling.
- I. Water Treatment Devices: Nameplates.

2.2 NAMEPLATES

- A. Manufacturers:
 - 1. Brimar Industries, Inc.: www.pipemarker.com.
 - 2. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
 - 3. Preferred Utilities Mfg. Corp.
 - 4. Seton Identification Products: www.seton.com.
 - 5. Brady Corporation.
- B. Description: Laminated three-layer plastic with black engraved letters on light contrasting background.
 - 1. Letter Color: Black.
 - 2. Letter Height: 1/4 inch.
 - 3. Background Color: light, contrasting background.
 - 4. Plastic: Comply with ASTM D709.

2.3 TAGS

- A. Manufacturers:
 - 1. Brady Corporation: www.bradycorp.com.
 - 2. Brimar Industries, Inc.: www.pipemarker.com.
 - 3. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
 - 4. Seton Identification Products: www.seton.com.
- B. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.
- C. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.4 PIPE MARKERS

- A. Manufacturers:
 - 1. Brady Corporation: www.bradycorp.com.
 - 2. Carlton Industries, Inc.
 - 3. Brimar Industries, Inc.: www.pipemarker.com.
 - 4. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
 - 5. Seton Identification Products: www.seton.com.
- B. Comply with ASME A13.1.

- C. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- D. Color: Standard colors for selected plumbing piping, attached at end of Section.
- E. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- F. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service. Message must repeat within a maximum of 40". Printed legend shall be indicative of type of underground line. Underground gas lines shall have insulated copper tracer wire, minimum 18 AWG with insulation suitable for direct burial and ends shall terminate above grade.

2.5 CEILING TACKS

- A. Manufacturers:
 - 1. Craftmark Pipe Markers; _____: www.craftmarkid.com/#sle.
 - 2. MSI.
 - 3. Seton.
- B. Description: Steel with 3/4 inch diameter color coded head.
- C. Install label on ceiling grid in proximity to device above ceiling. Indicate type of device and associated service on label. (e.g. "CW-21"). Next to label, on ceiling grid, provide round dot.
- D. Provide custom printed labels, either of vinyl suitable for indoor/outdoor applications or of polypropylene for each device. Utilize portable printer equal to Brady HandiMark Portable Industrial Labeling System.
- E. Maximum height of label is one inch. Black lettering on white tape. Font size 18.
- F. Color code as follows unless Owner has their own standard - Contractor to verify prior to start of work:
 - 1. Cold Water: Blue dot
 - 2. Hot Water: Green dot
 - 3. Hot Water Return: Green dot
 - 4. All other valves: Black Dot

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

- A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.

- C. All exposed piping in mechanical rooms, boiler rooms, on and above mezzanine levels, both insulated and uninsulated, shall be either painted or color coded using 0.030" PVC jacketing by the Plumbing Contractor and labeled by the Contractor as per the following schedule:
 - 1. Domestic Cold Water: Blue
 - 2. Domestic Hot Water: Red
 - 3. Makeup Water: Green
 - 4. Fuel Gas: Yellow
 - 5. Non-Potable Water: Purple
- D. All non-potable water outlets shall include a phenolic sign with yellow background and black letters 1/2" high stating: "NON-POTABLE WATER – NOT SAFE FOR DRINKING"
- E. Install plastic pipe markers in accordance with manufacturer's instructions.
- F. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- G. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- H. Use tags on piping 3/4 inch diameter and smaller.
 - 1. Identify service, flow direction, and pressure.
 - 2. Install in clear view and align with axis of piping.
 - 3. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- I. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.
- J. Identify water heaters, with plastic nameplates. Small devices may be identified with tags.
- K. Identify control panels, manual motor starters, combination motor starters, disconnects, emergency shutoff switches, water heater override switches, water heater emergency switches and major control components outside panels with plastic nameplates.
- L. Identify aquastats or temperature sensors relating to water heaters or valves with nameplates.
- M. Identify valves in main and branch piping with valve tags.
- N. Tag automatic controls, instruments, and relays. Key to control schematic.
- O. Identify water heaters with plastic nameplates indicating unit number and area served.
- P. Identify pumps with plastic nameplates indicating pump number and system served.

3.3 SCHEDULES

- A. Standard Color Identification for Plumbing Piping unless Owner has their own standard - Contractor to verify prior to start of work (all labels shall be provided with flow arrows):

SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

1. Domestic Cold Water: White Lettering/Green Background
 2. Domestic Hot Water: Black Lettering/Yellow Background
 3. Domestic Hot Water Return: Black Lettering/Yellow Background
 4. Fuel Gas Piping: Black Lettering/Yellow Background
 5. Fuel Oil Piping: Black Lettering/Yellow Background
 6. Compressed Air: White Lettering/Blue Background
 7. Roof Drain: Black Lettering/White Background
 8. Overflow Roof Drain: Black Lettering/White Background
 9. Condensate Drain: Black Lettering/White Background
 10. Non-Potable Water: Black Lettering/Yellow Background
- B. All medical gas piping shall conform to NFPA 99 marking standards.

END OF SECTION 22 05 53

**SECTION 22 07 19
PLUMBING PIPING INSULATION**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Flexible elastomeric cellular insulation.
- B. Glass fiber insulation.
- C. Jacketing and accessories.

1.2 REFERENCE STANDARDS

- A. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2019).
- B. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2023.
- C. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2022a.
- D. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2022.
- E. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).
- F. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2023.
- G. ASTM C585 - Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing; 2022.
- H. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation; 2022.
- I. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).
- J. ASTM D1056 - Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber; 2020.
- K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023c.
- L. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a, with Editorial Revision (2023).
- M. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.3 SUBMITTALS

- A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum three years of experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.6 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723

2.2 GLASS FIBER INSULATION

- A. Manufacturers:
 - 1. CertainTeed Corporation
 - 2. Johns Manville Corporation
 - 3. Knauf Insulation; Earthwool 1000 Degree Pipe Insulation
 - 4. Owens Corning Corporation
 - B. Insulation: ASTM C547and ASTM C795; rigid molded, noncombustible.
 - 1. K Value: ASTM C177, 0.24 at 75 degrees F.
 - 2. Maximum Service Temperature: 850 degrees F.
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
 - C. Insulation: ASTM C547and ASTM C795; rigid molded, noncombustible, with wicking material to transport condensed water to the outside of the system for evaporation to the atmosphere.
 - 1. K Value: ASTM C177, 0.23 at 75 degrees F.
 - 2. Maximum Service Temperature: 220 degrees F.
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
 - D. Insulation: ASTM C547and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
 - 1. K Value: ASTM C177, 0.24 at 75 degrees F.
 - 2. Maximum Service Temperature: 650 degrees F.
-

- 3. Maximum Moisture Absorption: 0.2 percent by volume.
- E. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm inch.
- F. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- G. Vapor Barrier Lap Adhesive: Compatible with insulation.
- H. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
- I. Indoor Vapor Barrier Finish:
 - 1. Cloth: Untreated; 9 oz/sq yd weight.
- J. Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

2.3 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturers:
 - 1. Aeroflex USA, Inc: www.aeroflexusa.com.
 - 2. Armacell LLC: www.armacell.us.
 - 3. K-Flex USA LLC: www.kflexusa.com.
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
 - 1. Minimum Service Temperature: Minus 40 degrees F.
 - 2. Maximum Service Temperature: 220 degrees F.
 - 3. Connection: Waterproof vapor barrier adhesive.
- C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.4 JACKETING AND ACCESSORIES

- A. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive. (INTERIOR)
 - 1. Lagging Adhesive: Compatible with insulation.
- B. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet. (EXTERIOR)
 - 1. Thickness: 0.016 inch sheet.
 - 2. Finish: Smooth.
 - 3. Joining: Longitudinal slip joints and 2 inch laps.
 - 4. Fittings: 0.016 inch thick die-shaped fitting covers with factory-attached protective liner.
 - 5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

PART 3 EXECUTION**3.1 EXAMINATION**

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
 - B. Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.
 - C. All valve handles on insulated piping shall be extended beyond the surface of the insulation using approved listed valve stem handle extensions made by same manufacturer of the valves.
 - D. Exposed Piping in Mechanical Spaces and Exposed to Public View Piping (open ceiling): Shall be covered with eight-ounce canvas jacket, pasted in place and glue sized twice for painting - locate insulation and cover seams in least visible locations. Canvas shall be coated twice with Foster fireproof lagging to assure flame and smoke spread ratings. Coordinate sequencing with painting schedule and finishes - refer to architecture documents for painting requirements at Open-to-View ceilings.
 - E. All waste piping above slab carrying cold condensate, for instance roof drain piping carrying cold condensate from rooftop mechanical units, including traps and floor drain bodies, except in a crawl space, shall be fully insulated as specified herein within the thermal envelope.
 - F. All horizontal storm drain piping above slab on grade and all vertical risers up to, and including, elbows and roof drain bodies, shall be fully insulated as specified herein.
 - G. Closed cell insulation, may be used in lieu of fiberglass on all water pipes - especially in block walls. All Closed cell insulation shall be jacketed with canvas jacketing prior to being painted and shall be jacketed with Prefroemd PVC Covers when exposed to view.
 - H. Insulation shall be finished with a fire retardant coating to attain proper fire rating.
 - I. Glass fiber insulated pipes conveying fluids below ambient temperature:
 - 1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
 - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.
 - J. Glass fiber insulated pipes conveying fluids above ambient temperature:
 - 1. Provide standard jackets, with vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
 - K. Inserts and Shields:
-

1. Application: Piping 1-1/2 inches diameter or larger.
 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 3. Insert Location: Between support shield and piping and under the finish jacket.
 4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- L. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. Refer to referenced Rated Partition and/or Floor Penetration UL Details and Non-Rated Partition and/or Floor Penetration Details in the drawings where applicable.
- M. All insulation shall be finished with a fire retardant coating to attain proper fire rating.
- N. Closed cell insulation shall be installed in strict accordance with the manufacturer's installation instructions.
- O. Insulate fittings with pre-fabricated PVC fitting covers.
- P. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Cover with aluminum jacket with seams located on bottom side of horizontal piping.
- Q. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil, 0.001 inch thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.
- R. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.3 SCHEDULES

- A. Plumbing Systems:
1. Domestic Hot Water Supply:
 - a. Glass Fiber Insulation:
 - 1) Pipe Size Range: 0-6 inch.
 - 2) Thickness: 1 inch.
 - b. Cellular Foam Insulation:
 - 1) Pipe Size Range: 0-6 inch.
 - 2) Thickness: 1 inch.
 2. Domestic Hot Water Recirculation:
 - a. Glass Fiber Insulation:

- 1) Pipe Size Range: All sizes.
- 2) Thickness: 1 inch.
- b. Polyurethane Foam Insulation:
 - 1) Pipe Size Range: All sizes.
 - 2) Thickness: 1/2 inch.
3. Tempered Domestic Water Supply:
 - a. Same as Domestic Hot Water Supply
4. Domestic Cold Water:
 - a. Glass Fiber Insulation:
 - 1) Pipe Size Range: All sizes
 - 2) Thickness: 1/2 inch
 - 3) Thickness: 1 inch (WCPSS)
 - b. Closed Cell Insulation:
 - 1) Pipe Size Range: All sizes
 - 2) Thickness: 1/2 inch
 - 3) Thickness: 1 inch (WCPSS)
5. Roof Drain Bodies:
 - a. Glass Fiber Insulation:
 - 1) Thickness: 1 inch
6. Roof Drainage Above Grade:
 - a. Glass Fiber Insulation:
 - 1) Thickness: 1 inch
7. Mechanical Condensate, including traps and floor drain bodies:
 - a. Glass Fiber Insulation:
 - 1) Pipe Size Range: All sizes.
 - 2) Thickness: 1 inch.

END OF SECTION 22 07 19

SECTION 22 07 19.11
UNDER-LAVATORY PIPE AND SUPPLY COVERS - PLUMBEREX

PART 2 PRODUCTS

END OF SECTION 22 07 19.11

**SECTION 22 10 05
PLUMBING PIPING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe, pipe fittings, specialties, and connections for piping systems.
 - 1. Sanitary Sewer Drain, Waste and Vent Pipe and Fittings
 - 2. Lead-Free Domestic Water Pipe and Fittings
 - 3. Stormwater Drain Pipe and Fittings
 - 4. Condensate Drain Pipe and Fittings
 - 5. Natural or LP Gas Pipe and Fittings
 - 6. Flanges, unions, and couplings
 - 7. Manufactured sleeve-seal systems
 - 8. Thermostatic, Self-Actuating Balancing Valves (replaced circuit setters)
 - 9. Water pressure reducing valves
 - 10. Relief valves
 - 11. Strainers

1.2 REFERENCE STANDARDS

- A. ANSI Z21.22 - American National Standard for Relief Valves for Hot Water Supply Systems; 2015 (Reaffirmed 2020).
- B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- C. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- D. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2021.
- E. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2021.
- F. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- G. ASTM B32 - Standard Specification for Solder Metal; 2020.
- H. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2020.
- I. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- J. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2016.

-
- K. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2016.
 - L. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2020a.
 - M. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2021a.
 - N. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series); 2020.
 - O. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2023.
 - P. ASTM D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings; 2020.
 - Q. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2020.
 - R. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2020.
 - S. ASTM D2846/D2846M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems; 2019a.
 - T. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2020.
 - U. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2023.
 - V. ASTM F437 - Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2021.
 - W. ASTM F438 - Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40; 2023.
 - X. ASTM F439 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2019.
 - Y. ASTM F441/F441M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80; 2023.
 - Z. ASTM F442/F442M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR); 2023.
 - AA. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings; 2022.
 - BB. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 1992 (Reapproved 2022).
 - CC. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing; 2023a.
 - DD. ASTM F877 - Standard Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems; 2023.
-

- EE. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2018.
- FF. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2017, with Errata (2018).
- GG. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2021.
- HH. NSF 61 - Drinking Water System Components - Health Effects; 2023.
- II. NSF 372 - Drinking Water System Components - Lead Content; 2022.

1.3 SUBMITTALS

- A. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
- B. Welder Certificate: Include welders certification of compliance with ASME BPVC-IX.
- C. Project Record Documents: Record actual locations of valves.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Valve Repacking Kits: One for each type and size of valve.

1.4 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.
- D. Welder Qualifications: Certified in accordance with ASME BPVC-IX.
- E. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.
- F. All wetted components of system shall comply with United States Safe Drinking Water Act (Sec.1417) amended 1-4-2011.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.6 FIELD CONDITIONS

- A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.
- B. Pipe Bedding - PVC Piping to be bedded in the ground shall be installed according to the requirements and recommendations in ASTM-D2321 and shall be backfilled with Soils meeting the Soils Class III unless otherwise approved by the engineer of record prior to installation. PVC Piping less than 8" in diameter shall be backfilled with material with a maximum aggregate size of 10% of the diameter of the pipe being covered.

2.2 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Cast Iron Pipe: ASTM A74 extra heavy weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.
 - 3. Pipe and Fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and shall be listed with NSF International.
- B. PVC Pipe: ASTM D2665 or ASTM D3034.
 - 1. Fittings: PVC.
 - 2. Joints: Solvent welded, with ASTM D2564 solvent cement.
 - 3. Foam Core PVC Piping is not allowed.

2.3 SANITARY SEWER PIPING, ABOVE GRADE

- A. Cast Iron Pipe: CISPI 301, hubless, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies. Heavy-Duty (4-band) type only.
 - 3. Pipe and Fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and shall be listed with NSF International.
- B. CPVC Pipe: ASTM D2846/D2846M, ASTM F441/F441M, or ASTM F442/F442M.
 - 1. Fittings: CPVC; ASTM D2846/D2846M, ASTM F437, ASTM F438, or ASTM F439.
 - 2. Joints: ASTM D2846/D2846M, solvent weld with ASTM F493 solvent cement.
- C. PVC Pipe: ASTM D1785 Schedule 40, or ASTM D2241 SDR 26 with not less than 150 psi pressure rating.
 - 1. Fittings: ASTM D2466, PVC.
 - 2. Joints: Solvent welded, with ASTM D2564 solvent cement.
 - 3. Foam Core PVC Piping is not allowed.

2.4 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Piping larger than 2 inch: Ductile Iron Pipe: AWWA C151/A21.51.
 - 1. Fittings: Ductile or gray iron, standard thickness.
 - 2. Joints: AWWA C111/A21.11, styrene butadiene rubber (SBR) or vulcanized SBR gasket with 3/4 inch diameter rods.
- B. Piping 2 inch and smaller: Type K copper, soft drawn
 - 1. ASTM B88 (ASTM B88M)
 - 2. Fittings: ASME B16.22, wrought copper and bronze.
 - 3. Use silver solder on all joints underground.

2.5 DOMESTIC WATER PIPING, ABOVE GRADE

- A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).
 - 1. Fittings: ASME B16.22, wrought copper and bronze.
 - 2. Use 95-5 solder (95% tin - 5% antimony) on all water piping joints smaller than 2". Use silver solder on piping 2" and larger and on all joints underground.
 - 3. Joints: Grooved mechanical couplings on piping 3" and larger is acceptable
 - 4. Mechanical Press Sealed Fittings: Double-pressed type, NSF 61 and NSF 372 approved or certified, utilizing EPDM, nontoxic, synthetic rubber sealing elements.
 - a. Manufacturers:
 - 1) Apollo Valves
 - 2) Grinnell Products
 - 3) Viega LLC
 - 4) Nibco.

2.6 STORM WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Cast Iron Pipe: ASTM A74 extra heavy weight.
 - 1. Fittings: Cast iron.
 - 2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.
- B. PVC Pipe: ASTM D2665 or ASTM D3034.
 - 1. Fittings: PVC.
 - 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.7 STORM WATER PIPING, ABOVE GRADE

- A. Cast Iron Pipe: CISPI 301, hubless, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.
- B. PVC Pipe: ASTM D2665 or ASTM D3034.
 - 1. Fittings: PVC.
 - 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.8 CONDENSATE PIPING

- A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).
 - 1. Fittings: ASME B16.22, wrought copper and bronze.
- B. Cast Iron Pipe: CISPI 301, hubless, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies. Heavy-Duty (4-band) type only.

2.9 NATURAL GAS PIPING, BURIED BEYOND 5 FEET OF BUILDING

- A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
 - 1. Fittings: ASTM A234/A234M, wrought steel welding type, with AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.
 - 2. Joints: ASME B31.1, welded.

2.10 NATURAL GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
 - 1. Fittings: ASTM A234/A234M, wrought steel welding type.
 - 2. Joints: ASME B31.1, welded.
 - 3. Jacket: AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.

2.11 NATURAL GAS PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
 - 1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
 - 2. Joints: Threaded or welded to ASME B31.1.

2.12 FLANGES, UNIONS, AND COUPLINGS

- A. No-Hub Couplings:
 - 1. Gasket Material: Neoprene complying with ASTM C564.

2. Band Material: Stainless steel.
3. Eyelet Material: Stainless steel.
4. Must meet CISPI 310 and shall be listed by NSF International.
5. NOTE: Transition fittings from Cast Iron piping to PVC Piping must be FM Approved PVC Transition Fitting specifically deisgned for transition from Cast Iron to PVC - "Band" type transition fittings are not approved.

2.13 MANUFACTURED SLEEVE-SEAL SYSTEMS

A. Manufacturers:

1. The Metraflex Company
2. Approved Equal

B. Modular/Mechanical Seal:

1. Synthetic rubber interlocking links continuously fill annular space between pipe and wall/casing opening.
2. Provide watertight seal between pipe and wall/casing opening.
3. Elastomer element size and material in accordance with manufacturer's recommendations.
4. Glass reinforced plastic pressure end plates.

2.14 PIPING SPECIALTIES

A. Thermostatic Flow Controls (Replacing Circuit Setters): Thermostatic, self-actuating balancing valve that automatically and continuously adjusts the flow of domestic hot water recirculation systems to maintain a specified temperature at the end of each branch.

1. Manufacturers:

- a. Circuit Solver
- b. Acorn
- c. Approved Equal

2. Construction: Class 125, Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, blowdown/backflush drain
3. Calibration: Device Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi.
4. Installation / TAB: During the initial start-up of the Domestic Hot Water System (DHWS), the valve shall be set to wide open and will begin to close once the system temperature requirements are met. System shall be placed into operation and time given for the valves to make the necessary adjustments. BAS Control of Recirculation Pump on and off will not allow the system to properly balance - The specified Aquastat shall be allowed to run Pump On and Off for proper balancing.

2.15 WATER PRESSURE REDUCING VALVES

- A. Manufacturers:
 - 1. Amtrol Inc
 - 2. Apollo Valves
 - 3. Watts Regulator Company
 - 4. Victaulic Series 386 Pressure Reducing Valve Stations

2.16 RELIEF VALVES

2.17 STRAINERS

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Testing of all piping under this contract shall be made in the presence of the Engineer or a designated representative of the Owner. No piping shall be covered or put into operation before such testing has been approved.
- C. Copper tubing which is out of round will not be acceptable.
- D. The arrangement of the piping shall follow the general locations shown on the Drawings, such that clearances, line drainages, etc., shall be maintained.
- E. No notching or mitering of copper tubing will be permitted.
- F. Joints in Type "K" copper tubing will not be permitted underfloor unless otherwise noted on drawings.
- G. In pipe chases, the Contractor shall provide for suspension of all piping from the structure. Do not allow piping to rub against masonry when expanding and contracting.
- H. Close and protect open ends of piping until final connections are made. Such closing shall be made with fittings which cannot be easily removed. Caps or plugs shall be required at all times during construction so that no pipes are left open at the end of any day's work, even though continuation is expected the next day.
- I. Copper pipe ends shall be reamed, sanded and deburred before soldering. Non-corrosive flux shall be used.
- J. Any leaky joints shall be remade with new materials. Caulking to make joints tight is absolutely prohibited.

-
- K. Sleeves shall be provided wherever pipes pass through walls, floors and ceilings. Sleeves shall be Schedule 40, Black Steel, ½ inch in diameter larger than the pipe or insulation on the pipe. Sleeves through walls and ceiling shall be flush. Sleeves through floors shall extend 1 inch above finished floor. Sleeves installed in exterior walls shall be caulked and made water-tight.
 - L. Pipe joint compound shall be LACO, Hercules, Oatey, or Rector Seal.
 - M. All water piping shall be hydrostatically tested at 150 psig for a period of one hour.
 - N. All piping and equipment installed under this Contract shall be tested in the presence of the Engineer and the proper Plumbing Inspector, and provided tight for the periods stated above, or longer if required by the Inspector. The test shall be administered in sections if deemed advisable.
 - O. No plumbing system or part thereof shall be covered or concealed until after it has been tested and approved. If such work has been covered or concealed before testing, it shall be exposed for testing.
 - P. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
 - Q. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
 - R. Install piping to maintain headroom, conserve space, and not interfere with use of space.
 - S. Group piping whenever practical at common elevations.
 - T. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 05 16.
 - U. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
 - 1. Refer to Section 22 07 19.
 - V. Provide access where valves and fittings are not exposed.
 - 1. Coordinate types, sizes, finish, and locations of Access doors with General Contractor, Other Trades, Owner, and Architect prior to completion of wall and/or ceiling framing in all cases.
 - W. Establish elevations of buried piping outside the building to ensure not less than 2 ft of cover. Provide Additional cover where required by code.
 - X. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.
 - Y. Manufactured Sleeve-Seal Systems:
 - 1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
 - 2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
 - 3. Locate piping in center of sleeve or penetration.
 - 4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
 - 5. Tighten bolting for a watertight seal.
-

-
6. Install in accordance with manufacturer's recommendations.

3.4 APPLICATION

- A. Where allowed by Piping Material and Type specified, use grooved mechanical couplings and fasteners only in accessible locations.
- B. Install unions downstream of valves and at equipment or apparatus connections.
- C. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- D. Install ball or butterfly valves for throttling, bypass, or manual flow control services.
- E. Provide spring-loaded check valves on discharge of water pumps.
- F. Provide flow controls in water recirculating systems where indicated.

3.5 TOLERANCES

- A. Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated and slope to drain at minimum of 1/8" per foot or 1/4 inch per foot slope where indicated in plans and required by code.
- B. Water Piping: Slope at minimum of 1/32 inch per foot and arrange to drain at low points.

3.6 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Prior to starting work, verify system is complete, flushed, and clean.
- B. Inject disinfectant, free chlorine in liquid, powder, tablet, or gas form throughout system to obtain 50 to 80 mg/L residual.
- C. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- D. Maintain disinfectant in system for 24 hours, after which the system shall be flushed prior to being put into service.
- E. During the flushing of the system, all flush valves shall be thoroughly flushed out to insure the removal of sediment, pipe dope, etc., from water lines and flush valves, removing such working parts of the flush valves as may be deemed necessary.
- F. After flushing of the system has been completed, the Contractor shall have water samples taken and delivered to an independent laboratory for testing to show that the water is suitable for drinking. Copies of the laboratory report shall be provided to the Owner and the Engineer. If the State Construction Office is involved, provide form "Water Test Report for Use."
- G. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

3.7 DWV SMOKE TEST

- A. The final test of the completed drainage and vent systems shall be visual and in sufficient detail to determine compliance with the provisions of the NC Plumbing Code. Where a smoke test is utilized, it shall be made by filling all traps with water and then introducing into the entire system a pungent, thick smoke produced by one or more smoke machines or devices with the appropriate capacity for a system of this size.

- B. in sufficient detail to determine compliance with the provisions of the NC Plumbing Code. Where a smoke test is utilized, it shall be made by filling all traps with water and then introducing into the entire system a pungent, thick smoke produced by one or more smoke machines or devices with the appropriate capacity for a system of this size. When the
- C. smoke appears at stack openings on the roof (VTRs), the stack openings shall be closed and a pressure equivalent to a 1-inch water column (248.8 Pa) shall be held on the entire system for a test period of not less than 15 minutes while personnel spread throughout the area of the test observe for visual or olfactory detection of smoke. Where leaks or deficiencies are detected they shall be repaired and the test repeated until owner's and engineer of record's representatives are satisfied that the test has been "passed". Written observations (minutes) of the test shall be documented by the Plumbing Contractor and provided for record with O&M Materials.
- D. When the smoke appears at stack openings on the roof (VTRs), the stack openings shall be closed and a pressure equivalent to a 1-inch water column (248.8 Pa) shall be held on the entire system for a test period of not less than 15 minutes while personnel spread throughout the area of the test observe for visual or olfactory detection of smoke. Where leaks or deficiencies are detected they shall be repaired and the test repeated until owner's and engineer of record's representatives are satisfied that the test has been "passed".
- E. Written observations (minutes) of the test shall be documented by the Plumbing Contractor and provided for record with O&M Materials.

3.8 DWV HYDROSTATIC TESTING

- A. Waste and vent piping shall be hydrostatically tested at each floor. A test tee will be installed below each floor and pipe will be filled with water for a height of 10' above finished floor. The pipe shall be gas and watertight. Water shall stand in the system for a period of 30 minutes without evidence of leakage. After the waste and vent piping has been hydrostatically tested for the entire system the piping shall be smoke tested using smoke bombs. The contractor shall plug waste line where it exits building, fill all of the traps with water and test the waste and vent piping by using a smoke bomb in a wall or floor cleanout. He shall install a plug on the cleanout once the smoke bomb has been dropped into the cleanout. The smoke bomb test shall be held for thirty minutes without evidence of leakage in the piping. The smoke bombs for this testing shall be furnished by the contractor. Once the testing of the piping has been completed, the contractor shall flush all of the smoke bombs from the waste piping system
- B. All piping and equipment installed under this Contract shall be tested in the presence of the Engineer and the proper Plumbing Inspector, and proved tight for the periods stated above, or longer if required by the Inspector
- C. The final test of the completed drainage and vent systems shall be visual and
- D. No plumbing system or part thereof shall be covered or concealed until after it has been tested and approved.
- E. If such work has been covered or concealed before testing, it shall be exposed for testing
- F. After the pipe is installed, tested and inspected, backfill shall be installed and compacted. Backfill material shall conform to ASTM D-2371 Soil Class III. Backfill shall be installed, compacted and tested in 6" layers up to 12" above top of pipe. Backfill shall continue in 12" layers to finished grade

3.9 DWV UNDERGROUND CAMERA INVESTIGATION

- A. The entire underground waste piping system shall be videoed and recorded by the Contractor on an audible CD/DVD to ensure that the Owner knows the location of the piping being viewed. The recorded CD/DVD shall be provided to the Engineer of Record and the Owner's Project Manager three (3) weeks prior to Substantial Completion inspection. The Substantial Completion inspection cannot occur until the video has

been reviewed and all the underground waste piping system has been approved by the Engineer in Record.

3.10 SCHEDULES

A. Pipe Hanger Spacing:

1. Metal Piping:

a. Pipe Size: 1/2 inches to 1-1/4 inches:

- 1) Maximum Hanger Spacing: 6.5 ft.
- 2) Hanger Rod Diameter: 3/8 inches.

b. Pipe Size: 1-1/2 inches to 2 inches:

- 1) Maximum Hanger Spacing: 10 ft.
- 2) Hanger Rod Diameter: 3/8 inch.

c. Pipe Size: 2-1/2 inches to 3 inches:

- 1) Maximum Hanger Spacing: 10 ft.
- 2) Hanger Rod Diameter: 1/2 inch.

d. Pipe Size: 4 inches to 6 inches:

- 1) Maximum Hanger Spacing: 10 ft.
- 2) Hanger Rod Diameter: 5/8 inch.

e. Pipe Size: 8 inches to 12 inches:

- 1) Maximum hanger spacing: 14 ft.
- 2) Hanger Rod Diameter: 7/8 inch.

2. Plastic Piping:

a. All Sizes:

- 1) Maximum Hanger Spacing: 6 ft.
- 2) Hanger Rod Diameter: 3/8 inch.

3. Install hangers for PEX tubing in strict accordance with manufactures instructions.

END OF SECTION 22 10 05

**SECTION 22 10 06
PLUMBING PIPING SPECIALTIES**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Drains
- B. Cleanouts
- C. Hose bibbs
- D. Hydrants
- E. Washing machine boxes and valves
- F. Refrigerator valve and recessed box
- G. Back water valves
- H. Backflow preventers
- I. Double check valve assemblies
- J. Water hammer arrestors
- K. Sumps
- L. Sanitary waste interceptors
- M. Mixing valves
- N. Exterior penetration accessories.

1.2 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASME A112.6.3 - Floor Drains; 2022.
- C. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers; 2023.
- D. ASSE 1019 - Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance; 2011 (Reaffirmed 2016).
- E. NSF 61 - Drinking Water System Components - Health Effects; 2023.
- F. NSF 372 - Drinking Water System Components - Lead Content; 2022.
- G. PDI-WH 201 - Water Hammer Arresters; 2017.

1.3 SUBMITTALS

- A. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
- B. Certificates: Certify that grease interceptors meet or exceed specified requirements.

- C. Operation Data: Indicate frequency of treatment required for interceptors.
- D. Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, water hammer arrestors, access panels.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Loose Keys for Outside Hose Bibbs: One.
 - 2. Extra Hose End Vacuum Breakers for Hose Bibbs: One.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than five years documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

2.2 DRAINS

- A. Roof Drains:
 - 1. Strainer: Removable polyethylene dome with vandal proof screws.
- B. Roof Overflow Drains:
- C. Floor Drains:
- D. Floor Drain (FD-1):

2.3 CLEANOUTS

- A. Manufacturers:
 - 1. Jay R. Smith Manufacturing Company; _____: www.jayrsmith.com/#sle.
 - 2. Josam Company; _____: www.josam.com/#sle.
 - 3. Zurn Industries, LLC; _____: www.zurn.com/#sle.
- B. Cleanouts at Exterior Surfaced Areas (CO-1):
- C. Cleanouts at Exterior Unsurfaced Areas (CO-2):
- D. Cleanouts at Interior Finished Floor Areas (CO-3):

2.4 HOSE BIBBS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company; _____: www.jayrsmith.com/#sle.
2. Murdock Manufacturing, Inc; _____: www.murdockmfg.com/#sle.
3. Watts Regulator Company; _____: www.wattsregulator.com/#sle.
4. Zurn Industries, LLC; _____: www.zurn.com/#sle.

B. Interior Hose Bibbs:

1. Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose thread spout, chrome plated where exposed with handwheel, integral vacuum breaker in compliance with ASSE 1011.

2.5 REFRIGERATOR VALVE AND RECESSED BOX

A. Box Manufacturers:

1. IPS Corporation/Water-Tite; _____: www.ipscorp.com/#sle.
2. Oatey Supply Chain Services, Inc; _____: www.oatey.com/#sle.

B. Description: Plastic preformed rough-in box with brass valves with wheel handle, slip in finishing cover.

2.6 BACKFLOW PREVENTERS

2.7 DOUBLE CHECK VALVE ASSEMBLIES

A. Manufacturers:

1. Apollo Valves; _____: www.apollovalves.com/#sle.
2. Watts Regulator Company, a part of Watts Water Technologies; _____: www.wattsregulator.com/#sle.
3. Zurn Industries, LLC; _____: www.zurn.com/#sle.

2.8 WATER HAMMER ARRESTORS

A. Manufacturers:

1. Cash Acme, a brand of Reliance Worldwide Corporation
2. Jay R. Smith Manufacturing Company: www.jayrsmith.com/#sle.
3. Watts Regulator Company, a part of Watts Water Technologies
4. Zurn Industries, LLC

B. Water Hammer Arrestors:

1. Stainless steel construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range minus 100 to 300 degrees F and maximum 250 psi working pressure.

2.9 SANITARY WASTE INTERCEPTORS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company; _____: www.jrsmith.com/#sle.
2. Zurn Industries, LLC; _____: www.zurn.com/#sle.
3. Mifab.

2.10 EXTERIOR PENETRATION ACCESSORIES

- A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.
- B. Roof Drain Outlet Pipe Connection: Drain seal to connect roof drain to drain piping.
- C. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for piping, cables, and roofing system to be installed; designed to accommodate existing penetrations where applicable.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Encase exterior cleanouts in concrete flush with grade.
- C. Install floor cleanouts at elevation to accommodate finished floor.

END OF SECTION 22 10 06

**SECTION 22 13 29
SANITARY SEWERAGE PUMPS**

PART 2 PRODUCTS

END OF SECTION 22 13 29

**SECTION 22 30 00
PLUMBING EQUIPMENT**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Water Heaters:
 - 1. Commercial gas fired.
- B. Diaphragm-type compression tanks.
- C. In-line circulator pumps.
- D. Sump pumps.

1.2 REFERENCE STANDARDS

- A. ANSI Z21.10.1 - Gas Water Heaters, Volume I, Storage Water Heaters with Input Ratings of 75,000 Btu Per Hour or Less; 2019, with Errata (2020).
- B. ANSI Z21.10.3 - Gas-Fired Water Heaters, Volume III, Storage Water Heaters with Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous; 2019.
- C. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2023.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- E. NEMA MG 1 - Motors and Generators; 2021.
- F. NFPA 31 - Standard for the Installation of Oil-Burning Equipment; 2020, with Amendment (2023).
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 174 - Standard for Household Electric Storage Tank Water Heaters; Current Edition, Including All Revisions.
- I. UL 778 - Standard for Motor-Operated Water Pumps; Current Edition, Including All Revisions.
- J. UL 1453 - Standard for Electric Booster and Commercial Storage Tank Water Heaters; Current Edition, Including All Revisions.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittals procedures.

- B. Product Data:
 - 1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
 - 2. Indicate pump type, capacity, power requirements.
 - 3. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
 - 4. Provide electrical characteristics and connection requirements.
- C. Project Record Documents: Record actual locations of components.
- D. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Pump Seals: One of each type and size.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum ten years of documented experience.
- B. Certifications:
 - 1. Water Heaters: NSF approved.
 - 2. Gas Water Heaters: Certified by CSA International to ANSI Z21.10.1, as applicable, in addition to requirements specified elsewhere.
 - 3. Pressure Vessels for Heat Exchangers: ASME labeled to ASME BPVC-VIII-1.
 - 4. Water Tanks: ASME labeled to ASME BPVC-VIII-1.
 - 5. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.
- C. Identification: Provide pumps with manufacturer's name, model number, and rating/capacity identified by permanently attached label.
- D. Performance: Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.
- E. ASME STAMP: All Boilers, Water Heaters, and/or Pressure Vessels and their components shall bear the ASME Stamp and where applicable shall bear the ASME HLW stamp.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.7 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide seven year manufacturer warranty for domestic water heaters.

PART 2 PRODUCTS

2.1 WATER HEATERS

- A. Manufacturers:
 - 1. A.O. Smith Water Products Co
 - 2. Rheem Manufacturing Company
 - 3. Lochinvar LLC
 - 4. Bradford-White
 - 5. Substitutions: Not permitted.
- B. Commercial Gas Fired:
 - 1. Type: Automatic, natural gas-fired, vertical storage.
 - 2. Performance:
 - a. Energy Factor: see fixture schedule.
 - b. Storage Capacity: see fixture schedule gal.
 - c. First Hour Rating: see fixture schedule gal.
 - d. Input: see fixture schedule Btuh at sea level.
 - e. Minimum Recovery Rate: see fixture schedule gph with 100 degrees F temperature rise.
 - f. Maximum Working Pressure: 150 psig.
 - 3. Tank: Glass-Lined, Duplex Alloy, Nickel-Plated, or approved lining, welded steel ASME labeled; multiple flue passages, 4 inch diameter inspection port, thermally insulated with minimum 2 inches glass fiber, encased in corrosion-resistant steel jacket; baked-on enamel finish; floor shield and legs.
 - 4. Accessories:
 - a. Water Connections: Brass.
 - b. Dip Tube: Brass.
 - c. Drain valve.
 - d. Anode: By Manufacturer.
 - e. Temperature and Pressure Relief Valve: ASME labeled.
 - 5. Certified For The Following Applications:

- a. Automatic storage water heater.
 - b. Automatic circulating tank water heater.
 - c. For operation at 180 degrees F.
 - d. For operation on combustible floors.
6. Controls: Automatic direct immersion thermostat with temperature range adjustable minimum 175 degrees F differential, automatic reset high temperature limiting thermostat factory set at 195 degrees F, gas pressure regulator, multi-ribbon or tubular burner, 100 percent safety shut-off pilot and thermocouple, intermittent electronic ignition monitoring pilot and main flame, trial for re-ignition for momentary loss of flame, shutdown of pilot and main burner in "2 to 4" seconds after loss of flame, and automatic flue damper.

2.2 DIAPHRAGM-TYPE COMPRESSION TANKS

- A. Manufacturers:
1. Amtrol Inc: www.amtrol.com/#sle.
 2. Bell & Gossett, a xylem brand: www.bellgossett.com/#sle.
 3. Taco, Inc: www.taco-hvac.com/#sle.
 4. Watts.
 5. Substitutions: Not permitted.
- B. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.
- C. Accessories: Pressure gauge and air-charging fitting, tank drain; precharge to 12 psig.

2.3 IN-LINE CIRCULATOR PUMPS

- A. Manufacturers:
1. Armstrong Fluid Technology: www.armstrongfluidtechnology.com/#sle.
 2. Bell & Gossett, a xylem brand: www.bellgossett.com/#sle.
 3. Taco.
 4. Grundfos
 5. Substitutions: Not permitted.
- B. Casing: Bronze, rated for 125 psig working pressure, with stainless steel rotor assembly.
- C. Impeller: Bronze.
- D. Shaft: Alloy steel with integral thrust collar and two oil lubricated bronze sleeve bearings.
- E. Seal: Carbon rotating against a stationary ceramic seat.

- F. Drive: Flexible coupling.
- G. Performance:

2.4 SUMP PUMPS

- A. Manufacturers:
 - 1. Armstrong Fluid Technology: www.armstronfluidtechnology.com/#sle.
 - 2. Liberty Pumps.
 - 3. Bell & Gossett, a xylem brand
 - 4. Franklin Electric
 - 5. Substitutions: Not permitted.
- B. Type: Vertical centrifugal, direct connected, simplex arrangement.
- C. Casing: Cast iron volute with radial clearance around impeller, inlet strainer, or per listed manufacturer.
- D. Impeller: Cast Iron or per manufacturer; open non-clog, keyed to stainless steel shaft.
- E. Support: Cast iron pedestal motor support on steel floor plate with gas tight gaskets.
- F. Bearings: Forced grease lubricated bronze sleeve spaced maximum 48 inches and grease lubricated ball thrust at floor plate.
- G. Drive: Flexible coupling to vertical, solid shaft ball bearing electric motor.
- H. Sump: Steel cover plate with steel curb frame for grouting into concrete sump with inspection opening and cover, and alarm fittings.
- I. Controls (Simplex): Float switch with float rod, stops, and corrosion resistant float, and separate pressure switch high level alarm with transformer, alarm bell and stand-pipe.
- J. Performance:
 - 1. Flow: see fixture schedule gal/min, at see fixture schedule feet lift.
 - 2. Motor: see fixture schedule hp, see fixture schedule volt, single phase, 60 Hz.

2.5 ELECTRICAL WORK

- A. Provide electrical motor driven equipment specified complete with motors, motor starters, controls, and wiring.
- B. Electrical characteristics to be as specified or indicated.
- C. Furnish motor starters complete with thermal overload protection and other appurtenances necessary for the motor control specified.
- D. Supply manual or automatic control and protective or signal devices required for the operation specified, and any control wiring required for controls and devices not shown.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.
- B. Coordinate with plumbing piping and related fuel piping work to achieve operating system.
- C. Domestic Water Storage Tanks:
 - 1. Provide steel pipe or concrete pad support, independent of building structural framing members.
 - 2. Clean and flush prior to delivery to site. Seal until pipe connections are made.
- D. Pumps:
 - 1. Ensure shaft length allows sump pumps to be located minimum 24 inches below lowest invert into sump pit and minimum 6 inches clearance from bottom of sump pit.
 - 2. Provide air cock and drain connection on horizontal pump casings.
 - 3. Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.
 - 4. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches and over.
 - 5. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
 - 6. Align and verify alignment of base mounted pumps prior to start-up

END OF SECTION 22 30 00

**SECTION 22 40 00
PLUMBING FIXTURES**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Flush valve water closets.
- B. Wall hung urinals.
- C. Lavatories.
- D. Sinks.
- E. Under-lavatory pipe supply covers.
- F. Bottle filling drinking fountains.
- G. Bi-level, electric water coolers.
- H. Mop sinks.

1.2 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASHRAE Std 18 - Methods of Testing for Rating Drinking-Water Coolers with Self-Contained Mechanical Refrigeration; 2008 (Reaffirmed 2013).
- C. ASME A112.6.1M - Floor-Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use; 1997 (Reaffirmed 2017).
- D. ASME A112.18.1 - Plumbing Supply Fittings; 2018, with Errata.
- E. ASME A112.18.9 - Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures; 2011 (Reaffirmed 2022).
- F. ASME A112.19.2 - Ceramic Plumbing Fixtures; 2018, with Errata.
- G. ASME A112.19.3 - Stainless Steel Plumbing Fixtures; 2022.
- H. ASME A112.19.5 - Flush Valves and Spuds for Water Closets, Urinals, and Tanks; 2022.
- I. ASTM C1822 - Standard Specification for Insulating Covers on Accessible Lavatory Piping; 2021.
- J. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- K. NSF 61 - Drinking Water System Components - Health Effects; 2023.
- L. NSF 372 - Drinking Water System Components - Lead Content; 2022.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

- B. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- C. Manufacturer's Instructions: Indicate installation methods and procedures.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Accept fixtures on-site in factory packaging. Inspect for damage.
- B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Potable Water Systems: Provide plumbing fittings and faucets that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.2 FLUSH VALVE WATER CLOSETS

- A. Water Closets:
 - 1. Vitreous china, ASME A112.19.2, floor mounted, siphon jet flush action, china bolt caps.
 - 2. Flush Valve: Exposed (top spud).
 - 3. Flush Operation: Sensor operated.
 - 4. Handle Height/Position: 44 inches or less. Coordinate left or right position with architect and ADA requirements.
 - 5. Manufacturers:
 - a. American Standard, Inc; Baby Devoro, 2-Piece Gravity: www.americanstandard-us.com/#sle.
 - b. Kohler Company; _____: www.kohler.com/#sle.
 - c. Zurn Industries, LLC; _____: www.zurn.com/#sle.
- B. Flush Valves:
 - 1. Valve Supply Size: 1 inch.
 - 2. Manufacturers:
 - a. American Standard, Inc; _____: www.americanstandard-us.com/#sle.
 - b. Sloan Valve Company; _____: www.sloanvalve.com/#sle.
 - c. Zurn Industries, LLC; ZEMS Series: www.zurn.com/#sle.
 - 3. Manual Operated:
 - a. Type: ASME A112.18.1 or ASME A112.19.5; diaphragm type complete with vacuum breaker stops, and accessories.

b. Supplied Volume Capacity: 1.5 gal per flush.

C. Toilet Seats:

1. Manufacturers:

a. Bemis Manufacturing Company; _____: www.bemismfg.com/#sle.

2. Plastic: Black finish, open front, extended back, self-sustaining hinge, brass bolts, with cover.

2.3 WALL HUNG URINALS

A. Manufacturers:

1. American Standard, Inc; _____: www.americanstandard-us.com/#sle.

2. Kohler Company; _____: www.kohler.com/#sle.

B. Vitreous china, ASME A112.19.2, wall hung with side shields and concealed carrier.

1. Consumption Volume: 1.0 gal per flush, maximum.

2. Flush Valve: Exposed (top spud).

3. Flush Operation: Sensor operated.

4. Trapway Outlet: Integral.

C. Flush Valves:

1. Manufacturers:

a. American Standard, Inc; _____: www.americanstandard-us.com/#sle.

b. Sloan Valve Company; _____: www.sloanvalve.com/#sle.

c. Zurn Industries, LLC; ZEMS Series: www.zurn.com/#sle.

2. Manual Operated:

a. Type: ASME A112.18.1 or ASME A112.19.5; diaphragm type, complete with vacuum breaker stops, and accessories.

b. Supplied Volume Capacity: 1.5 gal per flush.

D. Urinal Carriers:

1. Manufacturers:

a. Jay R. Smith Manufacturing Company; _____: www.jrsmith.com/#sle.

b. JOSAM Company; _____: www.josam.com/#sle.

c. Zurn Industries, LLC; Z1221: www.zurn.com/#sle.

2. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing studs.

2.4 LAVATORIES

A. Manufacturers:

1. American Standard, Inc: www.americanstandard-us.com/#sle.
2. Kohler Company: www.kohler.com/#sle.
3. Zurn Industries, LLC: www.zurn.com/#sle.

B. Wall-Hung Basin:

1. Vitreous China, Grade A: ASME A112.19.2; white, rectangular commercial-grade sink with predrilled holes, rear-center drain, front overflow, and hanger. Size as indicated on drawings with 4-inch centerset spacing.
2. Carrier:
 - a. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded studs for fixture hanger, bearing plate and studs.
 - b. Manufacturers:
 - 1) Jay R. Smith MFG. Co: www.jrsmith.com/#sle.
 - 2) Zurn Industries, LLC; Z1231: www.zurn.com/#sle.

C. Supply Faucet:

1. Deck Mounted Faucet Manufacturers:
 - a. American Standard, Inc; _____: www.americanstandard-us.com/#sle.
 - b. Kohler Company; _____: www.kohler.com/#sle.
 - c. Zurn Industries, LLC; Aqua Sense Series: www.zurn.com/#sle.
2. ASME A112.18.1; chrome plated combination supply fitting with pop-up waste, water economy aerator with maximum flow of 2.2 gpm, indexed handles.

2.5 SINKS

A. Manufacturers:

1. American Standard, Inc; _____: www.americanstandard-us.com/#sle.
2. Kohler Company; _____: www.kohler.com/#sle.

B. Single Compartment Bowl

1. ASME A112.19.3; _____ by _____ by _____ inch outside dimensions 20 gauge, 0.0359 inch thick, Type 302 stainless steel, self rimming and undercoated, with ledge back drilled for trim.
2. Drain: 1-1/2 inch chromed brass.
3. Drain: 3-1/2 inch crumb cup and tailpiece.

C. Kitchen Faucets:

1. Manufacturers:

- a. American Standard, Inc; _____: www.americanstandard-us.com/#sle.

2. Single Handle Faucet with Three-Function Pulldown Spray Head:

- a. Minimum Spout Height: 8 inch.
- b. Minimum Spout Reach: 8-1/4 inch.
- c. Type: Deck-mount, swivel faucet with mounting plate.
- d. Spray Functions: Stream, full spray and pause at 1.8 gpm, maximum.
- e. ASME A112.18.1, ADA Standards, and NSF 61 compliant assembly.
- f. Materials: Ceramic disc-cartridge valve on brass body with polished chrome finish.

2.6 UNDER-LAVATORY PIPE SUPPLY COVERS

A. Manufacturers:

1. Plumberex Specialty Products, Inc; _____: www.plumberex.com/#sle.

B. Basis of Design: Plumberex Specialty Products, Inc; www.plumberex.com/#sle.

1. Under-Lavatory Covers with Snap-Lock Fasteners (Molded): Plumberex Pro-Extreme.

C. General:

1. Insulate exposed drainage piping including hot, cold and tempered water supplies under lavatories or sinks per ADA Standards.
2. Construction: 1/8 inch PVC with antimicrobial, antifungal and UV resistant properties.
- a. Comply with ASTM C1822 Type III for covers on accessible lavatory piping.
- b. Comply with ASME A112.18.9 for covers on accessible lavatory piping.
- c. Comply with ICC A117.1.
3. Fasteners: Reusable, snap-locking fasteners with no sharp or abrasive external surfaces. No cable ties allowed.

2.7 BOTTLE FILLING DRINKING FOUNTAINS

A. Manufacturers:

1. Elkay Manufacturing Company; _____: www.elkay.com/#sle.
2. Murdock Manufacturing, Inc; _____: www.murdockmfg.com/#sle.

B. Fountain: Molded white reinforced glass fiber with underside vandal proof cowling, hooded elevated anti-squirt bubbler with stream guard, automatic stream regulator, cross handle, mounting bracket, screwdriver stop.

C. Bottle Filler: Materials to match fountain.

2.8 BI-LEVEL, ELECTRIC WATER COOLERS

A. Manufacturers:

1. Elkay Manufacturing Company; _____: www.elkay.com/#sle.
2. Haws Corporation; _____: www.hawesco.com/#sle.

B. Water Cooler: Bi-level, electric, mechanically refrigerated; surface mounted, ADA compliant; stainless steel top, vinyl on steel body, elevated anti-squirt bubbler with stream guard, automatic stream regulator, push button, mounting bracket; integral air cooled condenser and stainless steel grille.

1. Capacity: 8 gph of 50 degrees F water with inlet at 80 degrees F and room temperature of 90 degrees F, when tested in accordance with ASHRAE Std 18.
2. Electrical: 115 VAC, 60 Hertz compressor, 6 foot cord and plug for connection to electric wiring system including grounding connector.

2.9 MOP SINKS

A. Manufacturers:

1. Just Manufacturing Company; _____: www.justmfg.com/#sle.
2. Zurn Industries, LLC; _____: www.zurn.com/#sle.

B. Accessories:

1. 5 feet of 1/2 inch diameter plain end reinforced plastic hose.
2. Hose clamp hanger.
3. Mop hanger.

C. Terrazzo Mop Sink Manufacturers:

1. American Bath Group; _____: www.americanbathgroup.com/#sle.
2. Just Manufacturing Company; _____: www.justmfg.com/#sle.
3. Zurn Industries, LLC; _____: www.zurn.com/#sle.

D. Material: Precast terrazzo composed of marble chips cast in Portland cement.

E. Type: Rectilinear, standard height.

F. Tiling Flange Construction: Galvanized steel.

G. Grid strainer: Stainless steel; integral; removable.

2.10 HOSE BIB BOXES

A. Manufacturers:

B. Material: 316 stainless steel.

- C. Finish: Satin.
- D. Mount in wall fully recessed.
- E. Provide with NPT PVC ball valves and fittings.
- F. Provide with internal hose drain bracket and waste outlet.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

3.2 INSTALLATION

- A. Install each fixture with trap, easily removable for servicing and cleaning.
- B. Provide chrome-plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.
- C. Install components level and plumb.
- D. Install and secure fixtures in place with wall supports and bolts.
- E. Solidly attach water closets to floor with lag screws. Lead flashing is not intended to hold fixture in place.

3.3 INTERFACE WITH WORK OF OTHER SECTIONS

- A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

END OF SECTION 22 40 00

DIVISION 23
HVAC

**SECTION 23 01 00
HVAC GENERAL PROVISIONS**

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. The Contractor shall provide all materials, equipment and labor necessary to install and set into operation the heating and air conditioning equipment as shown on the Engineering Drawings and as contained herein.

1.2 QUALITY ASSURANCE

- A. See the General and Supplementary General Conditions and Division 1.
- B. All work shall be in accordance with local, state and federal regulations. Minimum requirements shall be the North Carolina State Building Code.
- C. The Contractor shall be responsible for obtaining all permits and shall notify inspection departments as work progresses.
- D. Whenever the words "Approval", "Approved", or "Approved Equal" appear, it is intended that items other than the model number specified shall be subject to the approval of the engineer.
- E. All material and equipment that the Contractor proposed to substitute in lieu of those specified in the Specifications, shall be submitted to the Engineer ten (10) days prior to the bid date for evaluation. The submittal shall include a full description of the material or equipment and all pertinent engineering data required to substantiate the equality of the proposed item to that specified. Items that are submitted for approval after this date will not be accepted.
- F. "Provide" as used herein shall mean that the Contractor responsible shall furnish and install said item or equipment. "Furnish" as used herein shall mean that the Contractor responsible shall acquire and make available said item or equipment and that installation shall be by others. "Install" as used herein shall mean that the Contractor responsible shall make installation of items or equipment furnished by others.
- G. Boiler Inspection Certificate - It shall be the responsibility of the Contractor to complete the installation of fired or unfired pressure vessels and their safety devices in accordance with the requirements of the latest edition of the North Carolina Department of Labor, "Boiler Inspection Law, Rules and Regulations".
 - 1. The Contractor shall be responsible for notifying the Bureau of Boiler Inspection in writing at least two weeks prior to the date of completion of all equipment requiring inspection. Certificates furnished by the Bureau of Boiler Inspection shall be installed in a frame having a removable glass cover and posted near the pressure vessel. Certificates shall be installed before requesting final inspection of the completed project. The pressure vessel is NOT to be operated before it is inspected and approved.

1.3 SUBSTITUTIONS

- A. Products are specified for use on this project by one of the following:
 - 1. Reference Standards and Description: Any products meeting the Reference Standards and Description will be acceptable (i.e., piping).
 - 2. Naming of a product as an example to denote the quality standard of the product desired, in which case three or more brands will be denoted (where applicable) to establish equivalent designs. Naming of a product does not restrict Bidders to a specific brand (i.e., fixtures, valves, etc.).

3. Requests for approval of manufacturer's or substitutions which have not been preapproved shall be made by using the forms at the end of this section.
- B. During bidding period: Submitted written requests from Bidders Only, using the forms herein, will be considered if received ten (10) calendar days prior to the date of receipt of bids to allow for proper evaluation. Requests from suppliers or subcontractors will not be considered. Substitutions will be considered when a product becomes unavailable through no fault of the Contractor. A request constitutes a representation that the Bidder/Contractor:
1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product and is suitable for use in the Work.
 2. Will provide the same warranty for the substitution as for the specified product.
 3. Will coordinate installation and make changes to other work which may be required for the work to be complete with no additional cost to the Owner.
 4. Waives claims for additional cost or time extension which may subsequently become apparent.
 5. Has included a list of similar projects on which this product has been used with names and telephone numbers for verification.
 6. Has written verification from the product manufacturer that this product has been in use a minimum of two (2) years on a project similar to this work.
 7. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.
- C. Architect/Engineer Review
1. Review and approval will rely on manufacturer's literature and other data as outlined herein.
 2. Inadequacies in such submittals that fail to identify unsuitability are the responsibility of the parties making submittal.
- D. Substitution Procedure
1. Submit three copies of request for substitution for consideration. Limit each request to one proposed substitution.
 2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence.
 3. Submit listing of similar projects.
 4. Submit manufacturer's written verification that product has been in use a minimum of two (2) years at similar projects.
 5. The Architect/Engineer will notify Contractor, in writing, of decision to accept or reject request.
 6. Products bid or incorporated in the work that are not specified and without written approval of the Architect/Engineer may not be acceptable, and if not, the Contractor will be required to furnish and install the products specified.

7. The Architect/Engineer will issue written approvals of product substitutions to all Bidders. Substitutions are not approved without written approval.
8. FORMS: Copy forms incorporated at the end of this section and use for all product substitution requests.

1.4 SUBMITTALS

- A. See General and Supplementary General Conditions and Division 1.
- B. Within ten days after notification of the award of the Contract and written notice to begin work, the Contractor shall submit to the Architect/Engineer for approval a detailed list of equipment and material which he proposes to use. Items requiring submittal data for approval will be noted at this time.
- C. The Contractor shall provide an electronic PDF copy of submittal data. The pdf shall contain complete submittal data on all products, methods, etc. proposed for use on the project.
- D. Each submittal shall bear the approval of the Contractor indicating that he has reviewed the data and found it to meet the requirements of the specifications as well as space limitations and other project conditions. The submittals shall be clearly identified showing project name, manufacturer's catalog number, and all necessary performance and fabrication data.
- E. The Contractor shall submit to the Engineer a set of accurately marked up plans indicating all changes encountered during the construction. Final payment will be contingent on receipt of these as-built plans.
- F. The Contractor shall furnish an electronic PDF copy of maintenance and operating instructions as outlined in Paragraph C (Execution), of this specification section.
- G. The Contractor shall submit to the Owner all certificates required for operating system in compliance with local, state and federal regulations.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. All material and equipment shall be delivered and unloaded by the Contractor within the project site as noted herein or as directed by the Owner.
- B. The Contractor shall protect all material and equipment from breakage, theft, or weather damage. No material or equipment shall be stored on the ground.
- C. The material and equipment shall remain the property of the Contractor until the project has been completed and turned over to the Owner.

1.6 WORK CONDITIONS AND COORDINATION

- A. The Contractor shall review the electrical plans to establish points of connection and the extent of electrical work to be provided in his Contract. All electrical work shall be performed by a licensed electrical contracting firm.
 - B. This Contractor shall be responsible for the final electrical connections to all equipment installed as part of his contract. Unless otherwise noted, this Contractor shall wire from his equipment to disconnect switches, junction boxes, or panelboard circuit breakers as provided by the Electrical Contractor.
 - C. Electrical work shall be in accordance with all local, state and national codes and as specified in Division 26.
 - D. Pipe, conduit and duct chases required for installation of work shall be provided by the General Contractor unless otherwise noted. This Contractor shall be responsible for coordinating the location of all required
-

chases.

- E. All work shall be coordinated with other trades. Cutting of new work and subsequent patching shall be at the Contractor's expense at no extra cost to the Owner.

1.7 GUARANTEE

- A. See the General and Supplementary General Conditions
- B. Where extended warranties or guarantees are available from the manufacturer, the Contractor shall prepare the necessary contract documents to validate these warranties as required by the manufacturer and present them to the Architect/Engineer.
- C. The Contractor shall include in his bid a full warranty and guarantee for a five (5) year period on the compressors for the refrigeration equipment, including all chillers. This warranty does not include labor following the first year's Labor and Material Warranty.

PART 2 PRODUCT

2.1 GENERAL REQUIREMENTS

- A. Materials and equipment shall be new, unless noted otherwise, of the highest grade and quality and free from defects or other imperfections. Materials and equipment found defective shall be removed and replaced at the contractor's expense.
- B. The contractor shall provide name plates for identification of all equipment, switches, panels, etc.
- C. The name plates shall be laminated phenolic plastic, black front and back with white core, white engraved letters (1/4" minimum) etched into the white core. Name plates shall be fastened with sheet metal screws.

PART 3 EXECUTION

3.1 INSPECTION

- A. This Contractor shall examine the areas of completed work and shall insure that no defects or errors are present which would result in the poor application or installation of subsequent work.

3.2 INSTALLATION

- A. All work shall be performed in a manner indicating proficiency in the trade.
- B. This Contractor shall be responsible for completely cleaning the fireproofing from ALL materials or equipment installed as part of this Contract. This includes, but is not limited to, ductwork, piping, conduit, equipment, faceplates, boxes, disconnects, control panels, and cabling.
- C. All conduit, pipes, ducts, etc. shall be either parallel to building walls or plumb where installed in a vertical position and shall be concealed when located in architecturally finished areas.
- D. Any cutting or patching required for installation of this Contractor's work shall be kept to a minimum. Written approval shall be required by the Architect/Engineer if cutting of primary structure is involved.
- E. All patching shall be done in such a manner as to restore the areas or surfaces to match existing finishes.
- F. The Contractor shall lay out and install his work in advance of pouring concrete floors or walls. He shall furnish all sleeves to the General Contractor for openings through poured masonry floors or walls, above grade, required for passage of all conduits, pipes, or ducts installed by him. The Contractor shall provide all

inserts and hangers required to support his equipment.

- G. The annular space around ALL wall and floor penetrations shall be properly sealed. For rated assemblies, a UL listed method shall be used. For non-rated wall and floors, the annular space shall be packed with mineral wool, or another suitable non-combustible material, and caulked air tight.
- H. Installation of piping and ductwork shall not interfere with walkways or service access.
- I. All trapeze hanger rods shall be cut to within 1" of the bottom nut.

3.3 PERFORMANCE

- A. The Contractor shall perform all excavation and backfill operations necessary for installation of his work.

3.4 ERECTION

- A. All support steel, angles, channels, pipes or structural steel stands and anchoring devices that may be required to rigidly support or anchor material and equipment shall be provided by this Contractor.

3.5 FIELD QUALITY CONTROL

- A. The Contractor shall conform to the requirements of Division 3 for concrete testing.
- B. All testing required for compliance with the Contract shall be as stated in subsequent sections.

3.6 ADJUST AND CLEAN

- A. All equipment and installed materials shall be thoroughly clean and free of all dirt, oil, grit, grease, etc.
- B. Factory painted equipment shall not be repainted unless damaged areas exist. These areas shall be touched up with a material suitable for intended service. In no event shall name plates be painted.
- C. At a scheduled meeting, the Contractor shall instruct the Owner or the Owner's representative in the operation and maintenance of all equipment installed under his Contract (in the presence of the Engineer).
- D. Equipment with filter media shall be run for a period of two (2) weeks after completion of work at which time a new filter media shall be installed with one change of filter media provided the Owner for future replacement. (Provide a total of three (3) sets).
- E. The Contractor shall adjust the tension on all belts six months after the final inspection.

3.7 MAINTENANCE AND OPERATING MANUAL

- A. The Contractor shall prepare a PDF version of the manual describing the proper maintenance and system operation. This manual shall not consist of standard factory printed data intended for dimension or design purposes (although these may be included), but shall be prepared to describe this particular job. This manual shall include the following:
 - 1. A check list for periodic maintenance of all equipment.
 - 2. Suggested setting of all controls and switches for normal operation, with description of control and its location.
 - 3. A check list for seasonal shutdown.
 - 4. Maintenance and spare parts data for each major piece of equipment.

5. As-built wiring, interlock and control diagrams for equipment with color coding shown on wiring and interlock diagrams.
 6. Air and Water Balance Report.
- B. The PDF shall be indexed, bookmarked, dated and signed by the Contractor when completed.
- C. The operating and maintenance manuals shall be submitted to the Engineer for approval. When the manuals are considered complete by the Engineer, they will be turned over to the Owner for their permanent use.

END OF SECTION 23 01 00 23 01 00

**SECTION 23 05 12
ELECTRICAL WORK**

PART 1 GENERAL

1.1 DIVISION OF WORK

- A. This Contractor shall be responsible for the final electrical and the entire control connections and wiring to all equipment installed as part of his contract.
- B. Contractor shall review the electrical plans, where applicable, to establish points of connection and the extent of his electrical work to be provided in his contract.
- C. Unless otherwise noted, this Contractor shall wire from his equipment to disconnect switches, junction boxes, or panelboard circuit breakers as provided by the Electrical Contractor or as required by the existing conditions.
- D. All power and control wiring shall be in conduits. Refer to electrical specifications for conduit and conduit fittings.
- E. All electrical work shall be performed by a licensed electrician.
- F. All electrical work shall be in accordance with the State Building Code and all its supplements, the latest edition of the National Electrical Code and the electrical specifications.

PART 2 PRODUCT

2.1 GENERAL REQUIREMENTS

- A. All motor starters, disconnects, switches, relays, conduits, conductors, etc. that are required for a complete electrical power and/or control system shall conform to the requirements set forth by NEC.
- B. Refer to the plans for the type, size and electrical characteristics of the starters, disconnects, switches, relays, conductor and conduits.
- C. All conductors and conduits shall be sized as noted on the plans or As required per NEC.
- D. All individual motor starters for mechanical equipment (i.e., fans, pumps, etc.) shall be furnished and installed under Division 23.
- E. All relays, actuators, timers, seven-day clocks, alternators, pressure, vacuum, float, flow, pneumatic-electric, and electric-pneumatic switches, aquastats, freezestats, line and low voltage thermostats, thermals, remote selector switches, remote push-button stations, emergency break-glass stations, interlocking, disconnect switches beyond termination point, and other appurtenances associated with equipment under Division 23 shall be furnished, installed and wired under Division 23.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

- A. All motor starters, disconnects, and switches shall be installed on or as close to the equipment they are serving as possible, or where shown on the plans.
- B. Electrical connection to equipment subject to vibration which develops objectionable noises shall be made from the conduit system with short lengths of flexible "Liquid-Tite" conduit. Connection to other equipment shall be made with rigid conduit.

- C. Conduits shall be run in a concealed space such as wall cavities, ceiling cavities, etc. except in the mechanical rooms where conduit may be run exposed.

END OF SECTION 23 05 12 23 05 12

**SECTION 23 05 13
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General construction and requirements.
- B. Applications.
- C. Single phase electric motors.
- D. Three phase electric motors.
- E. Electronically Commutated Motors (ECM).

1.2 RELATED REQUIREMENTS

- A. Section 26 05 83 - Wiring Connections: Electrical characteristics and wiring connections.
- B. Section 26 29 13 - Enclosed Controllers.

1.3 REFERENCE STANDARDS

- A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015 (Reaffirmed 2020).
- B. IEEE 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators; 2017.
- C. NEMA MG 1 - Motors and Generators; 2021.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 SUBMITTALS

- A. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.
- B. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.
- C. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.5 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Provide certificate of compliance from Authority Having Jurisdiction indicating approval of high efficiency motors.
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Baldor Electric Company/ABB Group
- B. General Electric
- C. Leeson Electric Corporation
- D. Marathon
- E. Regal-Beloit Corporation (Century)
- F. Or Approved Equal

2.2 GENERAL CONSTRUCTION AND REQUIREMENTS

- A. Electrical Service:
 - 1. Motors 3/4 HP and Smaller: 115 volts, single phase, 60 Hz.
 - 2. Motors Larger than 3/4 Horsepower: 208/480 volts, three phase, 60 Hz as indicated on the Drawings.
- B. Nominal Efficiency:
 - 1. All motors shall be premium efficiency and meet or exceed the requirements of ASHRAE Standard 90.1-2013 and the North Carolina Energy Code.
 - 2. All motors shall conform to the efficiency standard for integral horsepower motors known as 10 CFR Part 431 Subpart B published by the US Department of Energy.
- C. Construction:
 - 1. Open drip-proof type except where specifically noted otherwise.
 - 2. Design for continuous operation in 104 degrees F environment.
 - 3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
- D. Motors driven by variable frequency drives (VFDs) shall be inverter duty and have a shaft grounding ring.
- E. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
- F. Wiring Terminations:
 - 1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
 - 2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.3 APPLICATIONS

- A. Exception: Motors less than 250 watts, for intermittent service may be the equipment manufacturer's standard and need not comply with these specifications.
- B. Motors located in exterior locations, air cooled condensers, humidifiers, direct drive axial fans, and explosion proof environments: Totally enclosed type.

2.4 SINGLE PHASE POWER - SPLIT PHASE MOTORS

- A. Starting Torque: Less than 150 percent of full load torque.
- B. Starting Current: Up to seven times full load current.
- C. Breakdown Torque: Approximately 200 percent of full load torque.
- D. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.
- E. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.5 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

- A. Starting Torque: Exceeding one fourth of full load torque.
- B. Starting Current: Up to six times full load current.
- C. Multiple Speed: Through tapped windings.
- D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

2.6 THREE PHASE POWER - SQUIRREL CAGE MOTORS

- A. Starting Torque: Between 1 and 1-1/2 times full load torque.
- B. Starting Current: Six times full load current.
- C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
- D. Insulation System: NEMA Class B or better.
- E. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.
- F. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
- G. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- H. Weatherproof Epoxy Sealed Motors: Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.

- I. Nominal Efficiency: As indicated at full load and rated voltage when tested in accordance with IEEE 112.
- J. Nominal Power Factor: As indicated at full load and rated voltage when tested in accordance with IEEE 112.

2.7 ELECTRONICALLY COMMUTATED MOTORS (ECM)

A. Applications:

1. Commercial:

a. Hydronic Fan - Blower Coil Unit:

- 1) Operating Mode: Constant cfm.
- 2) Input: Motor manufacturer to coordinate control requirements with the control board of the fan coil unit and/or specified sequence of operation.
- 3) Shaft Extension: Single.
- 4) Options: User-interface.
- 5) RPM: 300 through 1800.

b. Hydronic Pump:

- 1) Operating Mode: Constant speed.
- 2) Input: Motor manufacturer to coordinate control requirements with the control board of the hydronic pump and/or specified sequence of operation.
- 3) Flange Configuration: "C".

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- C. Check line voltage and phase and ensure agreement with nameplate.
- D. Motors with belt drives shall have adjustable motor mountings. Motor mounts shall have adjustable locking device for fixing motor position.
- E. Motor starters shall be installed as close to the motors they are serving as possible.
- F. Motor starters shall be installed at locations and heights to meet all State requirements and National Electric Code.

END OF SECTION 23 05 13

**SECTION 23 05 16
EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Flexible pipe connectors.
- B. Expansion joints and compensators.

1.2 RELATED REQUIREMENTS

- A. Section 23 21 13 - Hydronic Piping.
- B. Section 23 23 00 - Refrigerant Piping.

1.3 REFERENCE STANDARDS

- A. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2022.
- B. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984, with Editorial Revision (2019).

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data:
 - 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
 - 2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.

PART 2 PRODUCTS

2.1 FLEXIBLE PIPE CONNECTORS - STEEL PIPING

- A. Manufacturers:
 - 1. Flex-Weld, Inc: www.kelcoind.com/#sle.
 - 2. Mercer Rubber Company: www.mercer-rubber.com/#sle.
 - 3. The Metraflex Company: www.metraflex.com/#sle.
- B. Inner Hose: Bronze.
- C. Exterior Sleeve: Single braided, stainless steel.
- D. Pressure Rating: 125 psi up to 12 inch.
- E. Maximum Service Temperature: 450 degrees F.

- F. End Connections: Flanged.
- G. Size: Use pipe sized units.

2.2 FLEXIBLE PIPE CONNECTORS - COPPER PIPING

- A. Manufacturers:
 - 1. Mercer Rubber Company: www.mercer-rubber.com/#sle.
 - 2. The Metraflex Company: www.metraflex.com/#sle.
- B. Inner Hose: Bronze.
- C. Exterior Sleeve: Braided bronze.
- D. Pressure Rating: 125 psi up to 2 inch.
- E. Maximum Service Temperature: 450 degrees F.
- F. End Connections: Flanged.
- G. Size: Use pipe sized units.
- H. Maximum offset: 3/4 inch on each side of installed center line.
- I. Application: Copper piping.

2.3 EXPANSION JOINTS - STAINLESS STEEL BELLOWS TYPE

- A. Manufacturers:
 - 1. Flex-Weld, Inc; Keflex 7Q Series - Quadra-Side: www.kelcoind.com/#sle.
 - 2. Mercer Rubber Company: www.mercer-rubber.com/#sle.
 - 3. The Metraflex Company: www.metraflex.com/#sle.
- B. Maximum Compression: 1-3/4 inches.
- C. Maximum Extension: 1/4 inch.
- D. End Connections: Externally pressurized with flanged ends.

2.4 EXPANSION JOINTS - HOSE AND BRAID

- A. Manufacturers:
 - 1. Flex-Weld, Inc; Keflex Ke-Loop: www.kelcoind.com/#sle.
 - 2. The Metraflex Company; Metraloop: www.metraflex.com/#sle.
 - 3. Unisource Manufacturing, Inc; V-Loop: www.unisource-mfg.com/#sle.
- B. Provide flexible loops with two flexible sections of hose and braid, two 90 degree elbows, and 180 degree return with support brackets and plugged drain port for steam service.

SECTION 23 05 16 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

- C. Maximum Allowable Motion: 2 inch in the x, y, and z planes with no thrust loads to the building structure
- D. Maximum Working Pressure: 150 psi at 800 degrees F.
- E. Construction: Class 150, schedule 40, stainless steel hose and braid assembly with carbon steel fittings, including elbows and flanged end connections sized to match pipe segment
 - 1. Provide necessary accessories including, but not limited to, swivel joints.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

END OF SECTION 23 05 16

**SECTION 23 05 17
SLEEVES AND SLEEVE SEALS FOR HVAC PIPING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe sleeves.
- B. Pipe-sleeve seals.

1.2 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 23 05 23 - General-Duty Valves for HVAC Piping.
- C. Section 23 07 16 - HVAC Equipment Insulation.
- D. Section 23 07 19 - HVAC Piping Insulation.

1.3 REFERENCE STANDARDS

- A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2022a.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.

PART 2 PRODUCTS

2.1 PIPE SLEEVES

- A. Manufacturers:
 - 1. Flexicraft Industries; Pipe Wall Sleeve: www.flexicraft.com/#sle.
- B. Vertical Piping:
 - 1. Sleeve Length: 1 inch above finished floor.
 - 2. Provide sealant for watertight joint.
- C. Pipe Passing Through Below Grade Exterior Walls:
 - 1. Zinc coated or cast iron pipe.
 - 2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.
- D. Penetrations in concrete beam flanges are permitted but are prohibited through ribs or beams without prior approval from the Architect.

E. Clearances:

1. Provide allowance for insulated piping.
2. Wall, Floor, Partitions, and Beam Flanges: 1 inch greater than external pipe diameter.
3. All Rated Openings: Caulked tight with fire stopping material in compliance with ASTM E814 in accordance with Section 07 84 00 to prevent the spread of fire, smoke, and gases.

2.2 PIPE-SLEEVE SEALS

A. Manufacturers:

1. Advance Products & Systems, LLC; Innerlynx: www.apsonline.com/#sle.
2. American Polywater Corporation; PGKD Modular Seals: www.polywater-haufftechnik.com/#sle.

B. Modular Mechanical Sleeve-Seal:

1. Elastomer-based interlocking links continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
2. Watertight seal between pipe and wall-sleeve, wall or casing opening.
3. Size and select seal component materials in accordance with service requirements.
4. Service Requirements:
 - a. Corrosion resistant.
5. Glass-reinforced plastic pressure end plates.

C. Sealing Compounds:

1. Provide packing and sealing compound to fill pipe to sleeve thickness.
2. Combined packing and seal compound is to match partition fire-resistance hourly rating.

D. Pipe Sleeve Material:

1. Bearing Walls: Steel, cast iron, or terra-cotta pipe.
2. Masonry Structures: Sheet metal or fiber.

E. Wall Sleeve: PVC material with waterstop collar, and nailer end-caps.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- B. Install piping to conserve building space, to not interfere with use of space and other work.
- C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

- D. Inserts:
1. Provide inserts for placement in concrete formwork.
 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- E. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
1. Underground Piping: Caulk pipe sleeve watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.
 2. Aboveground Piping:
 - a. Pack solid using mineral fiber in compliance with ASTM C592.
 - b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.
 3. All Rated Openings: Caulk tight with fire stopping material in compliance with ASTM E814 in accordance with Section 07 84 00 to prevent the spread of fire, smoke, and gases.
 4. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.
- F. Manufactured Sleeve-Seal Systems:
1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
 2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
 3. Locate piping in center of sleeve or penetration.
 4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
 5. Tighten bolting for a water-tight seal.
 6. Install in accordance with manufacturer's recommendations.
- G. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

END OF SECTION 23 05 17

**SECTION 23 05 19
METERS AND GAUGES FOR HVAC PIPING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pressure gauges and pressure gauge taps.
- B. Thermometers and thermometer wells.

1.2 REFERENCE STANDARDS

- A. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014 (Reapproved 2020).
- B. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014 (Reapproved 2021).

1.3 SUBMITTALS

- A. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.
- B. Project Record Documents: Record actual locations of components and instrumentation.

1.4 FIELD CONDITIONS

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.1 PRESSURE GAUGES

- A. Manufacturers:
 - 1. Dwyer Instruments, Inc
 - 2. Moeller Instrument Company, Inc
 - 3. Omega Engineering, Inc
 - 4. U.S. Gauge
 - 5. Or Approved Equal
- B. Pressure Gauges: Liquid filled, 316L stainless steel case and bezel ring, seamless 316L stainless steel bourdon tube, 304 stainless steel movement, 316L stainless steel process connection, with front recalibration adjustment, white aluminum dial with black lettering.
 - 1. 4" diameter
 - 2. Range: 0-100 psi or to match system pressure
 - 3. Accuracy: +/- 1% of full scale
 - 4. Window: Shatter resistant glass or polycarbonate

5. Pointer: Aluminum, black painted
 6. Working Pressure: 125% of full scale
 7. Working temperature:
 - a. Ambient: -40 - 140 Degrees F
 - b. Fluid: -4 - 212 Degrees F
 8. Weather Protection: NEMA 4X/IP67
 9. Liquid: Glycerin, Mineral oil, or Silicon oil
- C. Gauges used on cooling tower pumps shall be compound gauges.

2.2 PRESSURE GAUGE TAPPINGS

- A. Gauge Cock: Tee or lever handle, brass for maximum 150 psi.
- B. Needle Valve: Brass, 1/4 inch NPT for minimum 150 psi.
- C. Pulsation Damper: Pressure snubber, brass with 1/4 inch connections.

2.3 STEM TYPE THERMOMETERS

- A. Manufacturers:
 1. Dwyer Instruments, Inc
 2. Omega Engineering, Inc
 3. Weksler Glass Thermometer Corp
 4. Or Approved Equal
- B. Thermometers - Adjustable Angle: Blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
 1. Size: 9 inch scale.
 2. Window: Clear Lexan.
 3. Stem: 3/4 inch 304 stainless steel.
 4. Accuracy: 1 percent Full Scale, ASME B40.3.
 5. Calibration: Degrees F.
 6. Range:
 - a. Hot Water: 30 - 180 Degrees F

2.4 DIAL THERMOMETERS

- A. Manufacturers:
-

1. Dwyer Instruments, Inc
 2. Omega Engineering, Inc
 3. Weksler Glass Thermometer Corp
- B. Thermometers - Fixed Mounting: Dial type bimetallic actuated; ASTM E1; stainless steel case, silicone fluid damping, white with black markings and black pointer, hermetically sealed lens, stainless steel stem.
1. Size: 5 inch diameter dial.
 2. Lens: Clear Lexan.
 3. Accuracy: 1 percent.
 4. Calibration: Degrees F.

2.5 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

2.6 TEST PLUGS

- A. Test Plug: 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with neoprene core for temperatures up to 200 degrees F.
- B. Test Kit: Carrying case, internally padded and fitted containing one 3-1/2 inch diameter pressure gauges, two gauge adapters with 1/8 inch probes, two 1-1/2 inch dial thermometers.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install pressure gauges with pulsation dampers. Provide ball valve to isolate each gauge. Extend nipples to allow clearance from insulation.
- C. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
- D. Install thermometer sockets adjacent to controls system thermostat, transmitter, or sensor sockets. Refer to Section 23 09 23.
- E. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- F. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- G. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- H. Locate test plugs adjacent to pressure gages and pressure gage taps and thermometers and thermometer sockets.

END OF SECTION 23 05 19

**SECTION 23 05 23
GENERAL-DUTY VALVES FOR HVAC PIPING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Applications.
- B. Globe valves.
- C. Ball valves.
- D. Butterfly valves.
- E. Check valves.
- F. Gate valves.
- G. Plug valves.
- H. Chainwheels.

1.2 ABBREVIATIONS AND ACRONYMS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. PTFE: Polytetrafluoroethylene.
- G. RS: Rising stem.
- H. SWP: Steam working pressure.
- I. TFE: Tetrafluoroethylene.
- J. WOG: Water, oil, and gas.

1.3 REFERENCE STANDARDS

- A. ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).
- B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
- C. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard; 2020.
- D. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- E. ASME B31.9 - Building Services Piping; 2020.

- F. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2021.
- G. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2022.
- H. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2023).
- I. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2022).
- J. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984, with Editorial Revision (2019).
- K. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.
- L. AWWA C606 - Grooved and Shouldered Joints; 2015.
- M. MSS SP-67 - Butterfly Valves; 2022.
- N. MSS SP-68 - High Pressure Butterfly Valves with Offset Design; 2021.
- O. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves; 2019.
- P. MSS SP-108 - Resilient-Seated Cast Iron Eccentric Plug Valves; 2020.
- Q. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .
- R. MSS SP-125 - Check Valves: Gray Iron and Ductile Iron, In-Line, Spring-Loaded, Center-Guided; 2018.

1.4 SUBMITTALS

- A. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- B. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- C. Maintenance Materials: Furnish Owner with one wrench for every five plug valves, in each size of square plug valve head.
 - 1. See Section 01 60 00 - Product Requirements for additional provisions.

1.5 QUALITY ASSURANCE

- A. Manufacturer:
 - 1. Obtain valves for each valve type from single manufacturer.
 - 2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Welding Materials and Procedures: Comply with ASME BPVC-IX.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
 - 2. Protect valve parts exposed to piped medium against rust and corrosion.
 - 3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
 - 4. Secure check valves in either the closed position or open position.
 - 5. Adjust butterfly valves to closed or partially closed position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection and protect flanges and specialties from dirt.
 - a. Provide temporary inlet and outlet caps.
 - b. Maintain caps in place until installation.
 - 2. Store valves in shipping containers and maintain in place until installation.
 - a. Store valves indoors in dry environment.
 - b. Store valves off the ground in watertight enclosures when indoor storage is not an option.
- C. Exercise the following precautions for handling:
 - 1. Handle large valves with sling, modified to avoid damage to exposed parts.
 - 2. Avoid the use of operating handles or stems as rigging or lifting points.

PART 2 PRODUCTS

2.1 APPLICATIONS

- A. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).
- B. Provide the following valves for the applications if not indicated on drawings:
 - 1. Isolation (Shutoff): Butterfly and Ball.
 - 2. Swing Check (Pump Outlet):
 - a. Size 2 inch and Smaller: Bronze with bronze disc.
 - b. 2-1/2 NPS and Larger: Iron with center-guided with resilient seat.
 - 3. Dead-End: Butterfly, single-flange (lug) type.
- C. Substitutions of valves with higher CWP classes or WSP ratings for same valve types are permitted when specified CWP ratings or WSP classes are not available.
- D. Required Valve End Connections for Non-Wafer Types:
 - 1. Steel Pipe:

- a. Size 2 inch and Smaller: Threaded ends.
 - b. Size 2-1/2 inch and Larger: Welded.
2. Copper Tube:
- a. 2 NPS and Smaller: Solder-joint valve-ends.
- E. Chilled Water Valves:
- 1. 2 NPS and Smaller, Bronze Valves:
 - a. Ball: Full port, two piece, stainless steel trim.
 - b. Swing Check: Bronze disc, Class 150.
 - c. Gate: NRS, Class 125.
 - d. Globe: Bronze disc, Class 125.
 - 2. 2-1/2 NPS and Larger, Iron Valves:
 - a. 2-1/2 NPS to 4 NPS: Threaded ends.
 - b. Ball: 2-1/2 NPS to 10 NPS, Class 150.
 - c. Single-Flange Butterfly: 2-1/2 NPS to 12 NPS, aluminum-bronze disc, EPDM seat, 200 CWP.
 - d. Butterfly: High performance, single flange, Class 150.
 - e. Center-Guided Check: Compact-wafer, resilient seat, Class 150.
 - f. Eccentric Plug: Resilient seating, 175 CWP.
- F. Heating Hot Water Valves:
- 1. 2 NPS and Smaller, Bronze Valves:
 - a. Threaded ends for steel pipe.
 - b. Soldered ends for copper pipe.
 - c. Ball: Full port, two piece, stainless steel trim.
 - d. Swing Check: Bronze disc, Class 150.
 - 2. 2-1/2 NPS and Larger, Iron Valves:
 - a. Butterfly: High performance, single flange, Class 150.
 - b. Center-Guided Check: Compact-wafer, resilient seat, Class 150.

2.2 MANUFACTURERS

- A. Provide all valves of each type from a single manufacturer.
- B. Manufacturers:

1. Anvil
2. Apollo
3. Crane
4. Hammond
5. ITT Grinnell
6. Milwaukee
7. Nibco
8. Powell
9. Victaulic
10. Or Approved Equal

2.3 GENERAL REQUIREMENTS

- A. Valve Pressure and Temperature Ratings: No less than rating indicated.
- B. Valve Sizes: Match upstream piping unless otherwise indicated.
- C. Valve Actuator Types:
 1. Gear Actuator: Quarter-turn valves 8 NPS and larger.
 2. Handwheel: Valves other than quarter-turn types.
 3. Hand Lever: Quarter-turn valves 6 NPS and smaller.
 4. Wrench: Plug valves with square heads.
 5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator, of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- D. Valves in Insulated Piping: Provide 2-1/4" stem extensions and the following features:
 1. Chilled Water Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 2. Hot Water Ball Valves: Metal stem extension is acceptable.
 3. Butterfly Valves: Extended neck.
- E. Valve-End Connections:
 1. Threaded End Valves: ASME B1.20.1.
 2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
 3. Pipe Flanges and Flanged Fittings 1/2 NPS through 24 NPS: ASME B16.5.
 4. Solder Joint Connections: ASME B16.18.

- 5. Grooved End Connections: AWWA C606.
- F. General ASME Compliance:
 - 1. Building Services Piping Valves: ASME B31.9.
- G. Bronze Valves:
 - 1. Fabricate from dezincification resistant material.
 - 2. Copper alloys containing more than 15 percent zinc are not permitted.
- H. Source Limitations: Obtain each valve type from a single manufacturer.

2.4 BRONZE, GLOBE VALVES

- A. Class 150: CWP Rating: 300 psig.:
 - 1. Comply with MSS SP-80, Type 1.
 - 2. Body: Bronze; ASTM B62, with integral seat and screw in bonnet.
 - 3. Ends: Threaded or solder joint.
 - 4. Stem and Disc: Bronze or PTFE.
 - 5. Packing: Asbestos free.
 - a. Handwheel: Malleable iron.

2.5 BRONZE, BALL VALVES

- A. General:
 - 1. Fabricate from dezincification resistant material.
 - 2. Copper alloys containing more than 15 percent zinc are not permitted.
- B. Two Piece, Full Port with Stainless Steel Trim:
 - 1. Comply with MSS SP-110.
 - 2. SWP Rating: 150 psig.
 - 3. CWP Rating: 600 psig.
 - 4. Body: Bronze
 - 5. Stem: 316 Stainless steel.
 - 6. Ball: Stainless steel vented.
 - 7. Handle: Provide lever handle with 2-1/4" stem extension for insulation. On chilled water valves or other fluids below ambient temperature, use non-conductive handle extensions.

2.6 IRON, SINGLE FLANGE BUTTERFLY VALVES

A. Lug type: Bi-directional dead end service without downstream flange.

1. Comply with MSS SP-67, Type I.
2. CWP Rating: 150 psig.
3. Body Material: ASTM A536 ductile iron.
4. Seat: EPDM or Viton.
5. Disc: Aluminum-bronze.

2.7 HIGH-PERFORMANCE SINGLE FLANGE BUTTERFLY VALVES

A. Lug type: Bi-directional dead end service without downstream flange.

1. Comply with MSS SP-68.
2. Class 150: CWP Rating: 285 psig at 100 degrees F.
3. Body: Provide ductile Iron.
4. Seat: Metal or reinforced PTFE.
5. Offset stem: Stainless steel.
6. Disc: Stainless steel or Aluminum-bronze.

2.8 BRONZE SWING CHECK VALVES

A. Class 150: CWP Rating: 300 psig (2070 kPa).

1. Comply with MSS SP-80, Type 3.
2. Body Design: Horizontal flow.
3. Body Material: Bronze, ASTM B62.
4. Ends: Threaded.
5. Disc: Bronze.

2.9 IRON, CENTER-GUIDED CHECK VALVES

A. Class 150, Compact-Wafer:

1. Comply with MSS SP-125.
2. 2-1/2 NPS to 12 NPS, CWP Rating: 300 psig.
3. Body Material: ASTM A395/A395M or ASTM A536, ductile iron or cast iron.
4. Resilient Seat: EPDM or NBR.

2.10 BRONZE, GATE VALVES

A. Non-Rising Stem (NRS):

1. Comply with MSS SP-80, Type I.
2. Class 150: CWP Rating: 300 psig.
3. Body Material: Bronze with integral seat and union-ring bonnet.
4. Ends: Threaded.
5. Stem: Bronze.
6. Disc: Solid wedge; bronze.
7. Packing: Asbestos free.
8. Handwheel: Malleable iron or bronze.

2.11 ECCENTRIC PLUG VALVES

- A. Resilient Seating with Flanged Ends.
 1. Comply with MSS SP-108.
 2. CWP Rating: 175 psig minimum.
 3. Body and Plug: Gray or ductile iron.
 4. Bearings: Oil-impregnated bronze or Stainless Steel.
 5. Stem-Seal Packing: Asbestos free.
 6. Plug, Resilient-Seating Material: Approved for potable water service.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Discard all packing materials and verify that valve interior, including threads and flanges, are completely clean without signs of damage or degradation that could result in leakage.
- B. Verify valve parts to be fully operational in all positions from closed to fully open.
- C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.
- D. Should valve be determined to be defective, replace with new valve.

3.2 INSTALLATION

- A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.
- B. All valves shall be installed within 24" of the lay-in ceiling.
- C. DO NOT install valves above cable tray.
- D. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.

SECTION 23 05 23 - GENERAL-DUTY VALVES FOR HVAC PIPING

- E. Where valve support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welds.
- F. Install check valves where necessary to maintain direction of flow as follows:
 - 1. Swing Check: Install horizontal maintaining hinge pin level.
 - 2. Orient center-guided into horizontal or vertical position, between flanges.

END OF SECTION 23 05 23

SECTION 23 05 29
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Support and attachment components.

1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 05 50 00 - Metal Fabrications: Materials and requirements for fabricated metal supports.
- C. Section 23 05 48 - Vibration and Seismic Controls for HVAC.

1.3 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping; 2023.
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
- F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
- G. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2022).
- H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- I. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
- J. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023c.
- L. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a, with Editorial Revision (2023).
- M. FM (AG) - FM Approval Guide; Current Edition.
- N. MFMA-4 - Metal Framing Standards Publication; 2004.
- O. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).

- P. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- Q. UL (DIR) - Online Certifications Directory; Current Edition.
- R. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.

PART 2 PRODUCTS

2.1 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
 - 1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
 - 2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
 - 3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
 - 4. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
 - a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
 - B. Prefabricated Trapeze-Framed Metal Strut Systems:
 - 1. Strut Channel or Bracket Material:
 - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
 - 2. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
 - 3. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.
 - 4. Accessories: Provide bracket covers, cable basket clips, cable tray clips, clamps, conduit clamps, fire-retarding brackets, j-hooks, protectors, and vibration dampeners.
 - C. Hanger Rods:
 - 1. Threaded zinc-plated steel unless otherwise indicated.
-

2. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2 inch diameter.
 - b. Piping up to 1 inch: 1/4 inch diameter.
 - c. Piping larger than 1 inch: 3/8 inch diameter.
 - d. Trapeze Support for Multiple Pipes: 3/8 inch diameter.

- D. Thermal Insulated Pipe Supports:
 1. General Requirements:
 - a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
 - b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
 - c. Pipe supports to be provided for nominally sized, 1/2 to 30 inch iron pipes.
 - d. Insulation inserts to consist of rigid phenolic foam insulation surrounded by a 360 degree, PVC jacketing.
 2. PVC Jacket:
 - a. Pipe insulation protection shields to be provided with a ball bearing hinge and locking seam.
 - b. Minimum Service Temperature: Minus 40 degrees F.
 - c. Maximum Service Temperature: 180 degrees F.
 - d. Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.
 - e. Thickness: 60 mil.
 - f. Connections: Brush on welding adhesive.
 3. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.
 4. Products:
 - a. Buckaroos, Inc; CoolDry: www.buckaroos.com/#sle.

- E. Pipe Supports:
 1. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
 2. Liquid Temperatures Up To 122 degrees F:
 - a. Overhead Support: MSS SP-58 Types 1, 3 through 12.
 - b. Support From Below: MSS SP-58 Types 35 through 38.

3. Operating Temperatures from 122 to 446 degrees F:
 - a. Overhead Support: MSS SP-58 Type 1 or 3 through 12, with appropriate saddle of MSS SP-58 Type 40 for insulated pipe.
 - b. Roller Support: MSS SP-58 Types 41 or 43 through 46, with appropriate saddle of MSS SP-58 Type 39 for insulated pipe.
 - c. Sliding Support: MSS SP-58 Types 35 through 38.

- F. Beam Clamps:
 1. Manufacturers:
 - a. FNW; 7201: www.fnw.com/#sle.
 - b. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. MSS SP-58 types 19 through 23, 25 or 27 through 30 based on required load.
 3. Beam C-Clamp: MSS SP-58 type 23, malleable iron and steel with plain, stainless steel, and zinc finish.
 4. Small or Junior Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish. For inverted usage provide manufacturer listed size(s).
 5. Wide Mouth Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish.
 6. Centerload Beam Clamp with Extension Piece: MSS SP-58 type 30, malleable iron with plain finish.
 7. FM (AG) and UL (DIR) Approved Beam Clamp: MSS SP-58 type 19, plain finish,
 8. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
 9. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.

- G. Riser Clamps:
 1. Manufacturers:
 - a. FNW; 7020: www.fnw.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
 3. MSS SP-58 type 1 or 8, carbon steel or steel with epoxy plated, plain, stainless steel, or zinc plated finish.
 4. Medium Split Horizontal Pipe Clamp: MSS SP-58 type 4, carbon steel or stainless steel with epoxy plated, plain, stainless steel, or zinc plated finish.
 5. Copper Tube Pipe Clamp: MSS SP-58 type 8, epoxy plated copper.

6. UL (DIR) listed: Pipe sizes 1/2 to 8 inch.
- H. U-Bolts:
1. Manufacturers:
 - a. FNW; 7610: www.fnw.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. MSS SP-58 Type 24, carbon steel u-bolt for pipe support or anchoring.
- I. Offset Pipe Clamps: Double-leg design two-piece pipe clamp.
- J. Strut Clamps:
1. Manufacturers:
 - a. FNW; 7815: www.fnw.com/#sle.
 - b. Gripple Inc; GCS: www.gripple.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. Pipe Clamp: Two-piece rigid, universal, or outer diameter type, carbon steel with epoxy copper or zinc finish.
 3. Cushioned Pipe or Tubing Strut Clamp: Provide strut clamp with thermoplastic elastomer cushion having dielectric strength of 670 V/mil.
 4. Service Temperature Range: Minus 65 to 275 degrees F.
- K. Insulation Clamps:
1. Manufacturers:
 - a. FNW; 7897: www.fnw.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. Two bolt-type clamps designed for installation under insulation.
 3. Material: Carbon steel with epoxy copper or zinc finish.
- L. Pipe Hangers:
1. Split Ring Hangers:
 - a. Provide hinged split ring and yoke roller hanger with epoxy copper or plain finish.
 - b. Material: ASTM A47/A47M malleable iron or ASTM A36/A36M carbon steel.

SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

- c. Provide hanger rod and nuts of the same type and material for a given pipe run.
 - d. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.
2. Band Hangers, Adjustable:
- a. Manufacturers:
 - 1) Substitutions: See Section 01 60 00 - Product Requirements.
 - 2) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - b. MSS SP-58 Type 7 or 9, Zinc-plated ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
3. J-Hangers, Adjustable:
- a. Manufacturers:
 - 1) FNW; 7025: www.fnw.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
 - b. MSS SP-58 Type 5, Zinc-plated ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
4. Swivel Ring Hangers, Adjustable:
- a. MSS SP-58 Type 10, epoxy-painted, zinc-colored.
 - b. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
 - c. FM (AG) and UL (DIR) listed for specific pipe size runs and loads.
- M. Intermediate Pipe Guides:
- 1. Manufacturers:
 - a. Substitutions: See Section 01 60 00 - Product Requirements.
 - b. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - 2. Pipe Diameter 6 inch and Smaller: Provide minimum clearance of 0.16 inch.
 - 3. Pipe Sizes 8 inch: 0.625 inch U-bolt with double nuts providing minimum clearance of 0.28 inch.
 - 4. Pipe Size 10 inch: 0.75 inch U-bolt.
 - 5. Pipe Sizes 12 to 16 inch: 0.875 inch U-bolt.
 - 6. Pipe Sizes 18 to 30 inch: 1 inch U-bolt.
 - 7. Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.
- N. Pipe Alignment Guides: Galvanized steel.
- 1. Pipe Sizes 8 inch and Smaller: Spider or sleeve type.

2. Pipe Sizes 10 inch and Larger: Roller type.
- O. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.
- P. Nonpenetrating Rooftop Supports for Low-Slope Roofs:
 1. Manufacturers:
 - a. Anvil International; H-Block: www.anvilintl.com/#sle.
 - b. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - c. Erico International Corporation, a brand of Pentair: www.erico.com/#sle.
 - d. Green Link, Inc: www.greenlinkengineering.com/#sle.
 - e. PHP Systems/Design: www.phpsd.com/#sle.
 - f. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
 - g. Substitutions: See Section 01 60 00 - Product Requirements.
 2. Provide steel pedestals with thermoplastic or rubber base that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
 3. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 4. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
 5. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.
- Q. Pipe Shields for Insulated Piping:
 1. Manufacturers:
 - a. Anvil International: www.anvilintl.com/#sle.
 - b. FNW; 7750: www.fnw.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. General Construction and Requirements:
 - a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
 - b. Shields Material: UV-resistant polypropylene with glass fill.
 - c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch.
 - d. Minimum Service Temperature: Minus 40 degrees F.

- e. Maximum Service Temperature: 178 degrees F.
 - f. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
- R. Anchors and Fasteners:
- 1. Manufacturers - Mechanical Anchors:
 - a. FNW; 7502: www.fnw.com/#sle.
 - b. Hilti, Inc: www.us.hilti.com/#sle.
 - c. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com/#sle.
 - d. Powers Fasteners, Inc: www.powers.com/#sle.
 - e. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
 - f. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Manufacturers - Powder-Actuated Fastening Systems:
 - a. Hilti, Inc: www.us.hilti.com/#sle.
 - b. ITW Ramset, a division of Illinois Tool Works, Inc: www.ramset.com/#sle.
 - c. Powers Fasteners, Inc: www.powers.com/#sle.
 - d. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
 - 3. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
 - 4. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
 - 5. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
 - 6. Hollow Masonry: Use toggle bolts.
 - 7. Hollow Stud Walls: Use toggle bolts.
 - 8. Steel: Use beam-ceiling clamps, beam clamps, machine bolts, or welded threaded studs.
 - 9. Beam Ceiling Flanges: ASTM A47/A47M Grade 32510, malleable iron or stainless steel with copper, plain, stainless steel, or zinc finish.
 - 10. Sheet Metal: Use sheet metal screws.
 - 11. Wood: Use wood screws.
 - 12. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - a. Comply with MFMA-4.

- b. Channel Material: Use galvanized steel.
 - c. Manufacturer: Same as manufacturer of metal channel (strut) framing system.
- S. Pipe Installation Accessories:
- 1. Copper Pipe Supports:
 - a. Manufacturers:
 - 1) HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
 - 3) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - 2. Thermal Insulated, Surface-Mounted Pipe Supports:
 - a. Manufacturers:
 - 1) FNW; 7701: www.fnw.com/#sle.
 - 2) HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - 3) Substitutions: See Section 01 60 00 - Product Requirements.
 - 4) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - b. Material: Carbon steel with epoxy copper or zinc finish.
 - c. Weather and UV light resistant foam, plastic, or rubber material with built-in strut. Maximum Load: 50 lb for single pipe or multiple landed on top strut.
 - 3. Seismic Bracing Hardware:
 - a. Cable Suspension Systems:
 - 1) Manufacturers:
 - (a) B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - (b) nVent Caddy, a brand of nVent: www.erico.com/#sle.
 - (c) Gripple, Inc; UniGrip Standard: www.gripple.com/#sle.
 - (d) Substitutions: See Section 01 60 00 - Product Requirements.
 - (e) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - 2) Strut channel or bracket-fitted fitting with locking mechanism for pipe or equipment suspension using cable wires extended to surface-mounted end-fixing fittings.
 - 3) Provide cable wire and end-fixing as required to hold minimum weight of 120 lb.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- C. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- D. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- E. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- F. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
- G. Equipment Support and Attachment:
 - 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
 - 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 - 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 - 4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 4 inch high concrete pad constructed in accordance with Section 03 30 00.
 - 5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- H. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.
- I. Secure fasteners according to manufacturer's recommended torque settings.
- J. Remove temporary supports.

3.2 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 23 05 29

**SECTION 23 05 31
COIL HOOKUPS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The Contractor shall have the option of using the coil hookups as specified and detailed in the drawings.

1.2 SUBMITTALS

- A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- B. Clearly indicate operable pressure range for each product being furnished.
- C. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labelled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Victaulic Company
- B. Flow Design, Inc.
- C. Griswold Manufacturing
- D. Pro Hydronic Specialties
- E. Bell & Gossett
- F. Kates Company
- G. Nexus
- H. Or pre-approved equal

2.2 AUTOMATIC FLOW CONTROL VALVE:

- A. Design
 - 1. The GPM for the automatic flow control valves shall be factory set and shall automatically limit the rate of flow to within 5% of the specified amount.

2. For 1/2" – 2", the flow cartridge shall be removable from the Y-body housing without the use of special tools to provide access for regulator change-out, inspection and cleaning without breaking the main piping. (Access shall be similar to that provided for removal of a Y-strainer screen).
3. True operating ranges of 2–32 psid or 5–60 psid are required. The design flow should be achieved at the minimum psi differential. A 50% safety factory applied to the lower operating range is not acceptable.
4. Each valve shall have two P/T ports.
5. All automatic flow control devices shall be supplied by a single source and certified flow tests, witnessed by a Professional Engineer, shall be available.
6. Five-year product warranty and free first year cartridge exchange.

B. Construction

1. The internal wear surfaces of the valve cartridge must be electroless nickel or stainless steel.
2. The internal flow cartridge body shall have machined threads so the spring free height may be compensated for without the use of fixed shims. A crimped sheet metal design is not acceptable.
3. The internal flow cartridge shall be permanently marked with the GPM and spring range.
4. For 1/2" through 2" pipe sizes: An assembly shall consist of a brass Y-type body, integral brass body ball valve and 'O' ring type union; Flow Design Model AC, Victaulic Series 76 or equal.
5. For 2-1/2" and larger flanged or grooved connections: Ductile iron body suitable for mounting wafer type between standard 150# and 300# flanges. The long flange bolts and nuts shall be provided with each control valve. Flow Design Model WS, Victaulic Series 76 or equal.
6. All valves shall be factory leak tested at 100 psi air under water.

C. Minimum Ratings

1. 1/2" through 2" pipe size: 400 PSIG at 250°F
2. 2-1/2" through 14" pipe size: 600 PSIG at 250°F.

D. Flow Verification

1. Where indicated on the plans, the differential pressure across the Automatic Flow Control Valve shall be measured for flow verification and to determine the amount of system over heading or under pumping.
2. The flow shall be verified by measuring the differential pressure across the coil served or the wide-open temperature control valve and calculating the flow using the coil or valve Cv.

E. Test Kit

1. Two (2) differential pressure test kits shall be supplied to verify flow and measure overheating. The kit shall consist of a 4-1/2" diaphragm gauge equipped with ten-foot hoses and P/T adapters all housed in a vinyl case. Calibration shall be 0–35 PSID for 2–32 PSI spring range or 0–65 PSID for 5-60 PSI range. In addition, provide four dial type temperature gauges to use in the provided P/T plugs.

F. Installation

1. Install automatic flow control valves on the return lines of coils as indicated on the plans. Balancing valve on supply side is not acceptable.
2. The standard ports and handles shall clear 1" thick insulation. Handle and port extensions are required for over 1" thick insulation.
3. Install, on the supply side of coils, a Y-strainer with a brass blow-down valve with 3/4" hose end connection with cap and chain.
4. Remove auto-flow devices during the flushing procedure.

G. Model YC

1. Combination ball valve, Y-strainer and union with two P/T's, automatic air vent, bypass adapter and hose end drain valve with cap and chain. Victaulic Series 78Y Strainer/Ball Valve Combination 1/2" through 2": 400 DZR brass body consisting of a full port ball valve and strainer with flow measuring ports. Ball valve shall be complete with double o-ring seal, plated ball, blow-out proof stem, and steel handle with vinyl grip. Strainer shall be Y-pattern, with 20 mesh stainless steel screen and blowdown port. Suitable for operating temperatures up to 230°F. The Series 78Y shall be Victaulic or equivalent.
2. Y-strainer shall have a 40 mesh stainless screen.
3. Assembly shall be rated for 400 PSIG at 250°F.

H. Model UP

1. Union with manual air vent and P/T plug.
2. Series 78U Union Port Fitting 1/2" through 2": 400 psi, DZR brass body with manual air vent port and pressure/temperature port, with EPDM seals. Union port fitting shall provide a simplified terminal hookup for installation at coil outlets. Suitable for operating temperatures to 230°F/110°C. The Series 78U shall be provided by Victaulic.
3. Assembly shall be rated for 400 PSIG at 250°F.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Dielectric fittings shall be used at all locations where dissimilar materials meet.
- B. Valve screws shall not be installed below horizontal.

END OF SECTION 23 05 31 23 05 31

**SECTION 23 05 33
HEAT TRACING FOR HVAC PIPING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Self-regulating parallel resistance electric heating cable.

1.2 RELATED REQUIREMENTS

- A. Section 23 05 53 - Identification for HVAC Piping and Equipment.
- B. Section 23 07 19 - HVAC Piping Insulation.
- C. Section 23 21 13 - Hydronic Piping.
- D. Section 23 21 14 - Hydronic Specialties.

1.3 REFERENCE STANDARDS

- A. IEEE 515.1 - IEEE Standard for the Testing, Design, Installation, and Maintenance of Electrical Resistance Trace Heating for Commercial Applications; 2022.
- B. ITS (DIR) - Directory of Listed Products; Current Edition.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. UL (DIR) - Online Certifications Directory; Current Edition.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.
- C. Coordinate the work with other trades to provide ground fault protection for electric heat tracing circuits as required by NFPA 70.
- D. Coordinate the work with other trades to provide circuit breaker ratings suitable for installed circuit lengths.

1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for electric heat tracing.
- C. Shop Drawings: Indicate electric heat tracing layout, electrical terminations, thermostats, controls, and branch circuit connections.
- D. Manufacturer's Installation Instructions: Indicate installation instructions and recommendations.
- E. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions of equipment and controls, maintenance and repair data, and parts listings.

F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

G. Project Record Documents: Record actual locations of electric heat tracing lines and thermostats.

1.6 QUALITY ASSURANCE

1.7 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.1 SELF-REGULATING PARALLEL RESISTANCE ELECTRIC HEATING CABLE

A. Manufacturers:

1. Chromalox, Inc: www.chromalox.com/#sle.
2. Pentair: www.pentairthermal.com/#sle.
3. Thermon Manufacturing Company: www.thermon.com/#sle.

B. Provide products listed, classified, and labeled by UL (DIR), ITS (DIR), or testing firm acceptable to authorities having jurisdiction (AHJ).

C. Factory Rating and Testing: Comply with IEEE 515.1.

D. Heating Element:

1. Provide pair of parallel No. 16 tinned or nickel coated stranded copper bus wires embedded in cross linked conductive polymer core with varying heat output in response to temperature along its length.
2. Terminations: Waterproof, factory assembled, non-heating leads with connector at one end and water-tight seal at opposite end.
3. Capable of crossing over itself without overheating.

E. Insulated Jacket: Flame retardant polyolefin.

F. Cable Cover: Provide tinned copper and polyolefin outer jacket with UV inhibitor.

G. Maximum Power-On Operating Temperature: 150 degrees F.

H. Maximum Power-Off Exposure Temperature: 185 degrees F.

I. Electrical Characteristics:

1. 5 W/lineal ft.
2. 120 volts, single phase, 60 Hz.

2.2 OUTER JACKET MARKINGS

A. Name of manufacturer, trademark, or other recognized symbol of identification.

B. Catalog number, reference number, or model.

- C. Month and year of manufacture, date coding, applicable serial number, or equivalent.
- D. Agency listing or approval.

2.3 CONNECTION KITS

- A. Name of manufacturer, trademark, or other recognized symbol of identification.
- B. Provide power connection, splice/tee, and end seal kits compatible with the heating cable and without requiring cutting of the cable core to expose bus wires.
- C. Furnish with NEMA 4X rating for prevention of corrosion and water ingress.
- D. Provide UV stabilized components.

2.4 ACCESSORIES

- A. Provide Accessories As Indicated or As Required for Complete Installation, Including but Not Limited To:
 - 1. High temperature, glass filament tape for attachment of heating cable to metal piping.
 - 2. Aluminum self-adhesive tape for attachment of heating cable to plastic piping.
 - 3. Heat-conductive putty.
 - 4. Cable ties.
 - 5. Silicone end seals and splice kits.
 - 6. Installation clips.
 - 7. Warning labels for attachment to exterior of piping insulation. Refer to Section 23 05 53.

2.5 CONTROLS

- A. Pipe Mounted Thermostats:
 - 1. Remote bulb unit with adjustable temperature range from 30 to 50 degrees F.
 - 2. Snap-action, open-on-rise, single pole switch with minimum current rating adequate for the connected cable.
 - 3. Remote bulb on capillary, resistance temperature device (RTD) or thermistor for direct sensing of pipe wall temperature.
 - 4. Control Enclosure: Corrosion resistant and waterproof.
- B. Provide minimum 30 ampere contactor to indicate operational status and on/off control.
- C. Programmable Timer:
 - 1. Micro-processor based.
 - 2. Capable of four separate schedules.
 - 3. On/Off/Auto switch.

4. 365 day calendar with 20 programmable holidays.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that piping and equipment are ready to receive work.
- B. Verify field measurements are as indicated on shop drawings.
- C. Verify required power is available, in proper location, and ready for use.

3.2 PREPARATION

- A. Clean all surfaces prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's recommendations.
- B. Comply with installation requirements of IEEE 515.1 and NFPA 70, Article 427.
- C. Apply heating cable linearly on pipe with fiberglass tape only after piping has successfully completed any required pressure testing.
- D. Comply with all national and local code requirements.
- E. Identification:
 1. After thermal insulation installation, apply external pipeline decals to indicate presence of the thermal insulation cladding at intervals not to exceed 20 ft including cladding over each valve or other equipment that may require maintenance.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Perform start-up by factory technician or factory representative as per Owner's requirements.
- C. Field Testing and Inspections:
 1. Commission system in accordance with installation and operation manual.
 2. Inspect for sources of water entry and proper sealing.
 3. Inspect weather barrier to confirm that no sharp edges are contacting the trace heating.
 4. Minimum Acceptable Insulation Resistance: 20 megohms or greater at a test voltage of 2500 VDC for polymer insulated trace heaters.
 5. Test heating cable integrity with megohmmeter at the following intervals:
 - a. Before installing the cable.
 - b. After cable has been installed onto the piping.

- c. After installing the connection kits.
 - d. After the installation of thermal insulation onto the piping.
 - e. Prior to initial start-up (commissioning).
6. Measure voltage and current at each unit.
7. Controls:
- a. Verify control parameters are set to the application requirements.
 - b. Verify factory provided digital temperature controller is correctly configured with the building automation system.

END OF SECTION 23 05 33

SECTION 23 05 48
VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Vibration isolation requirements.
- B. Vibration isolators.
- C. External seismic snubber assemblies.
- D. Seismic restraint systems.

1.2 REFERENCE STANDARDS

- A. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
 - 1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.
- C. Shop Drawings - Vibration Isolation Systems:
 - 1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.

1.4 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 VIBRATION ISOLATION REQUIREMENTS

- A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing HVAC equipment and/or HVAC connections to vibration-isolated equipment.
- B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:

C. General Requirements:

1. Select vibration isolators to provide required static deflection.
2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
3. Select vibration isolators for outdoor equipment to comply with wind design requirements.

D. Equipment Isolation: As indicated on drawings.

1. Provide neoprene vibration isolator pads under all Air Handling Units
2. Provide hanging vibration isolators for all suspended fans.

E. Piping Isolation:

1. Provide vibration isolators for piping supports:
 - a. Located in equipment rooms.
 - b. Located within 50 feet of connected vibration-isolated equipment.
2. Minimum Static Deflection:
 - a. First Three Supports Closest to Isolated Equipment: Same as static deflection of equipment; maximum of 2 inch deflection required.
 - b. Remainder of Supports: 0.75 inch deflection unless otherwise indicated.
3. Suspended Piping, Non-Seismic Applications: Use resilient material isolator hangers or spring isolator hangers.
4. Floor-Mounted Piping, Nonseismic Applications: Use open (unhoused) spring isolators.

F. Thrust Restraint Applications:

1. Use thrust restraints to resist horizontal motion due to thrust for fan heads, suspended fans, and base-mounted and suspended air handling equipment operating at 2.0 inches wg or greater total static pressure.
2. Minimum Static Deflection: Same as static deflection of equipment.

2.2 VIBRATION ISOLATORS

A. Manufacturers:

1. Vibration Isolators:
 - a. Kinetics Noise Control, Inc
 - b. Mason Industries
 - c. Vibration Eliminator Company, Inc
 - d. The VMC Group/Amber Booth

- e. Or pre-approved equal
 - 2. Source Limitations: Furnish vibration-isolators and associated accessories produced by a single manufacturer and obtained from a single supplier.
- B. General Requirements:
- 1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
 - 2. Spring Elements for Spring Isolators:
 - a. Color code or otherwise identify springs to indicate load capacity.
 - b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
 - c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
 - d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
 - e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
 - f. Selected to function without undue stress or overloading.
- C. Vibration Isolators for Nonseismic Applications:
- 1. Resilient Material Isolator Pads:
 - a. Description: Single or multiple layer pads utilizing elastomeric (e.g. neoprene, rubber) isolator material.
 - b. Pad Thickness: As required for specified minimum static deflection; minimum 0.25 inch thickness.
 - c. Multiple Layer Pads: Provide bonded, galvanized sheet metal separation plate between each layer.
 - 2. Resilient Material Isolator Mounts, Nonseismic:
 - a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g. neoprene, rubber) isolator material; fail-safe type.
 - 3. Open (Unhoused) Spring Isolators:
 - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) without a housing.
 - b. Bottom Load Plate: Nonskid, molded, elastomeric isolator material or steel with nonskid elastomeric isolator pad with provisions for bolting to supporting structure as required.
 - c. Furnished with integral leveling device for positioning and securing supported equipment.
 - 4. Restrained Spring Isolators, Nonseismic:
 - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing designed to prevent movement of supported equipment above an
-

- adjustable vertical limit stop.
- b. Bottom Load Plate: Steel with nonskid elastomeric isolator pad with provisions for bolting to supporting structure as required.
- c. Furnished with integral leveling device for positioning and securing supported equipment.
- d. Provides constant free and operating height.
- 5. Resilient Material Isolator Hangers, Nonseismic:
 - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g. neoprene, rubber) isolator material for the lower hanger rod connection.
- 6. Spring Isolator Hangers, Nonseismic:
 - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection.
 - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
- 7. Thrust Restraints:
 - a. Description: Assembly utilizing free-standing, laterally stable steel spring designed for resisting horizontal motion due to thrust (e.g., air pressure from a fan), and intended for installation in pairs.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Secure fasteners according to manufacturer's recommended torque settings.
- D. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.
- E. Vibration Isolation Systems:
 - 1. Spring Isolators:
 - a. Position equipment at operating height; provide temporary blocking as required.

- b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
 - c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
2. Isolator Hangers:
- a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
 - b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
3. Thrust Restraints:
- a. Adjust restraint movement under normal operating static pressure.
4. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
5. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
6. Adjust isolators to be free of isolation short circuits during normal operation.
7. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.

3.3 FIELD QUALITY CONTROL

- A. Inspect vibration isolation and/or seismic control components for damage and defects.
- B. Vibration Isolation Systems:
 - 1. Verify isolator static deflections.
 - 2. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.
- C. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

END OF SECTION 23 05 48

SECTION 23 05 53
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Pipe markers.

1.2 REFERENCE STANDARDS

- A. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

1.3 SUBMITTALS

- A. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- B. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Product Data: Provide manufacturers catalog literature for each product required.
- D. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

PART 2 PRODUCTS

2.1 IDENTIFICATION APPLICATIONS

- A. Automatic Controls: Tags. Key to control schematic.
- B. Control Panels: Nameplates.
- C. Dampers: Ceiling tacks, where located above lay-in ceiling.
- D. Heat Transfer Equipment: Nameplates.
- E. Instrumentation: Tags.
- F. Major Control Components: Nameplates.
- G. Piping: Stencilled painting.
- H. Pumps: Nameplates.
- I. Relays: Tags.
- J. Small-sized Equipment: Tags.
- K. Valves: Tags and ceiling tacks where located above lay-in ceiling.
- L. Water Treatment Devices: Nameplates.

2.2 NAMEPLATES

- A. Manufacturers:
 - 1. Advanced Graphic Engraving, LLC
 - 2. Brimar Industries, Inc
 - 3. Craftmark Pipe Markers
 - 4. Kolbi Pipe Marker Co
 - 5. Seton Identification Products, a Tricor Direct Company
 - 6. Or Approved Equal
- B. Letter Color: Black.
- C. Letter Height: 1/4 inch.
- D. Background Color: White.
- E. Phenolic: Conform to ASTM D709.

2.3 TAGS

- A. Manufacturers:
 - 1. Advanced Graphic Engraving
 - 2. Brady Corporation
 - 3. Brimar Industries, Inc
 - 4. Craftmark Pipe Markers
 - 5. Kolbi Pipe Marker Co
 - 6. Seton Identification Products, a Tricor Company
 - 7. Or Approved Equal
- B. Metal Tags: Aluminum with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges. Use metal tags in return air plenums.
- C. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.4 STENCILS

- A. Manufacturers:
 - 1. Brady Corporation
 - 2. Craftmark Pipe Markers
 - 3. Kolbi Pipe Marker Co

4. Seton Identification Products, a Tricor Company
 5. Or Approved Equal
- B. Stencils: With clean cut symbols and letters of following size:
1. 3/4 to 1-1/4 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 1/2 inch high letters.
 2. 1-1/2 to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.
 3. 2-1/2 to 6 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1-1/4 inch high letters.
 4. 8 to 10 inch Outside Diameter of Insulation or Pipe: 24 inch long color field, 2-1/2 inch high letters.
 5. Stencil Paint: Semi-gloss enamel, colors conforming to ASME A13.1.

2.5 CEILING GRID LABELS

- A. Label each device or valve above the ceiling and label the ceiling grid below each. Indicate the type of device or valve and its associated service (e.g. "Shutoff Valve – HW", "VAV-21").
- B. Provide custom printed labels for each device, either vinyl or polypropylene, suitable for indoor / outdoor applications. Use portable printer equal to Brady HandiMark Portable Industrial Labeling System.
- C. Labels shall be no more than 1-inch in height. Lettering shall be minimum 18-point font. Lettering shall be black on white tape.
- D. Provide a list of devices and valves labeled with the identical information in the O&M Manuals.
- E. Submit samples of markings on three different devices for approval of the Owner and Engineer.
- F. Ceiling grid markers shall be the color listed below:
 1. Electrical - Pull Box/Disconnects/Future - Neon Red
 2. Mechanical Equipment/Fan/Dampers, etc. - Neon Yellow
 3. Gas valves/regulators/etc. - Yellow
 4. Fire Alarm/Sprinklers/Life Safety - Red
 5. Heating Hot Water Valves/Low point drains/etc. - Red

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

- A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.

- C. All piping and duct shall be labeled at least once in EVERY room. Piping and ductwork shall be labeled every 15 ft and at every change of direction.
- D. Provide ceiling grid labels to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.
- E. Identify control panels, manual motor starters, combination motor starters, disconnects, variable frequency drives, boiler override switches, boiler emergency switches, and major control components outside panels with plastic nameplates.
- F. Identify thermostats or temperature sensors relating to air handling units or valves with labels.
- G. Identify valves in main and branch piping with valve labels.
- H. Tag automatic controls, instruments, and relays. Key to control schematic.
- I. Identify air handling units with plastic nameplates indicating unit number, area served, OEM and external static pressure, based on actual equipment submittal data, number and size of filters, and number and size of belts (where applicable).
- J. Identify pumps with plastic nameplates indicating pump number, system served, GPM, and feet of head.
- K. Provide ceiling track markers to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment. Markers shall be installed prior to request for above ceiling inspection.

3.3 SCHEDULE

- A. Standard Color Identification for Mechanical Piping (all labels shall be provided with flow arrows):
 - 1. Chilled Water Supply/Return CHWS/CHWR White Lettering/Blue Background
 - 2. Hot Water Supply/Return HWS/HWR White Lettering/Red Background

END OF SECTION 23 05 53

**SECTION 23 05 70
MECHANICAL COORDINATION DRAWINGS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The Mechanical Contractor shall be responsible for providing 1/4" scale coordination drawings for the entire project, format shall be as stated below.
- B. The drawings shall cover above ceiling space, mechanical rooms, electrical rooms and service yards.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 COORDINATION

- A. The Mechanical Contractor shall obtain the architectural, structural, and MEP REVIT models from the Architect. The models will be in REVIT 2021.
- B. Where ductwork, piping, or other materials are indicated or required to be installed in the webbing of joists or trusses, the Mechanical Contractor shall confirm the actual joist/truss profile with the Structural Steel supplier prior to finalizing the coordination drawings or fabricating materials.
- C. The Mechanical Contractor shall produce drawings that indicate all piping, equipment and ductwork on ¼ scale drawings. All items shall be drawn to scale, dimensioned and be easily identified. The drawings shall indicate a bottom of duct or bottom of pipe.
- D. The Mechanical Contractor shall import a file compatible with Navisworks from the Plumbing Contractor that indicates all piping and plumbing equipment. This includes underground piping. The drawings shall be to scale, dimensioned and clearly identified. The drawings shall indicate bottom of pipe (or centerline) for all equipment or pipes.
- E. The Mechanical Contractor shall import a file compatible with Navisworks from the Fire Protection Contractor that indicates all piping, heads, and equipment. The drawings shall be to scale, dimensioned and clearly identified. The drawings shall indicate bottom of pipe (or centerline) for all equipment or pipes.
- F. The Mechanical Contractor shall import a file compatible with Navisworks from the Electrical Contractor that indicate all conduits over 2", lights, cable tray, underground duct banks and electrical equipment. The drawings shall be to scale, dimensioned and clearly identified. The drawings shall indicate mounting heights of all equipment.
- G. The Mechanical Contractor shall incorporate the Plumbing Contractor's, Fire Protection Contractor's, and the Electrical Contractor's models with his own model to make one overall set of Coordination Drawings for each area. The Mechanical Contractor shall adjust layers, colors, etc., to make the drawing readable.
- H. Navisworks shall be used for clash detection. The Mechanical Contractor shall review the overall coordination model for conflicts. If a conflict is found, the Mechanical Contractor shall coordinate revisions to the plans with each sub contractor. There shall be as many iterations as required to produce a clash-free model
- I. If any problems cannot be worked out between the Contractors, the Mechanical Contractor shall contact the Engineer. At that time, a meeting with the Engineer and the Architect will be arranged. The Mechanical Contractor shall make the overall coordination model available for the meeting.

SECTION 23 05 70 - MECHANICAL COORDINATION DRAWINGS

- J. Once all conflicts have been resolved, the Mechanical Contractor shall provide the Architect and Engineer with a complete set of Coordination Drawings.
- K. In addition, the Mechanical Contractor shall send the completed overall coordination drawings to a printer so that the Plumbing, Fire Protection, and Electrical Contractors can order as many copies as they desire (at their expense). The Mechanical Contractor is responsible for providing the Engineer's set, the Architect's set, and the Mechanical Contractor's set(s).
- L. The Mechanical Contractor and the Construction Manager are responsible for setting the schedule for this process. The Plumbing Contractor, Fire Protection Contractor, Electrical Contractor and the Architect should approve the schedule.
- M. The Coordination Drawings shall be used as the basis for the As-built Drawings. These shall be made available to the Design Team for this purpose.
- N. The overall coordination drawings shall be completed prior to any plumbing, mechanical and electrical work beginning. Start of work, including underground work, without completed Coordination Drawings is at the Contractor's risk.
- O. Installation of materials and systems prior to completing the Coordination Drawings and/or not in accordance with the Coordination Drawings shall be relocated and reinstalled at the Contractor's expense.

END OF SECTION 23 05 70 23 05 70

SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.
- B. Testing, adjustment, and balancing of hydronic systems.
- C. Measurement of final operating condition of HVAC systems.

1.2 REFERENCE STANDARDS

- A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition; 2016.
- B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2008, with Errata (2019).
- C. NEBB (TAB) - Procedural Standard for Testing Adjusting and Balancing of Environmental Systems; 2019.

1.3 SUBMITTALS

- A. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
- B. Include at least the following in the plan:
 - 1. Indicate standard to be followed (AABC or NEBB)
 - 2. List of all waterflow and system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
 - 3. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
 - 4. Identification and types of measurement instruments to be used and their most recent calibration date.
 - 5. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
 - 6. Final test report forms to be used.
 - 7. Detailed step-by-step procedures for TAB work for each system and issue, including:
 - a. Terminal flow calibration (for each terminal type).
 - b. Diffuser proportioning.
 - c. Branch/submain proportioning.
 - d. Total flow calculations.
 - e. Rechecking.
 - f. Diversity issues.

8. Details of how TOTAL flow will be determined; for example:
 - a. Water: Pump curves, circuit setter, flow station, ultrasonic, etc.
 9. Specific procedures that will ensure that systems are operating at the lowest possible pressures and methods to verify this.
 10. Method of checking building static and exhaust fan and/or relief damper capacity.
 11. Methods for making coil or other system plant capacity measurements, if specified.
 12. Time schedule for TAB work to be done in phases (by floor, etc.).
 13. Description of TAB work for areas to be built out later, if any.
 14. Time schedule for deferred or seasonal TAB work, if specified.
 15. False loading of systems to complete TAB work, if specified.
 16. Procedures for formal deficiency reports, including scope, frequency and distribution.
- C. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.
- D. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
1. Revise TAB plan to reflect actual procedures and submit as part of final report.
 2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
 3. Provide final reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations. The Final Report shall be placed in and become a part of the Maintenance and Operations Manuals (4 copies).
 4. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
 5. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
 6. Units of Measure: Report data in I-P (inch-pound) units only.
 7. Include the following on the title page of each report:
 - a. Name of Testing, Adjusting, and Balancing Agency.
 - b. Address of Testing, Adjusting, and Balancing Agency.
 - c. Telephone number of Testing, Adjusting, and Balancing Agency.
 - d. Also include a certification sheet containing the seal and name, address, telephone number, and signature of the Certified Test and Balance Engineer. Include in this division a listing of the instruments used for the procedures along with proof of calibration.

- E. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.

1.4 QUALITY ASSURANCE

- A. The TAB agency shall be a subcontractor of the General Contractor (or Construction Manager) and shall report directly to and be paid by the General Contractor.
- B. The TAB agency shall be either a certified member of AABC or NEBB to perform TAB service for HVAC, water balancing and vibrations and sound testing of equipment. The certification shall be maintained for the entire duration of duties specified herein.
- C. Any agency that has been the subject of disciplinary action by either the AABC or NEBB within the five years preceding Contract Award shall not be eligible to perform any work related to the TAB. All work performed in this Section and in other related Sections by the TAB agency shall be considered invalid if the TAB agency loses its certification prior to Contract completion, and the successor agency's review shows unsatisfactory work performed by the predecessor agency.
- D. TAB Specialist: The TAB specialist shall be either a member of AABC or an experienced technician of the Agency certified by NEBB. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, the General Contractor shall immediately notify the Engineer and submit another TAB Specialist for approval. Any individual that has been the subject of disciplinary action by either the AABC or NEBB within the five years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections performed by the TAB specialist shall be considered invalid if the TAB Specialist loses its certification prior to Contract completion and must be performed by an approved successor.
- E. TAB Specialist shall be identified by the General Contractor within 60 days after the notice to proceed. The TAB specialist will be coordinating, scheduling and reporting all TAB work and related activities and will provide necessary information as required by the Resident Engineer. The responsibilities would specifically include:
 - 1. Shall directly supervise all TAB work.
 - 2. Shall sign the TAB reports that bear the seal of the TAB standard. The reports shall be accompanied by report forms and schematic drawings required by the TAB standard, AABC, TABB or NEBB.
 - 3. Would follow all TAB work through its satisfactory completion.
 - 4. Shall provide final markings of settings of all HVAC adjustment devices.
 - 5. Permanently mark location of duct test ports.
 - 6. Shall document critical paths from the fan or pump. These critical paths are ones in which are 100% open from the fan or pump to the terminal device. This will show the least amount of restriction is being imposed on the system by the TAB firm.
- F. All TAB technicians performing actual TAB work shall be experienced and must have done satisfactory work on a minimum of 3 projects comparable in size and complexity to this project. Qualifications must be certified by the TAB agency in writing. The lead technician shall be certified by AABC or NEBB

1.5 WARRANTY

- A. National Project Performance Guarantee: Provide a guarantee AABC or NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
 - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.
 - 3. Warranty Period: Five (5) years.

PART 2 PRODUCTS

2.1 INSULATION REPAIR MATERIAL

- A. Refer to individual insulation sections for repair of insulation removed or damaged during TAB work.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Perform total system balance in accordance with one of the following:
 - 1. AABC (NSTSB), AABC National Standards for Total System Balance.
- B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
- C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
- D. TAB Agency Qualifications:
 - 1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
 - 2. Having minimum of three years documented experience.
 - 3. Certified by one of the following:
 - a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.
 - b. NEBB, National Environmental Balancing Bureau: www.nebb.org/#sle.
- E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.
- F. For each air handling system, provide a graphical static pressure profile indicating the pressure drop across each component of the air handling unit (filter, coils, dampers, wheel, etc).

3.2 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.

3. Proper thermal overload protection is in place for electrical equipment.
 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 5. Duct systems are clean of debris.
 6. Fans are rotating correctly.
 7. Fire and volume dampers are in place and open.
 8. Air coil fins are cleaned and combed.
 9. Access doors are closed and duct end caps are in place.
 10. Air outlets are installed and connected.
 11. Duct system leakage is minimized.
 12. Hydronic systems are flushed, filled, and vented.
 13. Pumps are rotating correctly.
 14. Proper strainer baskets are clean and in place.
 15. Service and balance valves are open.
 16. Clean and set automatic fill valves for required system pressure.
 17. Check expansion tanks to determine that they are not air bound and that the system is completely full of water.
 18. Check air vents at high points of systems and determine if all are installed to bleed air completely.
- B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.
- C. Beginning of work means acceptance of existing conditions.

3.3 PREPARATION

- A. Hold a pre-balancing meeting at least one week prior to starting TAB work.
1. Require attendance by all installers whose work will be tested, adjusted, or balanced.
- B. Obtain design drawings and specifications and become thoroughly acquainted with the design intent.
- C. Obtain copies of approved shop drawings of all air handling equipment, outlets (supply, return, and exhaust) and temperature control diagrams.
- D. Compare design to installed equipment and field installations.
- E. Walk the system to determine variations of installation from design.
- F. Check filters for cleanliness.
- G. Lubricate all motors and bearings.

3.4 ADJUSTMENT TOLERANCES

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

- A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 5 percent of design for return and exhaust systems.
- B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 5 percent of design.
- C. Hydronic Systems: Adjust to within plus or minus 5 percent of design.
- D. Air Systems Tolerances

Systems - Air	Tolerances of Drawing Design	Remarks
Air Handling Units, Fans (Supply, Return, Exhaust)	-5% to + 10%	Systems with Filters must be tested at dirty conditions
Outdoor Air	100% to 110%	To obtain this accuracy requires ductwork be traversed
Terminal Units	+/- 5%	Calibrate all boxes at minimum of two points. Single point calibration is not acceptable.
Diffusers and Grilles	+/-10%	If design is less than 100 CFM, tolerance can be +/- 10 CFM
Pressurized Rooms - Positive	Supply +100-105% Exhaust or Return 100-95%	Room offset tolerance to design 100% to +110%
Pressurized rooms - Negative	Supply 95% to 100% Exhaust or Return 100% to 105%	Room offset tolerance to design 100% to 105%

- E. Water System Tolerances

Systems - Water	Tolerances of Plan Design	Remarks
Coils, Heat Exchangers, Pumps, Evaporators, Condensers	+/- 5%	

3.5 RECORDING AND ADJUSTING

- A. Field Logs: Maintain written logs including:
 - 1. Running log of events and issues.
 - 2. Discrepancies, deficient or uncompleted work by others.
 - 3. Contract interpretation requests.
 - 4. Lists of completed tests.
- B. Ensure recorded data represents actual measured or observed conditions.
- C. Use only those instruments which have the maximum field measuring accuracy and are best suited to the function being measured.
- D. Apply instrument as recommended by the manufacturer.
- E. When averaging values, take a sufficient quantity of readings that will result in a repeatability error of less than 5 percent. When measuring a single point, repeat readings until 2 consecutive identical values are obtained.

- F. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- G. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.
- H. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- I. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- J. Seal ducts and piping, and test for and repair leaks.
- K. Seal insulation to re-establish integrity of vapor barrier.
- L. Retest, adjust, and balance systems subsequent to significant system modifications and resubmit test results.

3.6 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.
- B. Test, adjust, and balance the air systems before the hydronic systems.
- C. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- D. Measure air quantities at air inlets and outlets.
- E. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise. This includes adjusting the deflection of all diffuser and grilles.
- F. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- G. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
 - 1. Artificially load filters by partially blanking to produce static pressure air drop of filter manufacturer's recommended "dirty" pressure drop.
- I. Coordinate with Controls Contractor on adjusting static pressure setpoints of VAV systems and differential pressure setpoints of VFD controlled pumps.
- J. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- K. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- L. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.

- M. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.
- N. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.
- O. Single-duct, dual-duct, and fan-powered VAV boxes shall be calibrated using a multi-point calibration approach. Single-point calibration will not be acceptable.
 - 1. Check and readjust ATU flow rates as necessary to meet design criteria. Balance air distribution from ATU on full cooling maximum scheduled cubic meters per minute (cubic feet per minute). Reset room thermostats and check ATU operation from maximum to minimum cooling, to the heating mode, and back to cooling. Record and report the heating coil leaving air temperature when the ATU is in the maximum heating mode.
- P. The TAB report shall indicate the critical VAV box and how the static pressure set point was established.

3.7 DUCTWORK LEAKAGE CRITERIA:

- A. The TAB contractor shall be responsible for conducting and recording ALL duct leakage tests.
- B. All transverse joints and longitudinal seams shall conform to SMACNA's Class A sealing requirements as defined in the SMACNA Manual.
- C. Ductwork Sealing: As a minimum standard, ductwork and plenums shall be sealed in accordance with Table 6.2.4.3A of ASHRAE Standard 90.1 (as required to meet the requirements of Section 6.2.4.4 SMACNA Duct Leakage Test Procedures).
- D. Ductwork constructed to 3" w.g. pressure class (positive or negative) or higher shall be leak-tested according to the SMACNA HVAC Air Leakage Test Manual. All sections shall be tested, unless otherwise noted.
- E. The Test Pressure for each system shall be equal to the construction pressure class the respective duct system is constructed to.
- F. Maximum permitted duct leakage shall be:
 - 1. $L_{max} = CL \times \text{Test Pressure "P" raised to the 0.65 power}$ where L_{max} is maximum permitted leakage in CFM/100 sq. ft. duct surface area
 - 2. CL is duct leakage class in cfm/100 sq. ft. at 1-inch w.c., which shall be
 - a. "6" for rectangular sheetmetal, rectangular fibrous ducts, and round flexible ducts.
 - b. "3" for round/flat oval sheetmetal or fibrous glass ducts.
 - 3. P is test pressure, equal to the duct construction pressure class rating in inches w.c.
- G. Duct Air Leakage Testing (DALT):
 - 1. Installed ductwork shall be tested prior to installation of access doors, take-offs etc.
 - 2. All testing shall be witnessed by the engineer or owner's representative. Contractor shall give the engineer or owner's representative 72 hours' notice prior to testing.

3. The testing shall be performed as follows:
 - a. Perform testing in accordance with SMACNA HVAC Air Duct Leakage Test Manual.
 - b. Use a certified orifice tube for measuring the leakage.
 - c. Define section of system to be tested and blank off.
 - d. Determine the percentage of the system being tested.
 - e. Using that percentage, determine the allowable leakage (CFM) for that section being used.
 - f. Pressurize to operating pressure and repair any significant or audible leaks.
 - g. Re-pressurize and measure leakage.
 - h. Repeat steps 6 and 7 until the leakage is less than the allowable defined in step 5.

3.8 WATER SYSTEM PROCEDURE

- A. Adjust water systems to provide design quantities.
- B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gages to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
- C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- D. Effect system balance with automatic control valves fully open to heat transfer elements.
- E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.
- G. The TAB report shall indicate the critical circuit, which coils were closed for diversity (if applicable), and how the differential pressure setpoint was established.

3.9 CRITICAL FLOW PATH

- A. Provide a documented critical path for all fluid flows. There shall be at least one terminal device that can be traced back to the fan or pump where there is no damper or valves that are less than 100% open.

3.10 DEMONSTRATION

- A. Training
 1. Train the Owner's maintenance personnel on troubleshooting procedures and testing, adjusting, and balancing procedures. Provide four (4) hours on site training. Review with the Owner's personnel the information contained in the Operating and Maintenance Data specified in Division 1 and Section 23 01 00.
 2. Schedule training with the Owner through the Engineer with at least 7 days prior notice.

3.11 COMMISSIONING

- A. Perform prerequisites prior to starting commissioning activities.
- B. Fill out Prefunctional Checklists for:
 - 1. Air side systems.
 - 2. Water side systems.
- C. Furnish to the Commissioning Authority, upon request, any data gathered but not shown in the final TAB report.
- D. Re-check minimum outdoor air intake flows and maximum and intermediate total airflow rates for 50 percent of the air handlers plus a random sample equivalent to 50 percent of the final TAB report data as directed by Commissioning Authority.
 - 1. Original TAB agency shall execute the re-checks, witnessed by the Commissioning Authority.
 - 2. Use the same test instruments as used in the original TAB work.
 - 3. Failure of more than 25 of the re-checked items of a given system shall result in the rejection of the system TAB report; rebalance the system, provide a new system TAB report, and repeat random re-checks.
 - 4. For purposes of re-check, failure is defined as follows:
 - a. Air Flow of Supply and Return: Deviation of more than 10 percent of instrument reading.
 - b. Minimum Outside Air Flow: Deviation of more than 20 percent of instrument reading; for inlet vane or VFD OSA compensation system using linear proportional control, deviation of more than 30 percent at intermediate supply flow.
 - c. Temperatures: Deviation of more than one degree F.
 - d. Air and Water Pressures: Deviation of more than 10 percent of full scale of test instrument reading.
 - e. Sound Pressures: Deviation of more than 3 decibels, with consideration for variations in background noise.
 - 5. For purposes of re-check, a whole system is defined as one in which inaccuracies will have little or no impact on connected systems; for example, the air distribution system served by one air handler or the hydronic chilled water supply system served by a chiller or the condenser water system.
- E. In the presence of the Commissioning Authority, verify that:
 - 1. Final settings of all valves, splitters, dampers and other adjustment devices have been permanently marked.
 - 2. The air system is being controlled to the lowest possible static pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from fan to diffuser having all balancing dampers wide open and that during full cooling of all terminal units taking off downstream of the static pressure sensor, the terminal unit on the critical leg has its damper 90 percent or more open.

3. The water system is being controlled to the lowest possible pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from the pump to the coil having all balancing valves wide open and that during full cooling the cooling coil valve of that leg is 90 percent or more open.

3.12 SCOPE

A. Test, adjust, and balance the following:

1. HVAC Pumps.
2. Boilers.
3. Air Cooled Water Chillers.
4. Unit Air Conditioners.
5. Terminal Heat Transfer Units.
6. Air Handling Units.
7. Fans.
8. Air Filters.
9. Air Terminal Units.
10. Air Inlets and Outlets.

B. This Section does NOT include:

1. Testing boilers and pressure vessels for compliance with safety codes.
2. Specifications for materials for patching mechanical systems.
3. Specifications for materials and installation of adjusting and balancing; refer to the respective system sections for materials and installation requirements.
4. Requirements and procedures for piping and ductwork systems leakage tests.

3.13 MINIMUM DATA TO BE REPORTED

A. Electric Motors:

1. Manufacturer.
2. Model/Frame.
3. HP/BHP.
4. Phase, voltage, amperage; nameplate, actual, no load.
5. RPM.
6. Service factor.
7. Starter size, rating, heater elements.

8. Sheave Make/Size/Bore.

B. V-Belt Drives:

1. Identification/location.
2. Required driven RPM.
3. Driven sheave, diameter and RPM.
4. Belt, size and quantity.
5. Motor sheave diameter and RPM.
6. Center to center distance, maximum, minimum, and actual.

C. Pumps:

1. Identification/number.
2. Manufacturer.
3. Size/model.
4. Impeller.
5. Design flow rate, pressure drop, BHP.
6. Actual flow rate, pressure drop, BHP.
7. Discharge pressure.
8. Suction pressure.
9. Total operating head pressure.
10. Shut off, discharge and suction pressures.
11. Shut off, total head pressure.

D. Combustion Equipment:

1. Boiler manufacturer.
2. Model number.
3. Serial number.
4. Firing rate.
5. Gas pressure at meter outlet.
6. Gas flow rate.
7. Heat input.
8. Burner manifold gas pressure.

9. Ambient temperature.
10. Net stack temperature.
11. Heat output.

E. Air Cooled Condensers:

1. Identification/number.
2. Location.
3. Manufacturer.
4. Model number.
5. Entering DB air temperature, design and actual.
6. Leaving DB air temperature, design and actual.

F. Chillers:

1. Identification/number.
2. Manufacturer.
3. Capacity.
4. Model number.
5. Serial number.
6. Evaporator entering water temperature, design and actual.
7. Evaporator leaving water temperature, design and actual.
8. Evaporator pressure drop, design and actual.
9. Evaporator water flow rate, design and actual.
10. Condenser entering water temperature, design and actual.
11. Condenser pressure drop, design and actual.
12. Condenser water flow rate, design and actual.

G. Cooling Coils:

1. Identification/number.
2. Location.
3. Manufacturer.
4. Air flow, design and actual.
5. Entering air DB temperature, design and actual.

6. Entering air WB temperature, design and actual.
7. Leaving air DB temperature, design and actual.
8. Leaving air WB temperature, design and actual.
9. Water flow, design and actual.
10. Water pressure drop, design and actual.
11. Entering water temperature, design and actual.
12. Leaving water temperature, design and actual.
13. Air pressure drop, design and actual.

H. Heating Coils:

1. Identification/number.
2. Location.
3. Manufacturer.
4. Air flow, design and actual.
5. Water flow, design and actual.
6. Water pressure drop, design and actual.
7. Entering water temperature, design and actual.
8. Leaving water temperature, design and actual.
9. Entering air temperature, design and actual.
10. Leaving air temperature, design and actual.
11. Air pressure drop, design and actual.

I. Air Moving Equipment:

1. Location.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Air flow, specified and actual.
6. Return air flow, specified and actual.
7. Outside air flow, specified and actual.
8. Total static pressure (total external), specified and actual.

9. Inlet pressure.
10. Discharge pressure.
11. Fan RPM.

J. Return Air/Outside Air:

1. Identification/location.
2. Design air flow.
3. Actual air flow.
4. Design return air flow.
5. Actual return air flow.
6. Design outside air flow.
7. Actual outside air flow.
8. Return air temperature.
9. Outside air temperature.
10. Actual mixed air temperature.

K. Exhaust Fans:

1. Location.
2. Manufacturer.
3. Model number.
4. Air flow, specified and actual.
5. Total static pressure (total external), specified and actual.
6. Inlet pressure.
7. Discharge pressure.
8. Fan RPM.

L. Duct Traverses:

1. System zone/branch.
2. Duct size.
3. Design air flow.
4. Test velocity.
5. Test air flow.

6. Duct static pressure.

7. Air temperature.

M. Duct Leak Tests:

1. Description of ductwork under test.

2. Duct design operating pressure.

3. Duct design test static pressure.

4. Maximum allowable leakage duct capacity times leak factor.

5. Test apparatus:

6. Test static pressure.

7. Test orifice differential pressure.

8. Leakage.

N. Air Monitoring Stations:

1. System.

2. Size.

3. Area.

4. Design velocity.

5. Design air flow.

6. Test velocity.

7. Test air flow.

O. Flow Measuring Stations:

1. Identification/number.

2. Location.

3. Size.

4. Manufacturer.

5. Model number.

6. Design Flow rate.

7. Design pressure drop.

8. Actual/final pressure drop.

9. Actual/final flow rate.

P. Terminal Unit Data:

1. Manufacturer.
2. Type, constant, variable, single, dual duct.
3. Identification/number.
4. Location.
5. Model number.
6. Size.
7. Minimum design air flow.
8. Maximum design air flow.
9. Maximum actual air flow.
10. Inlet static pressure.

Q. Air Distribution Tests:

1. Air terminal number.
2. Room number/location.
3. Terminal type.
4. Terminal size.
5. Design air flow.
6. Test (final) air flow.
7. Percent of design air flow.

END OF SECTION 23 05 93

**SECTION 23 07 13
DUCT INSULATION**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Duct insulation.

1.2 REFERENCE STANDARDS

- A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- B. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).
- C. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- D. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 2020.
- E. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2019.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023c.
- G. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- C. Samples: Submit two samples of any representative size illustrating each insulation type.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.2 GLASS FIBER, FLEXIBLE

- A. Manufacturer:
 - 1. CertainTeed Corporation; _____: www.certainteed.com/#sle.
 - 2. Johns Manville; _____: www.jm.com/#sle.
 - 3. Knauf Insulation; Atmosphere Duct Wrap: www.knaufinsulation.com/#sle.

4. Owens Corning Corporation; _____: www.ocbuildingspec.com/#sle.
- B. Insulation: ASTM C553; flexible, noncombustible blanket.
1. K value: 0.36 at 75 degrees F, when tested in accordance with ASTM C518.
 2. Maximum Service Temperature: 1,200 degrees F.

2.3 GLASS FIBER, RIGID

- A. Manufacturer:
1. Knauf Insulation; _____: www.knaufinsulation.com/#sle.
 2. Owens Corning Corporation; 700 Series FIBERGLAS Insulation: www.ocbuildingspec.com/#sle.
- B. Insulation: ASTM C612; rigid, noncombustible blanket.
1. K Value: 0.24 at 75 degrees F, when tested in accordance with ASTM C518.
 2. Maximum Service Temperature: 450 degrees F.
 3. Maximum Density: 8.0 pcf.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

END OF SECTION 23 07 13

**SECTION 23 07 16
HVAC EQUIPMENT INSULATION**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Equipment insulation.
- B. Flexible removable and reusable blanket insulation.
- C. Jacketing and accessories.

1.2 RELATED REQUIREMENTS

- A. Section 23 21 13 - Hydronic Piping: Placement of hangers and hanger inserts.
- B. Section 23 21 14 - Hydronic Specialties.

1.3 REFERENCE STANDARDS

- A. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).
- B. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- C. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).
- D. ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation; 2021.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023c.
- F. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a, with Editorial Revision (2023).
- G. SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth; 2016b.
- H. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.2 GLASS FIBER, FLEXIBLE

- A. Manufacturers:
 - 1. Johns Manville Corporation; _____: www.jm.com/#sle.

2. Knauf Insulation; Atmosphere Duct Wrap: www.knaufinsulation.com/#sle.
3. Owens Corning Corporation; _____: www.ocbuildingspec.com/#sle.

B. Insulation: ASTM C553; flexible, noncombustible.

1. K Value: 0.36 at 75 degrees F, when tested in accordance with ASTM C177 or ASTM C518.

2.3 JACKETING AND ACCESSORIES

A. PVC Plastic:

1. Manufacturers:
2. Jacket: Sheet material, off-white color.
 - a. Minimum Service Temperature: Minus 40 degrees F.
 - b. Maximum Service Temperature: 150 degrees F.

B. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire-retardant lagging adhesive.

C. Reinforced Tape:

1. FSK tape suitable for sealing seams in insulation, insulated pipe bends, and fittings resulting in a tight, smooth surface without wrinkles.
2. Comply with UL 723 or ASTM E84.
3. Moisture Vapor Permeability: 0.00 perm inch, when tested in accordance with ASTM E96/E96M.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Cover glass fiber insulation with metal mesh and finish with heavy coat of insulating cement.

END OF SECTION 23 07 16

**SECTION 23 07 19
HVAC PIPING INSULATION**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Piping insulation.
- B. Flexible removable and reusable blanket insulation.
- C. Weather barrier coatings.
- D. Jacketing and accessories.

1.2 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 23 21 13 - Hydronic Piping: Placement of hangers and hanger inserts.
- C. Section 23 23 00 - Refrigerant Piping: Placement of inserts.

1.3 REFERENCE STANDARDS

- A. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.
- B. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).
- C. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2019).
- D. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2019).
- E. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- F. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2022a.
- G. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).
- H. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2023.
- I. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).
- J. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation; 2023.
- K. ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation; 2021.
- L. ASTM D610 - Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces; 2008 (Reapproved 2019).

- M. ASTM D5590 - Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay; 2017 (Reapproved 2021).
- N. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023c.
- O. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a, with Editorial Revision (2023).
- P. ASTM G153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials; 2013 (Reapproved 2021).
- Q. SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth; 2016b.
- R. MICA - Midwest Insulation Contractors Association National Commercial & Industrial Insulation Standards; 8th Edition.
- S. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations. Provide the following information:
 - 1. Schedule indicating insulation type, thickness, and location for each service (equipment, duct, and pipe with size).
 - 2. Density
 - 3. Compressive Strength
 - 4. "k" value at 75 deg F
 - 5. Nominal "R" value
 - 6. Mean temperature range
 - 7. Flame spread rating
- B. Shop Drawings: Show details for the following:
 - 1. Application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Attachment and covering of heat tracing inside insulation.
 - 3. Insulation application at pipe expansion joints for each type of insulation.
 - 4. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Application of field-applied jackets.
- C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

- D. Provide plates from MICA 8th edition manual for each insulation system on the project as part of the submittals. The plates for each system shall be filled out by the insulating contractor for each product being used.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum five years of experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.
- B. Store insulation in original wrapping and protect from weather and construction traffic. Protect insulation against dirt, water, chemical, and mechanical damage.

1.7 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.
- C. Insulation shall not be installed until all testing and inspection of pipe, duct, vessel, etc. has been completed and approved by Engineer/Owner's representative.
- D. Replace insulation damaged by either moisture or other means. Insulation which has been wet, whether dried or not, is considered damaged. Make repairs where condensation is caused by improper installation of insulation. Also replace any materials damaged by the condensation.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, UL 723, ASTM E84, or UL 723.

2.2 GLASS FIBER, FLEXIBLE

- A. Manufacturers:
 - 1. JP Lamborn Co; Thermal Sleeve MT: www.jpflex.com/#sle.
- B. Insulation: ASTM C553; flexible, noncombustible blanket.
 - 1. K Value: 0.36 at 75 degrees F, when tested in accordance with ASTM C518.
 - 2. Maximum Service Temperature: 1,200 degrees F.
 - 3. Maximum Water Vapor Absorption: 5.0 percent by weight.

2.3 GLASS FIBER, RIGID

- A. Manufacturers:

1. CertainTeed Corporation
 2. Johns Manville Corporation
 3. Knauf Insulation
 4. Owens Corning Corporation
 5. Manson Insulation
 6. Or Approved Equal
- B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
1. K Value: ASTM C177, 0.24 at 75 degrees F.
 2. Maximum Service Temperature: 850 degrees F.
 3. Maximum Moisture Absorption: 0.2 percent by volume.
- C. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.
- D. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- E. Vapor Barrier Lap Adhesive: Compatible with insulation.
- F. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
- G. Fibrous Glass Fabric:
1. Cloth: Untreated; 9 oz/sq yd weight.
 2. Blanket: 1.0 pcf density.
 3. Weave: 5 by 5.
- H. Indoor Vapor Barrier Finish:
1. Cloth: Untreated; 9 oz/sq yd weight.
 2. Vinyl emulsion type acrylic, compatible with insulation, white color.
- I. Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- J. Insulating Cement: ASTM C449.

2.4 EXPANDED POLYSTYRENE

- A. Insulation: ASTM C578; rigid closed cell.
1. K Value: 0.23 at 75 degrees F.
 2. Maximum Service Temperature: 165 degrees F.
 3. Maximum Water Vapor Permeance: 5.0 perm.

2.5 WEATHER BARRIER COATINGS

- A. Weather-Resistive Barrier Coating: Fire-resistive, UV resistant, water-based mastic for use over closed cell polyethylene and polyurethane foam insulation; applied with glass fiber or synthetic reinforcing mesh.
 - 1. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A, when tested in accordance with ASTM E84.
 - 2. Water Vapor Permeance: Greater than 1.0 perm in accordance with ASTM E96/E96M.
 - 3. Resistance to Fungal Growth: No growth when tested in accordance with ASTM D5590.
 - 4. Color: White.

2.6 JACKETING AND ACCESSORIES

- A. PVC Plastic.
 - 1. Manufacturers:
 - a. Johns Manville Corporation
 - b. Speedline Corporation
 - c. Knauf Insulation
 - d. Proto PVC Corp
 - e. Or Approved Equal
 - 2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: 0 degrees F.
 - b. Maximum Service Temperature: 150 degrees F.
 - c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 30 mil.
 - e. Connections: Brush on welding adhesive.
 - 3. Covering Adhesive Mastic: Compatible with insulation.
- B. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire-retardant lagging adhesive.
 - 1. Lagging Adhesive: Compatible with insulation.
 - a. Manufacturers:
 - 1) Vimasco Corporation:
 - 2) GLT Products
- C. Reinforced Tape:

1. FSK tape suitable for sealing seams between insulation, insulated pipe bends, and fittings resulting in a tight, smooth surface without wrinkles.
 2. Comply with UL 723, ASTM E84.
 3. Moisture Vapor Permeability: 0.00 perm inch, when tested in accordance with ASTM E96/E96M.
 4. Finish: Match insulation.
- D. Plain Foil Tape:
1. Aluminum foil with pressure-sensitive adhesive on paper release liner.

2.7 ACCESSORIES

- A. General Requirements:
1. Provide required accessories in accordance with and subject to the recommendations of the insulation manufacturer.
 2. Furnish compatible materials which do not contribute to corrosion, soften, or otherwise attack surfaces to which applied, in either the wet or dry state.
 3. Comply with ASTM C795 requirements for materials to be used on stainless steel surfaces.
 4. Supply materials that are asbestos free.
- B. Corrosion Inhibitors:
1. Corrosion Control Gel:
 - a. Corrosion Protection: Comply with ASTM B117 and ASTM D610.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Test piping for design pressure, liquid tightness, and continuity prior to applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions and the MICA manual 8th edition. In cases of conflict, the more stringent instructions shall apply.
- B. Where existing piping insulation is either removed or damaged during construction, it shall be reinsulated per these specifications.
- C. Where insulation thickness exceeds 3 inches, the insulation shall be two layers. Secure first layer before installing the next layer and stagger the joints.
- D. Install multiple layers of insulation with longitudinal and end seams staggered.
- E. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

- F. Install insulation with least number of joints practical.
- G. Exposed Piping: Locate insulation and cover seams in least visible locations.
- H. Insulated Pipes Conveying Fluids Below Ambient Temperature:
 - 1. Insulate entire system, including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
 - 2. Insulation on all pipes or ducts conveying air or liquids below the ambient temperature is required to have a continuous vapor barrier. On all insulation with a vapor barrier, seal the joints, duct wrap seams, vapor retarder (ASJ) film seams and penetrations in insulation at hangers, supports, anchors, and other projections with a vapor-barrier coating/mastic as specified in the individual insulation sections.
 - 3. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier coating/mastic.
 - 4. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 5. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- I. Glass Fiber Insulated Pipes Conveying Fluids Below Ambient Temperature:
 - 1. Provide vapor barrier jackets, factory-applied or field-applied; secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
 - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.
- J. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- K. For hot piping conveying fluids over 120 degrees F, insulate flanges and unions at equipment.
- L. Glass Fiber Insulated Pipes Conveying Fluids Above Ambient Temperature:
 - 1. Provide standard jackets, with vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- M. Inserts and Shields:
 - 1. Application: Piping 1-1/2 inches diameter or larger.
 - 2. Shields: Galvanized steel, 20 gauge, one half the circumference of the insulation, and a minimum of 12 inches long, between pipe hangers or pipe hanger rolls and inserts.
 - 3. Insert location: Between support shield and piping and under the finish jacket.

-
4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- N. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 07 84 00.
- O. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with canvas jacket sized for finish painting. Canvas shall be coated twice with Foster fireproof lagging to ensure specified flame and smoke spread ratings.
- P. Pipe Exposed in Mechanical Equipment Rooms: Finish with PVC jacket.
- Q. Pipe Exposed in Finished Spaces: Finish with canvas jacket sized for finish painting. Canvas shall be coated twice with Foster fireproof lagging to ensure specified flame and smoke spread ratings.
- R. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Provide with 0.016 inch aluminum rolled jacket. Cover with aluminum jacket with aluminum bands 12 inches on center and at each butt joint located on bottom side of horizontal piping. Fittings shall be covered with two piece factory fabricated "ELL-JACS."
- S. Buried Piping: Provide factory-fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with 1 mil, 0.001 inch thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with polyester film.
- T. Heat Traced Piping: All piping exposed outdoors shall be wrapped with electric trace before insulation is applied. Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.
- U. All exposed piping surfaces, insulation, supports, etc., shall be painted with two coats of oil base paint. Color shall be selected by the Owner.
- V. Insulation systems shall be installed per the applicable plate from the MICA manual 8th edition:
1. Pre-formed Pipe Insulation Single Layer Construction: Plate 1-100
 2. Non-metallic sealed jacketing systems: PVC, etc: Plate 1-510
 3. Split Ring Hangers: Plate 1-600
 4. Clevis Hanger with High Density Inserts: Plate 1-610
 5. Pre-Insulated Pipe Support, Standoff Clamp: Plate 1-640
 6. Traced Piping: Plate 1-900
 7. Pre-formed Elbow Insulation: Plate 2-100
 8. Mechanical Fitting Field Fabricated: Plate 2-116
 9. Pre-formed or Fabricated Tee Insulation: Plate 2-120
-

10. Field or Factory-Fabricated Valve Insulation: Plate 2-130
11. In-line Flange Insulation Built-up and Beveled: Plate 2-135
12. Non-metallic Jackets: Fitting and Valve Insulation Sealed Jacketing Systems: Plate 2-536
13. Vapor Stop (Dam) - Fittings: Plate 2-660
14. Vessels, Flexible Foam Sheets: 4-200
15. Flexible Foam for Low Temperature Equipment: 4-210
16. Vapor Stop (Dam) - Equipment: 4-660

3.3 SCHEDULE

A. Chilled Water:

1. All interior piping 1.5 inches and smaller shall have minimum 1.5 inch thick insulation.
2. All interior piping 2.0 inches and larger shall have 2.0 inch thick insulation.
3. Piping installed in Boiler, Chiller, Mechanical Rooms, and outside of the building shall have minimum 2.0 inch thick insulation. Insulation on all mezzanine and platform piping shall have minimum 2.0 inch thick insulation.
4. Chilled water piping insulation shall be closed-cell rigid phenolic foam type.

B. Hot Water:

1. Piping 1.5 inches in diameter and smaller shall have minimum 1.5 inch thick insulation.
2. Piping 2.0 inches or larger in diameter shall have minimum 2.0 inch thick insulation.
3. Hot Water Piping exposed to outdoor air shall have minimum 2.5 inch thick insulation.
4. Hot water piping insulation shall be fiberglass.

C. Underground PP-RCT piping:

1. All underground PP-RCT piping shall be insulated per the above (thickness based on hot or chilled water). Insulation shall be FOAMGLAS ONE by Owens Corning or equivalent. The insulation shall be listed by the manufacturer as approved for direct burial application.

D. Condensate

1. Condensate lines shall be insulated with 1.0 inch thick closed cell insulation. The insulation shall extend from the connection on the unit until it either terminates at a floor drain or other indirect waste receptor, or turns underground.

E. Refrigerant

1. Refrigerant lines shall be insulated with 1.5 inch thick closed cell elastomeric foam insulation. Both gas and liquid lines should be insulated.
2. Refrigerant Hot Gas:

END OF SECTION 23 07 19

**SECTION 23 08 00
COMMISSIONING OF HVAC**

PART 1 GENERAL

1.1 SUMMARY

- A. See Section 01 91 13 - General Commissioning Requirements for overall objectives; comply with the requirements of Section 01 91 13.
- B. This section covers the Contractor's responsibilities for commissioning; each subcontractor or installer responsible for the installation of a particular system or equipment item to be commissioned is responsible for the commissioning activities relating to that system or equipment item.
- C. The Commissioning Authority (CA) directs and coordinates all commissioning activities and provides Prefunctional Checklists and Functional Test Procedures for Contractor's use.
- D. The entire HVAC system is to be commissioned, including commissioning activities for the following specific items:
 - 1. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.
- E. The Prefunctional Checklist and Functional Test requirements specified in this section are in addition to, not a substitute for, inspection or testing specified in other sections.

1.2 REFERENCE STANDARDS

- A. ASHRAE Guideline 1.1 - HVAC&R Technical Requirements for the Commissioning Process; 2007, with Errata (2012).

1.3 SUBMITTALS

- A. Updated Submittals: Keep the Commissioning Authority informed of all changes to control system documentation made during programming and setup; revise and resubmit when substantial changes are made.
- B. Startup Reports, Prefunctional Checklists, and Trend Logs: Submit for approval of Commissioning Authority.
- C. HVAC Control System O&M Manual Requirements. In addition to documentation specified elsewhere, compile and organize at minimum the following data on the control system:
 - 1. Specific step-by-step instructions on how to perform and apply all functions, features, modes, etc. mentioned in the controls training sections of this specification and other features of this system. Provide an index and clear table of contents. Include the detailed technical manual for programming and customizing control loops and algorithms.
 - 2. Full as-built set of control drawings.
 - 3. Full as-built sequence of operations for each piece of equipment.
 - 4. Full points list; in addition to the information on the original points list submittal, include a listing of all rooms with the following information for each room:
 - a. Floor.

- b. Room number.
 - c. Room name.
 - d. Air handler unit ID.
 - e. Reference drawing number.
 - f. Air terminal unit tag ID.
 - g. Heating and/or cooling valve tag ID.
 - h. Minimum air flow rate.
 - i. Maximum air flow rate.
5. Full print out of all schedules and set points after testing and acceptance of the system.
 6. Full as-built print out of software program.
 7. Electronic copy on disk of the entire program for this facility.
 8. Marking of all system sensors and thermostats on the as-built floor plan and HVAC drawings with their control system designations.
 9. Maintenance instructions, including sensor calibration requirements and methods by sensor type, etc.
 10. Control equipment component submittals, parts lists, etc.
 11. Warranty requirements.
 12. Copies of all checkout tests and calibrations performed by the Contractor (not commissioning tests).
 13. Organize and subdivide the manual with permanently labeled tabs for each of the following data in the given order:
 - a. Sequences of operation.
 - b. Control drawings.
 - c. Points lists.
 - d. Controller and/or module data.
 - e. Thermostats and timers.
 - f. Sensors and DP switches.
 - g. Valves and valve actuators.
 - h. Dampers and damper actuators.
 - i. Program setups (software program printouts).
- D. Project Record Documents: See Section 01 78 00 for additional requirements.

1. Submit updated version of control system documentation, for inclusion with operation and maintenance data.
 2. Show actual locations of all static and differential pressure sensors (air, water and building pressure) and air-flow stations on project record drawings.
- E. Draft Training Plan: In addition to requirements specified in Section 01 79 00, include:
1. Follow the recommendations of ASHRAE Guideline 1.1.
 2. Control system manufacturer's recommended training.
 3. Demonstration and instruction on function and overrides of any local packaged controls not controlled by the HVAC control system.
- F. Training Manuals: See Section 01 79 00 for additional requirements.
1. Provide three extra copies of the controls training manuals in a separate manual from the O&M manuals.

PART 2 PRODUCTS

2.1 TEST EQUIPMENT

- A. Provide all standard testing equipment required to perform startup and initial checkout and required functional performance testing; unless otherwise noted such testing equipment will NOT become the property of Owner.
- B. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.

PART 3 EXECUTION

3.1 PREPARATION

- A. Cooperate with the Commissioning Authority in development of the Prefunctional Checklists and Functional Test Procedures.
- B. Furnish additional information requested by the Commissioning Authority.
- C. Prepare a preliminary schedule for HVAC pipe and duct system testing, flushing and cleaning, equipment start-up and testing, adjusting, and balancing start and completion for use by the Commissioning Authority; update the schedule as appropriate.
- D. Notify the Commissioning Authority when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and testing, adjusting, and balancing will occur; when commissioning activities not yet performed or not yet scheduled will delay construction notify ahead of time and be proactive in seeing that the Commissioning Authority has the scheduling information needed to efficiently execute the commissioning process.
- E. Put all HVAC equipment and systems into operation and continue operation during each working day of testing, adjusting, and balancing and commissioning, as required.
- F. Provide test holes in ducts and plenums where directed to allow air measurements and air balancing; close with an approved plug.

- G. Provide temperature and pressure taps in accordance with Contract Documents.

3.2 INSPECTING AND TESTING - GENERAL

- A. Submit startup plans, startup reports, and Prefunctional Checklists for each item of equipment or other assembly to be commissioned.
- B. Perform the Functional Tests directed by the Commissioning Authority for each item of equipment or other assembly to be commissioned.
- C. Provide two-way radios for use during the testing.
- D. Valve/Damper Stroke Setup and Check:
 - 1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
 - 2. Set pump/fan to normal operating mode.
 - 3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
 - 4. Command valve/damper open; verify position is full open and adjust output signal as required.
 - 5. Command valve/damper to a few intermediate positions.
 - 6. If actual valve/damper position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).
- E. Isolation Valve or System Valve Leak Check: For valves not by coils.
 - 1. With full pressure in the system, command valve closed.
 - 2. Use an ultra-sonic flow meter to detect flow or leakage.
- F. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.

3.3 TAB COORDINATION

- A. TAB: Testing, adjusting, and balancing of HVAC.
- B. Coordinate commissioning schedule with TAB schedule.
- C. Review the TAB plan to determine the capabilities of the control system toward completing TAB.
- D. Provide all necessary unique instruments and instruct the TAB technicians in their use; such as handheld control system interface for setting terminal unit boxes, etc.
- E. Have all required Prefunctional Checklists, calibrations, startup and component Functional Tests of the system completed and approved by the Commissioning Authority prior to starting TAB.
- F. Provide a qualified control system technician to operate the controls to assist the TAB technicians or provide sufficient training for the TAB technicians to operate the system without assistance.

3.4 CONTROL SYSTEM FUNCTIONAL TESTING

- A. Prefunctional Checklists for control system components will require a signed and dated certification that all system programming is complete as required to accomplish the requirements of Contract Documents and the detailed Sequences of Operation documentation submittal.
- B. Do not start Functional Testing until all controlled components have themselves been successfully Functionally Tested in accordance with Contract Documents.
- C. Using a skilled technician who is familiar with this building, execute the Functional Testing of the control system as required by the Commissioning Authority.
- D. Functional Testing of the control system constitutes demonstration and trend logging of control points monitored by the control system.
 - 1. The scope of trend logging is partially specified; trend log up to 50 percent more points than specified at no extra cost to Owner.
 - 2. Perform all trend logging specified in Prefunctional Checklists and Functional Test procedures.
- E. Functionally Test integral or stand-alone controls in conjunction with the Functional Tests of the equipment they are attached to, including any interlocks with other equipment or systems; further testing during control system Functional Test is not required unless specifically indicated below.
- F. Demonstrate the following to the Commissioning Authority during testing of controlled equipment; coordinate with commissioning of equipment.
 - 1. Setpoint changing features and functions.
 - 2. Sensor calibrations.
- G. Demonstrate to the Commissioning Authority:
 - 1. That all specified functions and features are set up, debugged and fully operable.
 - 2. That scheduling features are fully functional and setup, including holidays.
 - 3. That all graphic screens and value readouts are completed.
 - 4. Correct date and time setting in central computer.
 - 5. That field panels read the same time as the central computer; sample 10 percent of field panels; if any of those fail, sample another 10 percent; if any of those fail test all remaining units at no extra cost to Owner.
 - 6. Functionality of field panels using local operator keypads and local ports (plug-ins) using portable computer/keypad; demonstrate 100 percent of panels and 10 percent of ports; if any ports fail, sample another 10 percent; if any of those fail, test all remaining units at no extra cost to Owner.
 - 7. Power failure and battery backup and power-up restart functions.
 - 8. Global commands features.
 - 9. Security and access codes.
 - 10. Occupant over-rides (manual, telephone, key, keypad, etc.).
 - 11. O&M schedules and alarms.

- 12. Occupancy sensors and controls.
- 13. All control strategies and sequences not tested during controlled equipment testing.
- H. If the control system, integral control components, or related equipment do not respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice, under any of the conditions, sequences, or modes tested, correct all systems, equipment, components, and software required at no additional cost to Owner.

3.5 OPERATION AND MAINTENANCE MANUALS

- A. See Section 01 78 00 for additional requirements.
- B. Add design intent documentation furnished by Architect to manuals prior to submission to Owner.
- C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.
- D. Commissioning Authority will add commissioning records to manuals after submission to Owner.

3.6 DEMONSTRATION AND TRAINING

- A. See Section 01 79 00 for additional requirements.
- B. Demonstrate operation and maintenance of HVAC system to Owner's personnel; if during any demonstration, the system fails to perform in accordance with the information included in the O&M manual, stop demonstration, repair or adjust, and repeat demonstration. Demonstrations may be combined with training sessions if appropriate.
- C. These demonstrations are in addition to, and not a substitute for, Prefunctional Checklists and demonstrations to the Commissioning Authority during Functional Testing.
- D. Provide classroom and hands-on training of Owner's designated personnel on operation and maintenance of the HVAC system, control system, and all equipment items indicated to be commissioned. Provide the following minimum durations of training:
- E. TAB Review: Instruct Owner's personnel for minimum ____ hours, after completion of TAB, on the following:
 - 1. Review final TAB report, explaining the layout and meanings of each data type.
 - 2. Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.
 - 3. Identify and discuss any terminal units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.
 - 4. Discuss any temporary settings and steps to finalize them for any areas that are not finished.
 - 5. Other salient information that may be useful for facility operations, relative to TAB.
- F. HVAC Control System Training: Perform training in at least three phases:
 - 1. Phase 1 - Basic Control System: Provide minimum of ____ hours of actual training on the control system itself. Upon completion of training, each attendee, using appropriate documentation, should be able to perform elementary operations and describe general hardware architecture and functionality of the system.

- a. This training may be held on-site or at the manufacturer's facility.
 - b. If held off-site, the training may occur prior to final completion of the system installation.
 - c. For off-site training, Contractor shall pay expenses of up to two attendees.
2. Phase 2 - Integrating with HVAC Systems: Provide minimum of ____ hours of on-site, hands-on training after completion of Functional Testing. Include instruction on:
- a. The specific hardware configuration of installed systems in this facility and specific instruction for operating the installed system, including interfaces with other systems, if any.
 - b. Security levels, alarms, system start-up, shut-down, power outage and restart routines, changing setpoints and alarms and other typical changed parameters, overrides, freeze protection, manual operation of equipment, optional control strategies that can be considered, energy savings strategies and set points that if changed will adversely affect energy consumption, energy accounting, procedures for obtaining vendor assistance, etc.
 - c. Trend logging and monitoring features (values, change of state, totalization, etc.), including setting up, executing, downloading, viewing both tabular and graphically and printing trends; provide practice in setting up trend logging and monitoring during training session.
 - d. Every display screen, allowing time for questions.
 - e. Point database entry and modifications.
3. Phase 3 - Post-Occupancy: Six months after occupancy conduct minimum of ____ hours of training. Tailor training session to questions and topics solicited beforehand from Owner. Also be prepared to address topics brought up and answer questions concerning operation of the system.
- G. Provide the services of manufacturer representatives to assist instructors where necessary.
- H. Provide the services of the HVAC controls instructor at other training sessions, when requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

END OF SECTION 23 08 00

**SECTION 23 09 13.13
BAS ACTUATORS AND OPERATORS**

PART 1 GENERAL

1.1 REFERENCES

- A. Refer to Section 23 09 00 - References

1.2 ACRONYMS, ABBREVIATIONS AND DEFINITIONS

- A. Refer to Section 23 09 00 - Acronyms, Abbreviations and Definitions

PART 2 PRODUCT

2.1 ACTUATORS

- A. Manufacturers:
 - 1. Belimo
 - 2. Honeywell
 - 3. Johnson
 - 4. Siemens
 - 5. Schneider
 - 6. Or Approved Equal
- B. For dampers, the actuators used shall be provided from a single manufacturer.
- C. For valves, the actuators used shall be provided from a single manufacturer.
- D. Actuators shall be provided from a manufacturer registered under ISO9001:2000.
- E. Electronic Damper Actuators.
 - 1. Size for torque required for damper seal at load conditions.
 - 2. Coupling: V-bolt dual nut clamp with a V-shaped, toothed cradle.
 - 3. Mounting: Actuators shall be capable of being mechanically and electrically paralleled to increase torque if required.
 - 4. Overload Protection: Electronic overload or digital rotation-sensing circuitry without the use of end switches to prevent any damage to the actuator during a stall condition.
 - 5. Fail-Safe Operation: Mechanical, spring-return mechanism. Internal chemical storage systems, capacitors, or other internal non-mechanical forms of fail-safe operation are not acceptable.
 - 6. Power Requirements (Two-Position Spring Return): 24 or 120 VAC as required.
 - 7. Power Requirements (Proportional): Maximum 10 VA at 24 VAC or 8 W at 24 VDC.
 - 8. Temperature Rating: -22 to +122°F (-30 to +50°C)

9. Housing:
 - a. Minimum requirement NEMA type 2 / IP54 mounted in any orientation.
 - b. In outdoor locations, provide NEMA 3R
 10. Agency Listing: ISO 9001, UL, UL(C) and CSA C22.2 No. 24-93.
- F. Electronic Valve Actuators.
1. Size for torque required for valve close off at 150% of total system (head) pressure for 2-way valves; and 100% of pressure differential across the valve or 100% of total system (pump) head differential pressure for 3-way valves.
 2. Coupling: Directly couple end mount to stem, shaft, or ISO-style direct-coupled mounting pad.
 3. Mounting: Actuators shall be capable of being mechanically and electrically paralleled to increase torque if required.
 4. Overload Protection: Electronic overload or digital rotation-sensing circuitry without the use of end switches to deactivate the actuator at the end of rotation.
 5. Fail-Safe Operation: Mechanical, spring-return mechanism. Internal chemical storage systems, capacitors, or other internal non-mechanical forms of fail-safe operation are not acceptable.
 6. Power Requirements: Maximum 10 VA at 24 VAC or 8 W at 24 VDC.
 7. Maximum 1 VA at 24 VAC or 1 W at 24 VDC.
 8. Temperature Rating: -22 to +122°F (-30 to +50°C)
 9. Housing:
 - a. Minimum requirement NEMA type 2 / IP54 mounted in any orientation.
 - b. In outdoor locations, provide NEMA 3R
 10. Agency Listing: ISO 9001, UL, UL(C) and CSA C22.2 No. 24-93.
- G. Terminal Unit Actuators
1. Close-off (Differential) Pressure Rating: 200 psi.
 2. Coupling: V-bolt dual nut clamp with a V-shaped, toothed cradle or an ISO-style direct-coupled mounting pad.
 3. Power Requirements: Maximum 1 VA at 24 VAC or 1 W at 24 VDC.
 4. Temperature Rating: -22 to +122°F (-30 to +50°C). Housing Rating: Minimum UL94-5V(B) flammability.
 5. Agency Listing: CE, UL 60730-1A/-2-14, CAN/CSA E60730-1, CSA C22.2 No. 24-93, CE according to 89/336/EEC.

PART 3 EXECUTION

3.1 ACTUATORS

- A. General: Mount actuators and adapters according to manufacturer's recommendations.
- B. Electric and Electronic Damper Actuators.
 - 1. Mount actuators directly on damper shaft or jackshaft unless shown as a linkage installation.
 - 2. Link actuators according to manufacturer's recommendations.
 - 3. For low-leakage dampers with seals, mount actuator with a minimum 5° travel available for damper seal tightening.
 - 4. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately the 5° open position, manually close the damper, and then tighten linkage.
 - 5. Check operation of damper-actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
 - 6. Provide necessary mounting hardware and linkages for actuator installation.
- C. Valve Actuators.
 - 1. Connect actuators to valves with adapters approved by actuator manufacturer.

END OF SECTION 23 09 13.13

**SECTION 23 09 13.23
BAS SENSORS AND TRANSMITTERS**

PART 1 GENERAL

1.1 RELATED SECTIONS

- A. SECTION 23 09 13, BAS Instrumentation and Control Devices
- B. SECTION 23 09 13.13, BAS Sensors and Transmitters BAS Actuators and Operators
- C. SECTION 23 09 13.33, BAS Control Valves
- D. SECTION 23 09 13.43, BAS Control Dampers
- E. SECTION 23 09 23, BAS Direct Digital Control System

1.2 REFERENCES

- A. Refer to Section 23 09 00 - References

1.3 ACRONYMS, ABBREVIATIONS AND DEFINITIONS

- A. Refer to Section 23 09 00 - Acronyms, Abbreviations and Definitions

PART 2 PRODUCT

2.1 SENSORS AND DEVICES

- A. Input/output sensors and devices shall be closely matched to the requirements of the BAS controller for accurate, responsive, noise-free signal input/output. Control input response shall be high sensitivity and matched to the loop gain requirements for precise and responsive control.
- B. Sensors and transmitters shall be manually calibrated on site so that the wiring length does not detract from the sensor accuracy specified.
- C. Provide guards (plastic or wire) for sensors, thermostats, and transmitters that are installed in public areas such as gymnasiums, classrooms, corridors, and vestibules.
- D. Temperature sensors shall have the following characteristics:
 - 1. Sensors shall have +/- 1.0 °F accuracy between 32 °F and 212 °F.
 - 2. Space temperature sensors
 - a. Shall consist of an element within a ventilated cover.
 - b. Space sensors located in mechanical rooms and public shall contain a network jack, but shall have no ability to adjust temperature setpoint (Set Point Adjustment).
 - c. Space sensors shall be provided in accordance with the drawings and specifications with the following options:
 - 1) Sensor complete with Network Jack
 - 2) Sensor complete with Network Jack, and Set Point Adjustment

- 3) Sensor complete with Network Jack, and illuminated Override switch
- 4) Sensor complete with Network Jack, Set Point Adjustment, and illuminated Override switch
- 5) Sensor complete with Network Jack, Set Point Adjustment, illuminated Override switch and Fan Speed Selection.

E. RTD Transmitter

1. Where reference is made on the drawings for a RTD transmitter, it shall be interpreted as follows:
2. Transmitters shall meet at minimum the following requirements.
 - a. Provide an RTD transmitter in configurations below meeting the following requirements:
 - 1) 100 ohm or 1000 ohm PT RTD
 - 2) 24V ac/dc power supply.
 - 3) 4-20 mA, 0-10Vdc or 0-5Vdc outputs compatible with BMS.
 - 4) Electronics accuracy of +/-0.1% of span.
 - 5) Operating temperature range of 32°F to 158°F. OSA only - operating temperature range of -40°F to 185°F.
 - 6) Optional LCD display

F. Temperature Sensor – Outside Air

1. Provide outside air temperature sensors as indicated within the field termination schedules and/or controls diagrams.
2. Temperature sensors shall meet, at minimum, the following requirements:
 - a. Aluminum LB with PVC sun and windscreen.
 - b. Wall mount weatherproof enclosure with conduit entrance.
 - c. Thermistor or RTD compatible with BMS

G. Temperature Sensor – Duct Mounted – Single Point

1. Provide duct mounted, single point, temperature sensor as indicated within the field termination schedules and/or controls diagrams as follows:
 - a. In ducts less than 10 ft² in cross-sectional area.
 - b. In ducts greater than 10 ft² in cross-sectional area if there is no heating coil and no cooling coil and no mixing of air flows of different temperature upstream.
2. Temperature sensors shall meet, at minimum, the following requirements:
 - a. 0.25" stainless steel probe of length between one-third and two-thirds of the duct width.
 - b. Thermistor or RTD compatible with BMS, sealed in probe with 3 part moisture protection system.

- c. Duct mounted ABS plenum rated housing with conduit entrance. (Optional metal, weather proof or no enclosure available)

H. Temperature Sensor-Wall Mounted

- 1. Provide wall mounted temperature sensors for non-public spaces as indicated within the field termination schedules and/or controls diagrams as follows.
- 2. Temperature sensors shall meet, at minimum, the following requirements:
 - a. White protective enclosure.
 - b. The location to be selected by the Engineer/Architect or at a height of no higher than 48" to the top of the device. No sensor shall be mounted until the Engineer/Architect gives specific location instructions.
 - c. Thermistor or RTD compatible with BMS.
 - d. Optional set point adjustment, push button override switch, LED indication, bi-metal, alcohol or LCD display depended on owner requirement.

I. Temperature Sensor – Wall Mounted – Lobby, Hallways Or Security Spaces

- 1. Provide wall mounted stainless plate temperature sensors for lobbies and lobby vestibule spaces as indicated within the field termination schedules and/or control diagrams as follows.
- 2. Temperature sensors shall meet, at minimum, the following requirements:
 - a. Stainless plate sensors to fit 100 x 50mm (4"X2") junction box, available with or without tamperproof screws.
 - b. Thermistor or RTD compatible with BMS.

J. Temperature Sensor – Immersion - Thermo well Mounted

- 1. Provide thermo well mounted temperature sensors as indicated within the Field termination schedules and/or control diagrams as follows.
- 2. Temperature sensors shall meet, at minimum, the following requirements:
 - a. Rigid 0.25" stainless steel probe of length, which is, at minimum, 20% of the pipe width.
 - b. Thermistor or RTD Compatible with BMS sealed in probe with three-part moisture protection system.
 - c. BMS shall report the monitored temperature with an accuracy of 0.5°C (1.0°F).
 - d. Metal housing with conduit entrance.
 - e. Provide Brass or Stainless steel thermo well (316 or 304).
 - f. Provide with thermal grease to aid temperature sensing.

K. Relative Humidity Sensor – Wall Mounted

1. Provide wall mounted relative humidity sensors as indicated within the Field termination schedules and/or control diagrams. Humidity sensors shall meet, at minimum, the following requirements:
 - a. White protective enclosure
 - b. Sensor to be laser trimmed thermoset polymer based capacitive type.
 - c. 24 Vac/dc power supply
 - d. 4-20 mA two wire, 0-10 Vdc and 0-5 Vdc output proportional to relative humidity range of 0% to 100% and compatible with BMS.
 - e. 2% accurate (5-95% RH). (3 & 5 % accurate units available)
 - f. Operating temperature range of 32°F to 158°F.
 - g. Reverse voltage protected and output limited.
 - h. Optional LCD display-SP and RH100A series
 - i. Optional set point adjustment-SP series
 - j. Optional push button override-RH100A series

L. Relative Humidity Sensor – Duct Mounted

1. Provide duct mounted relative humidity sensors as indicated within the Field termination schedules and/or control diagrams. Duct mounted relative humidity sensors shall meet, at minimum, the following requirements:
 - a. ABS housing with conduit entrance.
 - b. Sensor to be laser trimmed thermoset polymer based capacitive type.
 - c. 24 Vac/dc power supply.
 - d. 4-20 mA two wires, 0-10 Vdc and/or 0-5 Vdc output proportional to relative humidity range of 0% to 100% and compatible with BMS.
 - e. 2% accurate (5-95% RH). (3 & 5 % accurate units available)
 - f. 230mm (9") probe length.
 - g. Operating temperature range of 32°F to 158°F.
 - h. Reverse voltage protected and output limited.
 - i. 60 micron HDPE filter

M. Relative Humidity Sensor – Outside Air

1. Provide OSA relative humidity sensors as indicated within the Field termination schedules and/or control diagrams. Humidity sensors shall meet, at minimum, the following requirements:
 - a. ABS hinged weatherproof housing with conduit entrance.
 - b. Sensor to be laser trimmed thermoset polymer based capacitive type.

- c. 24 Vac/dc power supply
- d. 4-20 mA two wire, 0-10 Vdc and 0-5 Vdc output proportional to relative humidity range of 0% to 100% and compatible with BMS.
- e. 2% accurate (5-95% RH).
- f. Operating temperature range of 32°F to 185°F.
- g. Reverse voltage protected and output limited.

N. Combination Relative Humidity And Temperature Sensors

O. Static Pressure Sensor – Duct Mounted

- 1. Provide duct mounted static pressure sensors as indicated within the Field termination schedules and/or control diagrams. Static pressure sensors shall meet, at minimum, the following requirements:
 - a. Input range shall be appropriate for the application. Select range such that it covers from zero duct static pressure relative to the exterior of the duct up to a static pressure of between 20% and 50% in excess of the maximum static pressure that could be encountered in the duct relative to the duct exterior. Typically, for low pressure commercial duct consider using a range of 0 to 2" wc., for medium pressure duct use a range of 0 to 6" wc. and for high-pressure duct use a range of 0 to 10" wc.
 - b. 4-20mA, 0-5 or 0-10Vdc output proportional to pressure input range compatible with BMS system.
 - c. 1% Full scale output accuracy
 - d. Operating temperature range of 32°F to 140°F.
 - e. Easily accessible, integral non-interacting zero adjustment.
 - f. Minimum over pressure input protection of two times rated input or 20 psi whichever is greater.

P. Differential Pressure Sensor – Air (Filter/Coil Monitoring)

- 1. Provide air differential pressure sensors as indicated in field termination schedules and/or control diagrams. Air differential pressure sensor shall meet, at minimum, the following requirements:
 - a. Sensors used for filter or coil differential pressures shall also have a display of the monitored differential pressure.
 - b. Output shall be 4-20mA, 0-10Vdc or 0-5Vdc output proportional to pressure input range compatible with BMS.
 - c. Select range as required, taking into consideration pressure drop across filter or coil. Typically 0-2" wc range for low-pressure commercial duct.
 - d. Operating temperature range of 32°F to 140°F.

Q. Differential Pressure Switch – Air

- 1. Provide air differential pressure switches as indicated in field termination schedules and/or control diagrams. Air differential pressure switches shall meet, at minimum, the following requirements:

- a. An IP54 (NEMA 13) polycarbonate housing.
- b. SPDT switch rated at 250 Vac at 1 amp.
- c. Field adjustable range from 0.02" wc to max range of device. Select range as required, taking into consideration pressure drop across filter or coil. Typically 0.2-2" wc range for low-pressure commercial duct.
- d. Temperature range of -4°F to 140°F.
- e. Set point adjustment knob with indication.
- f. Automatic reset.

R. Air Flow Sensor

- 1. Provide airflow rate sensors and transducers as indicated in the Field termination schedules and/or control diagrams. Air flow rate sensors and transducer shall meet, at minimum, the following requirements:
 - a. Hot wire anemometer type.
 - b. Self-compensation for changes in air temperature.
 - c. Probe and transducer housing shall be constructed of durable PVC.
 - d. Probe shall be adjustable from 2" - 7.3".
 - e. Power supply shall be 24 Vac/dc.
 - f. Output signal of 4-20 mA or 0-10Vdc proportional to air flow speed equal to 3150 ft/min or 1575 ft/min jumper selectable.
 - g. Air temperature range of 14°F to 140° F.
 - h. 5% accuracy of measured value.

S. Air Flow Measuring Station:

- 1. Provide airflow rate sensors and transducers as indicated in the Field termination schedules and/or control diagrams. Air flow rate sensors and transducer shall meet, at minimum, the following requirements:
 - a. UL 873 listed, BTL listed
 - b. Thermal Dispersion Technology based
 - c. Self-heated sensor: Precision, hermetically sealed, bead-in-glass thermistor
 - d. Temperature sensor: Precision, hermetically sealed, bead-in-glass thermistor
 - e. Sensing Node Housing:
 - 1) Material: Glass-filled Polypropylene
 - 2) Sensor Potting Materials: Waterproof marine epoxy

- f. Accuracy: $\pm 2\%$ of reading to NIST-traceable airflow standards (includes transmitter uncertainty)
- g. Calibrated Range: 0 to 10,000 fpm
- h. Accuracy: ± 0.15 °F to NIST-traceable temperature standards (includes transmitter uncertainty)
- i. Mounting Rods: Zinc plated steel
- j. Mounting Brackets: 304 stainless steel
- k. Manufacturer:
 - 1) Ebtron
 - 2) Or Approved Equal

T. Water Pressure Sensor

- 1. Provide water pressure sensors as indicated within the Field termination schedules and/or control diagrams. Pressure sensors shall meet the following requirements:
 - a. Operating range shall be suitable for the application. Select range such that it covers from zero pressure to twice the amount of pressure desired for control purposes or that could be encountered.
 - b. 4-20 mA output proportional to water pressure.
 - c. 0.25% accuracy of range.
 - d. Temperature range of -40°F to 260°F.
 - e. Over pressure input protection of a minimum two times rated input.
 - f. An optional ABS wiring housing is available for an interior application and weatherproof wiring housing is available for an exterior application.
 - g. 17-4PH stainless steel wetted parts.
 - h. Burst pressure of a minimum five times rated input.

U. Current Relay/Switch

- 1. Provide current sensing relays as indicated in the Field termination schedules and/or control diagrams. Current sensing relays shall meet, at minimum, the following specifications:
 - a. Rated for the applicable load.
 - b. The output relay shall have an accessible trip adjustment over its complete operating range. Provide LED indication of relay status.
 - c. Current relay shall have input and output isolation via current transformer.
 - d. Current relay shall be self-powered with no insertion loss.
 - e. Relay shall be in a dustproof housing.
 - f. Accuracy to be $< 2\%$ of full-scale max.

- g. Temperature rating of 5°F to 140°F.
- h. Whenever the status of a single speed motor is monitored it shall be done via a current sensing relay.
- i. The BMS contractor shall provide current sensing relays at the MCC starters.
- j. The BMS contractor shall provide the current sensing relays for motors with local starters and no MCC starter.

V. Current Sensor

- 1. Provide monitoring of the current as identified in Field termination sheets and/or control drawings. Current monitoring shall meet, at minimum, the following requirements:
 - a. 4-20 mA, 0-10 or 0-5 Vdc output proportional to current draw.
 - b. Reverse polarity protected and output limited.
 - c. 50/60 Hz operation.
 - d. Accuracy of better than 1%.
 - e. Operating temperature range of -20°F to 120°F.

W. Carbon Dioxide (CO2) Sensor

- 1. Provide a space or duct carbon dioxide gas detection sensor as indicated within the field termination schedules and/or control diagrams. Carbon dioxide detection sensors shall meet, at minimum, the following requirements:
 - a. Set-up to be fully microprocessor based c/w LCD.
 - b. 4-20 mA, 0-10 or 0-5 Vdc output compatible with BMS proportional to 0 to 2000 ppm of carbon dioxide concentration
 - c. Power supply to be 20-28Vac/dc @ 140 mA max for 24 Vac and 80 mA avg. @24 Vdc.
 - d. No maintenance or periodic sensor replacement needed. The sensor shall have a 5-year calibration interval, utilizing the Automatic Calibration Logic Program (ACLP).
 - e. Standard accuracy to be 3% of reading or 75 ppm, whichever is greater.
 - f. Optional integral humidity and temperature transmitter or temperature sensor (thermistor or RTD)
 - g. BACnet communications
 - h. Optional setpoint adjustment, override switch and relay.
 - i. Operating temperature of 32°F to 122°F.

PART 3 EXECUTION

3.1 INSTALLATION OF SENSORS

- A. Install sensors according to manufacturer's recommendations.

- B. Mount sensors rigidly and adequately for operating environment.
- C. Install room temperature sensors on concealed junction boxes properly supported by wall framing. Box heights shall be coordinated with Division 26 and other trades such that device heights match exactly light switches and other similar control devices.
- D. Air seal wires attached to sensors in their raceways or in the wall to prevent sensor readings from being affected by air transmitted from other areas.
- E. Use averaging sensors in mixing plenums and hot and cold decks. Install averaging sensors in a serpentine manner vertically across duct. Support each bend with a capillary clip.
- F. Install mixing plenum low-limit sensors in a serpentine manner horizontally across duct. Support each bend with a capillary clip. Provide 1 ft. of sensing element for each 1 ft² of coil area.
- G. Install pipe-mounted temperature sensors in wells. Install liquid temperature sensors with heat-conducting fluid in thermal wells.
- H. Install outdoor air temperature sensors on north wall at designated location with sun shield.
- I. Differential Air Static Pressure.
 - 1. Supply Duct Static Pressure. Pipe high-pressure tap to duct using a pitot tube. Make pressure tap connections according to manufacturer's recommendations.
 - 2. Return Duct Static Pressure. Pipe high-pressure tap to duct using a pitot tube. Make pressure tap connections according to manufacturer's recommendations.
 - 3. Building Static Pressure. Pipe pressure sensor's low-pressure port to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe high-pressure port to a location behind a thermostat cover.
 - 4. Piping to pressure transducer pressure ports shall contain a capped test port adjacent to transducer.
 - 5. Pressure transducers, except those controlling VAV boxes, shall be located in control panels, not on monitored equipment or on ductwork. Mount transducers in a vibration-free location accessible for service without use of ladders or special equipment.
 - 6. Mount gauge tees adjacent to air and water differential pressure taps. Install shut-off valves before tee for water gauges.
- J. Smoke detectors, high and low limit thermostats, high-pressure cut-offs, and other safety switches shall be hard-wired to de-energize equipment as described in the sequence of operation. Switches shall require manual reset. Provide contacts that allow DDC software to monitor safety switch status.

END OF SECTION 23 09 13.23

**SECTION 23 09 13.33
BAS CONTROL VALVES**

PART 1 GENERAL

1.1 RELATED SECTIONS

- A. SECTION 23 09 00, BAS Instrumentation and Control
- B. SECTION 23 09 13, BAS Instrumentation and Control Devices
- C. SECTION 23 09 13.13, BAS Actuators and Operators
- D. SECTION 23 09 13.23, BAS Sensors and Transmitters
- E. SECTION 23 09 13.43, BAS Control Dampers
- F. SECTION 23 09 23, BAS Direct Digital Control System

1.2 REFERENCES

- A. Refer to Section 23 09 00 - References

1.3 ACRONYMS, ABBREVIATIONS AND DEFINITIONS

- A. Refer to Section 23 09 00 - Acronyms, Abbreviations and Definitions

PART 2 PRODUCT

2.1 VALVES

- A. Acceptable Manufacturers:
 - 1. Belimo
 - 2. Bell & Gossett
 - 3. Danfoss
 - 4. Griswold
 - 5. Siemens
 - 6. Or Approved Equal
- B. Control Valves with Globe-style bodies shall have the following characteristics:
 - 1. NPS 2 and Smaller: ANSI Class 250 bronze body, stainless steel stem, brass plug, bronze seat, and a TFE packing.
 - 2. NPS 2-1/2 and Larger: ANSI Class 125 cast iron body, stainless steel stem, bronze plug, bronze seat, and a TFE V-ring packing.
 - 3. Sizing:
 - a. Two-Position: Line size or size using a pressure differential of 1 psi.

- b. 2-way Modulating: 5 psig or twice the load pressure drop, whichever is greater.
 - c. 3-way Modulating: Twice the load pressure drop, but not more than 5 psig.
 - 4. Flow Characteristics: 2-way valves shall have equal percentage characteristics; 3-way valves shall have linear characteristics.
 - 5. Close-off Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150% of total system head pressure for 2-way valves and 150% of the design pressure differential across the 3-way valves.
 - 6. Bodies for valves 3" to 6" shall be iron, cast iron or cast steel with flanged connections and shall be rated for ANSI Class 125 working pressure. Packing shall protect against leakage at the stem.
- C. Ball-style body automatic control valves shall adhere to the following:
- 1. NPS 4 and Smaller: Nickel-plated forged brass body rated at no less than 400 psi, stainless steel ball and blowout proof stem, NPT female end fittings, with a dual EPDM O-ring packing design, fiberglass reinforced Teflon seats, and a Tefzel flow characterizing disc.
 - 2. Sizing:
 - a. Two-Position: Line size or size using a pressure differential of 1 psi.
 - b. 2-way Modulating: 5 psig or twice the load pressure drop, whichever is greater.
 - c. 3-way Modulating: Twice the load pressure drop, but not more than 5 psig.
 - 3. Close-off Pressure Rating: 100 psi. [NPS 3/4" and Smaller for Terminal Units: 200 psi.]
 - 4. The actuator shall be the same manufacturer as the valve, integrally mounted to the valve at the factory with a single screw on a four-way DIN mounting-base.
 - 5. All control ball valves shall feature characterized flow guides when used for modulating applications.
- D. Butterfly-style Control Valves NPS 2 through NPS 6 and NPS 14 through NPS 24
- 1. Performance
 - a. Bubble-tight shutoff (no leakage).
 - b. Rotation: Zero to 90 degrees.
 - c. Modified equal percentage flow characteristic.
 - 2. Three-way valve arrangement: Two 2-way butterfly valves in a cast iron Tee configuration cross-linked to ensure proper flow orientation.
 - 3. Body: Polyester coated ductile iron fully lugged, body pressure rating consistent with ASME/ANSI Class 125.
 - 4. Disc: 304 stainless steel with a pin connection. Disc shells and coated discs are not acceptable.
 - 5. Shaft: 304 stainless steel.
 - 6. Seat: Reinforced EPDM.
-

7. Shaft Bushings: Stainless steel and PFE.
8. Temperature rating: negative Minus 22 Deg F to 250 Deg F.
9. Actuators for NPS 14 through NPS 24:
 - a. Overload Protection: Auto-reset thermal switch shall be embedded in the motor.
 - b. Actuator shall be equipped with a hand wheel or shaft for manual override to permit operation of the actuator in the event of an electrical power failure.
 - c. A visual indication beacon shall indicate position status of the device.
10. Corrosion-resistant nameplate indicating:
 - a. Model number and production date.
 - b. Body size.
 - c. Flow arrow.

PART 3 EXECUTION

3.1 APPLICATIONS

- A. Hydronic control valves 6" and smaller shall be ball-style.
- B. Hydronic control valves 8" and larger shall be butterfly-style.
- C. All VAV and other terminal unit control valve actuators shall be fully modulating and controlled by 0-10V or 4-20mA analog signal. Using floating type actuators with dual digital output for control will NOT be acceptable.

3.2 CO-ORDINATION

- A. Coordinate delivery of control valves to site.
- B. Clearly tag and mark valves for their purpose and location.
- C. Supervise Mechanical Contractor in the installation of the control valves ensuring proper valve(s) are located and installed in proper location(s)

END OF SECTION 23 09 13.33

**SECTION 23 09 13.43
BAS CONTROL DAMPERS**

PART 1 GENERAL

1.1 REFERENCE STANDARDS

- A. ANSI/AMCA Standard 500-D, Laboratory Methods of Testing Dampers for Rating.

1.2 ACRONYMS, ABBREVIATIONS AND DEFINITIONS

- A. Refer to Section 23 09 00 - Acronyms, Abbreviations and Definitions

1.3 QUALITY ASSURANCE

- A. All dampers shall be certified to bear the AMCA Certified Ratings Program seal for Air Performance, Efficiency, and Air Leakage.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data.
 - 1. Include leakage, velocity, pressure drop, maximum pressure data and energy efficiency performance.
 - 2. Indicate materials, construction, and dimensions.
 - 3. Include pressure drop data for all damper sizes in accordance with AMCA 500-D test figures 5.2 (Ducted Inlet, Free Outlet), 5.3 (Ducted Inlet, Ducted Outlet) and 5.5 (Free Inlet, Free Outlet).
 - 4. Include a copy of Installation Instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer, material, and location of installation.
- B. Storage: Store materials in a dry area indoor, protected from damage, and in accordance with manufacturer's instructions.
- C. Handling: Handle and lift dampers in accordance with manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage.

PART 2 PRODUCT

2.1 AUTOMATIC CONTROL DAMPERS

- A. Manufacturers:
 - 1. Tamco
 - 2. Ruskin
 - 3. Johnson
 - 4. Greenheck
 - 5. Nailor

6. Or Approved Equal

- B. Dampers shall be minimum leakage type to conserve energy and the temperature control manufacturer shall submit leakage data for all control dampers with the temperature control submittal.
- C. Damper leakage ratings shall be certified in accordance with AMCA Standard 500-D.
- D. Provide any automatic control dampers not specified to be integral with other equipment.

2.2 INSULATED THERMALLY BROKEN CONTROL DAMPERS

- A. Dampers shall have a maximum leakage of Class 1 @ 4 in. wg or Class 1A @ 1 in. wg as defined by AMCA (Leakage class 1 is defined as 8 cfm/ sq. ft. @ 4 in. wg and class 1A is defined as 3 cfm/ sq. ft. @ 1 in. wg. at -40°F).
- B. Dampers shall have a maximum differential pressure rating of 8 in. wg.
- C. Dampers shall have a maximum velocity rating of 4000 fpm
- D. Frame:
 - 1. Quick connect damper frame shall be aluminum formed into a 4 in. x 1 in. structural hat channel with a 0.125 in. minimum wall thickness.
 - 2. Thermally broken with dual polyurethane resin gaps.
 - 3. Quick connect mounting is a flangeless frame ordered oversized to mate with a connecting duct.
- E. Blades:
 - 1. Damper blades shall be heavy gauge extruded aluminum airfoil shape with metal blade to blade overlap. Each blade shall be symmetrical relative to its axle pivot point, presenting identical performance characteristics with air flowing in either direction through the damper.
 - 2. Blade orientation is horizontal, and operation is parallel or opposed. Polyurethane foam fills the airfoil blade cavity giving the blade its thermal transfer properties. Ends of blade have a thermal break to isolate the transfer of heat/cold through the aluminum material from one side of the blade to the other.
- F. Blade Stops: Each blade stop (at top and bottom of damper frame) shall occupy no more than ½ in. of the damper opening area to allow for maximum free area and to minimize pressure loss across the damper.
- G. Seals:
 - 1. Blade Edge: Silicone blade seals come standard which are mechanically fastened to each blade.
 - 2. Jamb seal: Stainless steel is standard. Silicone is optional.
- H. Linkage: Concealed in frame out of the airstream, plated steel material.
- I. Axles: Minimum ½ in. dia. plated steel. Removable control shaft extends 6 in. beyond the damper frame.
- J. Bearings: Dual bearing with acetal inner sleeve, flanged outer bearing resulting in no metal-to-metal or metal-to-plastic contact.
- K. Finish: Mill Aluminum

- L. Temperature Rating: -70° F to 200° F
- M. Mounting: Suitable for vertical and horizontal applications.

2.3 RECTANGULAR LOW LEAKAGE CONTROL DAMPER

- A. Dampers shall have a maximum leakage of Class 1 @ 4 in. wg or Class 1A @ 1 in. wg as defined by AMCA (Leakage class 1 is defined as 8 cfm/ sq. ft. @ 4 in. wg and class 1A is defined as 3 cfm/ sq. ft. @ 1 in. wg. at -40°F).
- B. Dampers shall meet or exceed the IECC (International Energy Conservation Code) requirements for damper leakage ratings of 3 cfm/ sq. ft. @ 1 in. wg or 8 cfm/sq. ft. @ 4in. wg or less when integral to the building envelope.
- C. Dampers shall have a maximum differential pressure rating of 6 in. wg.
- D. Dampers shall have a maximum velocity rating of 6000 fpm.
- E. The Damper manufacturer's submittal data shall certify that all pressure drop data is licensed in accordance with the AMCA Certified Ratings Program for Test Figures 5.2, 5.3, and 5.5. Damper air performance data shall be developed in accordance with the latest edition of AMCA Standard 500-D. Dampers shall be labeled with the AMCA Air Performance Seal. AMCA certified pressure drop for a 24 in. wide x 24 in. high damper shall not exceed 0.06 in. wg when subjected to an airflow velocity of 1500 fpm according to AMCA Test Figure 5.3.
- F. Blade Action:Opposed
- G. Frame:
 - 1. Damper frame shall be 16 ga. galvanized steel formed into a 5 in. x 1 in. structural hat channel. Top and bottom frame members on dampers less than 17 in. high shall be low profile design to maximize the free area of these smaller dampers. Frame shall be 4-piece construction with 1 ½ in. (minimum) integral overlapping gusset reinforcements in each corner to assure square corners and provide maximum resistance to racking.
 - 2. Blades:
 - a. Damper blades shall be heavy gauge extruded aluminum airfoil shape with metal blade to blade overlap. Each blade shall be symmetrical relative to its axle pivot point, presenting identical performance characteristics with air flowing in either direction through the damper. Provide symmetrical blades of varying size as required to completely fill the damper opening. Blade orientation is horizontal.
 - 3. Seals:
 - a. Shall be TEP mechanically fastened to each blade.
 - b. Jamb: Flexible stainless steel compression type.
 - 4. Blade Stops:
 - a. Dampers of whole inch height increments shall not require blade stops. When required, individual blade stops shall occupy no more than ½ in. of the damper opening to provide maximum free area and minimal pressure loss.
 - 5. Linkage: Plated steel.

6. Axles: Minimum ½ in. dia. Plated steel
7. Bearings:
 - a. Axle bearings shall be synthetic (acetal) sleeve rotating in polished extruded holes in the damper frame.
8. Finish: Mill galvanized finish

2.4 ROUND LOW LEAKAGE CONTROL DAMPER

- A. Dampers shall have a rating of 4 cfm /sq. ft. @ 1 in wg.
- B. Dampers shall have a minimum differential pressure rating of 4 in. wg.
- C. Dampers shall have a minimum velocity rating of 3000 fpm.
- D. Construction:
 1. Frame and Sleeve: The damper frame and sleeve shall be of one piece design, made with 20 ga. galvanized steel and a groove for added strength.
 2. Blades: galvanized steel
 3. Blade Seals: Silicone mechanically secured to the blades.
 4. Axles: Minimum ½ in. dia., material is plated steel
 5. Bearings: Axle bearings shall be bronze.
 6. Mounting: Vertical or horizontal

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install dampers in accordance with manufacturer's Installation Instructions.
- B. Dampers must be accessible to allow inspection, adjustment, and replacement of components. The sheet metal contractor shall furnish any access doors or removable section of duct in ductwork or plenums required to provide this access. The mechanical contractor shall furnish any access doors required in walls, ceilings, or other general building construction.
- C. Install dampers square and free from racking.
- D. The installing contractor shall provide and install bracing for multiple section assemblies to support assembly weight and to hold against system pressure.
- E. Do not compress or stretch the damper frame into the duct or opening.
- F. Attach multiple damper section assemblies together in accordance with manufacturer's instructions. Install support mullions as reinforcement between assemblies as required.
- G. Handle dampers using the frame or sleeve. Do not lift or move dampers using blades, actuator or jackshaft.

3.2 CO-ORDINATION

- A. Coordinate delivery of dampers to site.
- B. Clearly tag and mark dampers for their purpose and location.
- C. Supervise Mechanical Contractor in the installation of the dampers ensuring proper dampers(s) are located and installed in proper location(s)

END OF SECTION 23 09 13.43

**SECTION 23 09 23
BUILDING AUTOMATION SYSTEM**

PART 1

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.

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. CORBA: Common Object Request Broker Architecture
 - 3. CSMA/CD: Carrier Sense Multiple Access/Collision Detect
 - 4. DDE: Dynamic Data Exchange
 - 5. FTT: Free Topology Transceivers

6. HTTP: Hyper Text Transfer Protocol
7. IIOP: Internet Inter-ORB Protocol
8. LAN: Local Area Network
9. LON: Echelon Communication – Local Operating Network
10. MS/TP: Master Slave Token Passing
11. ODBC: Open Database Connectivity
12. ORB: Object Request Broker
13. SNVT: Standard Network Variables Types
14. SQL: Structured Query Language
15. UDP: User Datagram Protocol
16. 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. MCI: MicroInterface
9. NSC: Network Server Controller
10. PPC: Programmable Process Controller
11. SDCU: Standalone Digital Control Units
12. SLC: Supervisory Logic Controller
13. UEC: Unitary Equipment Controller
14. VAVDDC: Variable Air Volume Direct Digital Controller

D. Tools and Software

1. AMBCx: Automated Monitoring Based Commissioning
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

1.4 SCOPE OF WORK

- A. The controls work shall connect to and be integrated into the existing Johnston County Schools - Schneider Electric BAS System
- B. 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 or drawings. All components of the system – workstations, servers, application controllers, unitary controllers, etc. shall communicate using the BACnet protocol, as defined by ASHRAE Standard 135-2007, or EIA standard 709.1, the LonTalk™ protocol, or Modbus protocol. The only exception will be field controllers within the Schneider I/NET, Continuum, and NETWORK 8000 family. No gateways shall be used for communication to controllers furnished under this section.
- C. Except as otherwise noted, the control system shall consist of all necessary Ethernet Network Controllers, Standalone Digital Control Units, 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.
- D. 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.
- E. 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.
- F. Provide services and manpower necessary for check out and testing of the system in coordination with the HVAC Contractor, Balancing Contractor and Owner's representative.
- G. All work performed under this section of the specifications will 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 will govern. The Contractor shall obtain and pay for all necessary construction permits and licenses.
- H. Reuse existing controllers for new equipment.
- I. Provide a Global Controller for the building addition, upgrade all required software, and integrate all existing and new controls to the existing Schneider Electric Controls front end.
- J. Contractor shall provide and update all graphics on the Owner's existing front end to reflect the equipment installed in the Scope of Work.

- K. Coordinate with the Owner's maintenance staff on developing operating schedules for all equipment.

1.5 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, operator workstations and microcomputer controllers of modular design providing distributed processing capability, and allowing future expansion of both input/output points and processing/control functions.
1. For this project, the system shall consist of the following components:
 2. Administration and Programming Workstation(s): Unless already existing on the customer main site, the BAS Contractor shall furnish (qty) Administration and Programming Workstation Computers 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 will be acceptable.
 3. Ethernet-based Network Router and/or Network Server Controller(s): The BAS Contractor shall furnish Ethernet-based Network Server Controllers as described in Part 2 of the specification. These controllers will 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 will not be accepted.
 - a. Network Controllers shall be tested and certified by the BACnet Testing Laboratory (BTL) as Network Server Controllers (B-BC).
 4. 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 will operate completely standalone, containing all of the I/O and programs to control its associated equipment. BACnet SDCUs shall be tested and certified by the BACnet Testing Laboratory (BTL).
- B. The Local Area Network (LAN) shall be either a 10 or 100 Mbps Ethernet network supporting BACnet, Modbus, XML and HTTPS 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.
- C. The 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 ANSI / ASHRAE™ Standard 135-2007, BACnet functionality to assure interoperability between all system components. Native support for the the ANSI / ASHRAE™ Standard 135-2007, 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 the common communication protocol between all controllers and integral ANSI / ASHRAE™ Standard 135-2008, 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 135-2008, 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 135-2008, 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. Minimum BACnet compliance is Level 4; 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 support Modbus TCP and RTU protocols natively, and not require the use of gateways.
- 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 HTML5 and NOT require Java. Browser access that requires Java-enabled browsers will not be accepted.
 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, and circuit tested 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 10 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, 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 150 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 personal 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.
- L. The system shall have the capability to provide a web-based AMBCx (automated monitoring based commissioning) system. The AMBCx system shall be able to interface directly with the project BAS and energy/performance metering system to provide information on HVAC systems that are being controlled. Pricing is to be a separate line item from the BAS proposal.
-

- M. The system shall have the capability to provide a web-based APEO (automated predictive energy optimization) system and enable effective participation in local utility Demand Response (DR) programs. The vendor shall provide software and ongoing services that will identify actionable energy saving and peak reduction opportunities to assist the facility in achieving its energy and sustainability objectives, and automatically and continuously operate the systems necessary to achieve the targeted savings and reductions. Pricing is to be a separate line item from the BAS proposal.

1.6 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, sensor wells, flow meters and other similar equipment for installation by the Mechanical Contractor unless scheduled or specified to be provided with the equipment.

1.7 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.

1.8 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 or USB stick containing the identical information.
- 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. Typical 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. Submittals shall contain narrative descriptions of sequences of operation. Diagrams shall be on 11" by 17" foldouts.
- E. Submit five (5) electronic copies and (2) hardcopies 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.
- 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. 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. Reference the product manual that includes instructions on executing the task.
 13. Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.
 14. Licenses, guarantees, and warranty documents for equipment and systems.
 15. 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. Product data sheet for each component.
 8. Installation data sheet for each component.
 9. 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.

1.9 COORDINATION

- A. Coordinate equipment from other divisions including "Intrusion Detection," "Lighting Controls," "Motor Control Centers," "Panel boards," "Miscellaneous Integrated systems" and "Fire Alarm" to achieve compatibility with equipment that interfaces with those systems. It is expected that qualified vendor representatives will be present during startup for any of the above mentioned integrations as required. Costs for this support should be covered by the associated vendor as part of their base bid.
- B. Coordinate supply of conditioned electrical circuits for control units and operator workstation.
- C. Coordinate location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete".
- D. Coordinate with the Owner's IT department on locations for NSC's, Ethernet communication cabling and TCP/IP addresses.

1.10 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 of this contract. 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

1.11 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 will 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 will 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 and third party Commissioning Agent.
- C. The BAS Contractor shall provide a technician 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 completion. 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 Startup and Testing Report shall be provided upon test completion.

1.12 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.

1.13 TRAINING

- A. The BAS Contractor shall provide on-site training to the Owner's representative and maintenance personnel per the following description:
- B. On-site training shall consist of a minimum of (24) hours 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 EXISTING SYSTEM

- A. Control system shall be SmartStruxure system with SmartX IP, Room Controllers, Network 8000, or I/A BACnet field controls by Schneider Electric as an extension of the Johnston County Schools/Schneider Electric Enterprise control system. Refer to Alternates on Bid Form.
- B. Subject to compliance with requirements, provide products by one of the following pre-qualified manufacturers:
 1. Electric Components
 - a. Schneider-Electric and Veris Field Devices
 2. Electronic Components
 - a. Schneider-Electric and Veris Field Devices
 3. Direct Digital Control Systems Devices:
 - a. Schneider-Electric I/A BACnet.
- C. Equivalent Products
 1. The following products may be considered equivalent to Schneider Electric, but they will have to interface seamlessly with and be integrated into the existing Johnston County Schools/Schneider Electric control system:
 - a. Distech
 - b. Honeywell
 - c. Vykon

- d. ABB Cylon

2.2 SYSTEM ARCHITECTURE

A. General

1. All work shall be incorporated into the existing Schneider Enterprise Server.
2. The system shall be designed with a top-level 10/100bT Ethernet network, using the BACnet/IP, LonWorks IP, and/or Modbus TCP protocol.
3. 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. A sub-network of SDCUs using the BACnet MS/TP, LonTalk FTT-10A, and/or Modbus RTU protocol shall connect the local, stand-alone controllers with Ethernet-level Network Server Controllers/IP Routers.

B. TCP/IP Level

1. 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.

C. Fieldbus Level with Standalone Digital Control Units (SDCUs)

1. The fieldbus layer shall support all 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. Minimum speed of not less than 100Mbps. The field bus controllers shall support daisy chain topology of up to 50 controllers. The field bus controllers shall also support, where applicable, RSTP loop whereby up to 39 controllers are supported. These devices shall support a BACnet protocol stack in accordance with the ANSI/ASHRAE Standard 135-2008 and the BACnet Device Profile supported.
 - 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 135-2007. The NSCs shall be capable of at least two BACnet MS/TP field buses for a total capability of 254 SDCUs per NSC.
 - c. Modbus SDCU requirements: The system shall consist of one or more Modbus RTU (RS-485 or RS-232) field buses managed by the Network Server Controller. The field bus layer shall consist of up to 31 SDCUs for operation of HVAC, power metering, and lighting equipment. If utilizing Modbus TCP, the field bus layer shall consist of up to 100 SDCUs for operation of HVAC, power metering, and lighting equipment. The NSCs shall be capable of at least two Modbus RTU field buses for a total capability of 62 SDCUs per NSC.
 - d. NETWORK 8000 SDCU requirements: The system shall consist of one or more ASD or LCM field buses managed by the Network Server Controller. The field bus layer shall consist of up to 128 ASD SDCUs or 31 LCM SDCUs for operation of HVAC, power metering, and lighting equipment.
 - e. I/NET SDCU requirements: The system shall consist of one or more controller LANs and subLANs managed by the Network Server Controller. The network shall consist of up to 100,000 I/NET

points capable through numerous links and devices for operation of HVAC, power metering, and lighting equipment.

D. BAS LAN Segmentation

1. 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.

E. Standard Network Support

1. 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.

F. 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.

G. Support For Open Systems Protocols

1. 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 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. They shall also be responsible for monitoring and controlling their own HVAC equipment such as an AHU or boiler.
- E. 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.

- F. 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
- G. 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. One 10/100bT Ethernet for communication to Workstations, other NRCs and onto the Internet
 - 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. Two host USB Ports
 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).
- H. 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 will be protected.
- I. 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. kohm (Xenta)
 - h. 1 kohm (Balco)
 - i. 20 kohm (Honeywell)
 - j. 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)

J. Local Status Indicator Lamps:

1. 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.

K. Real Time Clock (RTC):

1. Each NSC shall include a battery-backed, 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 will allow for its own UTC offset, depending upon the time zone. When the time zone is set, the NSC will also store the appropriate times for daylight savings time.

L. 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.

M. Automatic Restart After Power Failure:

1. 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.

N. Battery backup:

1. The NSC shall include an on-board battery to back up the controller's RAM memory. The battery shall provide accumulated backup of all RAM and clock functions for at least 30 days. In the case of a power failure, the NSC shall first try to restart from the RAM memory. If that memory is corrupted or unusable, then the NSC shall restart itself from its application program stored in its FLASH memory.

O. 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 will 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.

P. 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.

Q. 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

R. Mathematical Functions:

1. 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.

- S. 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 Water Reset
 14. Chilled Water Reset
 15. Chiller Sequencing
- T. 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.

U. 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 will 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 will 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 will 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.

V. 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.

2.4 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
 - 1) A Network Server Controller shall be used to provide this functionality.
 - 2) These devices shall be configurable locally with IP crossover cable and configurable via the IP network.
 - 3) 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.

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

- 1) Devices shall have a light indicating that they are powered.
- 2) Devices shall be locally powered. Link powered devices (power is furnished from a central source over the field bus cable) are not acceptable.
- 3) 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. Network Server Controllers (NSCs)

- a. If NSCs have embedded I/O, all of the requirements for I/O that are described under Advance Application Controllers shall apply.
- b. Shall support the export of data to NSCs from other vendors that support the data sharing, read property service.
- c. Shall support the export of data using Change of Value (COV) initiation to NSCs from other vendors that support the subscription to data using the COV concept.
- d. Shall support the export of data to any BACnet OWS that supports the data sharing, read property service.
- e. Shall support the export of data using Change of Value (COV) initiation to any BACnet OWS that supports the subscription to data using the COV concept.
- f. Shall provide trend log support for all of the devices on the field bus. They shall provide sufficient memory to store up to 300 samples for each variable required to be trended by the sequence of control.
- g. Shall support the exporting of trend log data to any BACnet OWS that supports the read range BACnet service for trending.
 - 1) Shall provide time schedule support for all of the devices on the field bus.
- h. Shall support the editing of time schedule entries from any BACnet OWS that supports the BACnet service for writing of time schedule parameters.
 - 1) Shall provide alarm message initiation for all alarms conditions from any of the field bus devices.
- i. Shall deliver alarm messages to any BACnet OWS that supports the BACnet service for receiving alarm messages and is configured to be a recipient of the notification.
- j. Shall support alarm acknowledgement from any BACnet OWS that supports the BACnet service for executing alarm/event acknowledgement.

- k. 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.
 - l. Shall support the receipt and response to Time Synchronization commands from any device that supports the BACnet service for initiating time synchronization commands.
 - 1) Shall support the "Who is?" and "I am." BACnet service.
 - m. Shall support the "Who has?" and "I have." BACnet service.
 - n. Shall support Backup and Restore commands from any BACnet OWS that supports the initiation of Backup and Restore commands.
 - o. Shall be BTL certified.
- F. Advance Application Controllers (AAC)
- 1. The key characteristics of a AAC are:
 - 1) 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.
 - 2) 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.
 - 3) The application to be executed by a AAC is created by an application engineer using the vendor's application programming tool.
 - 4) If local time schedules are embedded, the AAC shall support the editing of time schedule entries from any BACnet OWS that supports the BACnet service for writing of time schedule parameters.
 - 5) If local trend logging is embedded, the AAC shall support the exporting of trend log data to any BACnet OWS that supports the read range BACnet service for trending.
 - 6) If local alarm message initiation is embedded, the AAC shall:
 - (a) 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.
 - (b) Support alarm acknowledgement from any BACnet OWS that supports the BACnet service for executing alarm/event acknowledgement,
 - (1) 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.
 - 7) 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.
 - 8) Shall support the "Who is" and "I am." BACnet services.
 - 9) 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 AAC shall provide software support for the linearization of the input signal.
3. Binary Input Circuits
 - 1) Dry contact sensors shall wire to the controller with two wires.
 - 2) 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 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. 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.

G. 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

PART 3 EXECUTION

3.1 CONTRACTOR RESPONSIBILITIES

A. General

1. 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. Code Compliance

1. All wiring shall be installed in accordance with all applicable electrical codes and will comply with equipment manufacturer's recommendations. Should any discrepancy be found between wiring specifications in Division 17 and Division 16, wiring requirements of Division 17 will prevail for work specified in Division 17.

C. Cleanup

1. 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 will 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	Per Mfr.	300 Volt
Class Three	Per Mfr.	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. Where wiring is required to be installed in conduit, EMT shall be used. Conduit shall be minimum 3/4 inch galvanized EMT. Refer to Division 26 specification.
- E. Flexible metallic conduit 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.
- F. 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.
- G. Fiber optic cable shall include the following sizes; 50/125, 62.5/125 or 100/140.
- H. Only glass fiber is acceptable, no plastic.
- I. 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.
- J. Hardware Installation
1. Installation Practices for Wiring
 2. All controllers are to be mounted per the manufacturer's installation documentation.
 3. The 120VAC power wiring to each Ethernet or Remote Site controller shall be a dedicated run, with a separate breaker. Each run will include a separate hot, neutral and ground wire. The ground wire will terminate at the breaker panel ground. This circuit will not feed any other circuit or device.
 4. A true earth ground must be available in the building. Do not use a corroded or galvanized pipe, or structural steel.
 5. 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.
 6. Conduit in finished areas will be concealed in ceiling cavity spaces, plenums, furred spaces and wall construction. Exception; metallic surface raceway may be used in finished areas on masonry walls. All surface raceway in finished areas must be color matched to the existing finish within the limitations of standard manufactured colors.
 7. Conduit, in non-finished areas where possible, will be concealed in ceiling cavity spaces, plenums, furred spaces, and wall construction. Exposed conduit will run parallel to or at right angles to the building structure.
 8. Wires are to be kept a minimum of three (3) inches from hot water, steam, or condensate piping.
 9. Where sensor wires leave the conduit system, they are to be protected by a plastic insert.

10. Wire will not be allowed to run across telephone equipment areas.

K. Installation Practices for Field Devices

1. Well-mounted sensors will include thermal conducting compound within the well to insure good heat transfer to the sensor.
2. Actuators will be firmly mounted to give positive movement and linkage will be adjusted to give smooth continuous movement throughout 100 percent of the stroke.
3. Water line mounted sensors shall be removable without shutting down the system in which they are installed.
4. For duct static pressure sensors, the high pressure port shall be connected to a static pressure probe inserted into the duct. The low pressure port shall be left open to the plenum area at the point that the high pressure port is tapped into the ductwork.
5. For building static pressure sensors, the high pressure port shall be inserted into the space via a static pressure pick-up. Pipe the low pressure port to the outside of the building.

L. Enclosures

1. For all I/O requiring field interface devices, these devices where practical will 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.
2. FIPs shall contain power supplies for sensors, interface relays and contactors, and safety circuits.
3. The FIP enclosure shall be of steel construction with baked enamel finish; NEMA 1 rated.
4. All wiring to and from the FIP will be to screw type terminals or lever nuts. Analog or communications wiring may use the FIP as a raceway without terminating.
5. All outside mounted enclosures shall meet the NEMA-3R rating.

M. Identification

1. Identify all control wires with labeling tape or sleeves using words, letters, or numbers that can be exactly cross-referenced with as-built drawings.
2. All field enclosures, other than controllers, shall be labeled.
3. Junction box covers will be marked to indicate that they are a part of the BAS system.
4. All I/O field devices (except space sensors) that are not mounted within FIP's shall be labeled.
5. All I/O field devices inside FIP's shall be labeled.

N. Existing Controls.

1. Existing controls which are to be reused must each be tested for proper operation. Existing controls which are to be reused and are found to be defective requiring replacement, will be noted to the Owner. The Owner will be responsible for all material and labor costs associated with their repair.

O. Location

1. The location of sensors is per mechanical and architectural drawings.
2. Field enclosures shall be located immediately adjacent to the controller panel(s) to which it is being interfaced.

P. Software Installation

1. 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.

Q. Database Configuration.

1. The Contractor will provide all labor to configure those portions of the database that are required by the points list and sequence of operation.

R. Color Graphic Displays.

1. Unless otherwise directed by the owner, the Contractor will 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.

S. Reports.

1. The Contractor will configure a minimum of 4 reports for the owner. These reports shall, at a minimum, be able to provide:
 - a. Trend comparison data
 - b. Alarm status and prevalence information
 - c. System user data

T. Point to Point Checkout.

1. 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.

U. Controller and Workstation Checkout.

1. 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.

V. System Acceptance Testing

1. All application software will be verified and compared against the sequences of operation.
2. Control loops will be exercised by inducing a setpoint shift of at least 10% and observing whether the system successfully returns the process variable to setpoint.
3. Test alarms 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.).

4. 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.
5. 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 23 09 23

**SECTION 23 09 23.13
BUILDING AUTOMATION SYSTEMS – ALTERNATE 4**

PART 1 GENERAL

1.1 APPLICABLE SECTIONS

- A. 23 09 13.13 BAS Actuators and Operators
- B. 23 09 13.23 BAS Sensors and Transmitters
- C. 23 09 13.33 BAS Control Valves
- D. 23 09 13.43 BAS Control Dampers

1.2 RELATED DOCUMENTS

- A. Products furnished But Not installed under this contract.
 - 1. Control Valves.
 - 2. Flow switches.
 - 3. Wells, sockets and other inline hardware for water sensors (temperature, pressure, flow).
 - 4. Automatic Control Dampers where not supplied with equipment.
 - 5. Airflow measuring stations.
 - 6. Terminal unit controllers and actuators, when installed by terminal unit manufacturer.
 - 7. Variable frequency drives (This does not include VFDs integral to machinery such as chillers or boilers.)
- B. Products Not Furnished or Installed But Integrated with the Work of This Section:
 - 1. Smoke Detectors (through relay contacts).
- C. Work Required Under Other Divisions Related to this Section.
 - 1. Power wiring to line side of motor starters
 - 2. Power wiring to load side of mechanical equipment.
 - 3. Provision and wiring of smoke detectors and other devices relating to fire alarm system.
 - 4. Campus LAN (Ethernet) connection adjacent to Network Area Controller (JACE).

1.3 DEFINITIONS AND ABBREVIATIONS

- A. Where definitions in Division 01 conflict with the definitions herein, Contractor will comply with the most stringent requirement.
- B. BAS Component: a generic reference to any hardware component which is provided by Contractor, including but not limited to controllers, power supplies, transformers, relays, actuators, sensors, or other devices.

- C. Building Automation System (BAS): Also referred to as Building Management System (BMS), Direct Digital Control (DDC).
- D. Building Controller: Controller, which is at, and controlling at, the building-level. Could also be a large portion of a building, such as a wing, depending on hardware capability. Generally, are the middle tier of the overall BAS network, and report up to a Building or Enterprise Supervisor. Also, generally what Device Controllers would be integrated with. See Section 2.5 System Architecture for full definition and specification.
- E. Building-Level Network (BLN): An ethernet, fiber, and/or wireless network dedicated to the BAS, which connects Building Controllers and Building Supervisors. The BLN may be a separate network from Owner's LAN, or as part of the LAN, which has been segmented to be used exclusively by the BAS. See Section 2.5 System Architecture for full definition and specification.
- F. Building Supervisor: Server, which is at, and controlling at, the building-level. Generally used when Building Controllers do not have sufficient hardware capability to support an entire building. Generally, are the middle tier of the overall BAS network, and installed on a Server in lieu of being a stand-alone piece of hardware. Also, generally what Building Controllers would be integrated with. Building Supervisors may be further integrated to an Enterprise Supervisor. See Section 2.5 System Architecture for full definition and specification.
- G. Controller: A generic reference to a BAS Controller, including but not limited to Device Controllers and Building Controllers.
- H. Contract Documents: All documents which compose the project, including but not limited to drawings, specifications, RFPs, scope of work, general conditions, and supplemental conditions.
- I. Control Panels: an assembly composed of an enclosure and one or more BAS Component(s).
- J. Critical: A special area or zone which receives specialized BAS Components.
- K. Device Controller: Also referred to as Field-Level Controller. Controller, which is at, and controlling at, at the device-level. Device in this instance is understood to reference MEP Equipment. Generally, are the lowest tier of the overall BAS network, and report up to a Building Controller. See Section 2.5 System Architecture for full definition and specification.
- L. Device-Level Network (DLN): A copper, ethernet, fiber, and/or wireless network dedicated to the BAS, which connects Device Controllers and Building Controllers. See Section 2.5 System Architecture for full definition and specification.
- M. Enterprise Supervisor: Server, which is at, and controlling at, the enterprise-level. Generally, are the highest tier of the overall BAS network, and installed on a server in lieu of being a stand-alone piece of hardware. Also, generally what Building Controllers and/or Supervisors would be integrated with. See Section 2.5 System Architecture for full definition and specification.
- N. Field-Level: See Device Controllers and Device-Level Network.
- O. Furnish: To supply and deliver to project site, ready for installation.
- P. Install: To place in position for service or use.
- Q. Local Area Network (LAN): Ethernet, fiber, and/or wireless network which connects computers and other networkable devices (printers, etc.), and has a connection to the WAN. See Section 2.5 System Architecture for full definition and specification.
- R. Manufacturer: The brand of the BAS being provided (ex: Distech, Honeywell, etc).

- S. MEP: Mechanical, electrical, and plumbing.
- T. MEP Equipment: Where MEP Equipment is used, it is understood to mean any piece of MEP Equipment which the BAS will in some way, shape, or form, interface with, via hardwired connection or integration. MEP Equipment includes, but is not limited to VAV, AHU, RTU, split systems, hot water heaters, heat exchangers, boilers, chillers, and pumps.
- U. Owner: The financial provider and user of the BAS, as well as Owner Representatives.
- V. Owner Representatives: Representatives for the Owner which are on staff, contracted, or hired to protect the interests of the Owner, such as Engineers, Architects, Commissioning Agents, and other parties.
- W. Project: The facility/building as defined in the Contract Documents.
- X. Server: A computer in which BAS software is installed on.
- Y. Sequence of Operation: The steps that MEP Equipment takes to achieve the desired operation to provide optimal comfort and/or ventilation for the Project.
- Z. Substantial Completion: Written authorization by the Owner that the project has reached a point of completion that it can be utilized.
- AA. Supervisor: A generic reference to a BAS Supervisor, including but not limited to Building Supervisors and Enterprise Supervisors.
- BB. Provide: To furnish and install, complete and ready for intended use.
- CC. Vendor: The installer, integrator, and/or contractor for the BAS being provided.
- DD. Wide Area Network (WAN): Ethernet and/or fiber-based network which connects multiple facilities via the internet. See Section 2.5 System Architecture for full definition and specification.
- EE. Warranty Period: The time between Substantial Completion and the duration of Warranty, as specified.

1.4 GENERAL SCOPE OF WORK AND SPECIFICATIONS.

- A. Scope of work: Provide a Tridium- based control system for the new addition only.
- B. Contractor shall provide all hardware, software, configuration, programming, graphics (GUI), checkout, alarms, trending, functional testing, and commissioning necessary to provide a complete and fully functioning BAS. Contractor shall include all hardware, control wiring, wiring accessories, wiring connections, software, and programming not specifically itemized in these Specifications, which is necessary to implement, maintain, operate, and diagnose the system, now and in the future.
 - 1. Provide all necessary BAS Components on each piece of MEP Equipment to:
 - a. Perform the specified Sequence of Operation and meet the design/performance intent of the MEP Equipment.
 - b. Comply with BAS Components as shown on the control diagrams.
 - c. Comply with the point lists.
 - d. Comply with the Specifications herein.
 - e. Comply with the design intent of the BAS.

2. Where the Sequence of Operation, control diagrams, points list, or specifications conflict with each other, Contractor will comply with the most stringent requirement.
- C. It is Contractor's responsibility to review all the Contract Documents and report any discrepancies to Owner.
- D. Substitutions
1. Wherever the words "approved equal," "for review," or "for acceptance" are used in regard to manufactured specialties, or wherever it is desired to substitute a different make or type of BAS Component for that specified, submit all information pertinent to the adequacy and adaptability of the proposed BAS Component to Owner and secure their approval before the BAS Component is ordered.
- E. Warranty
1. The entire BAS and all ancillary equipment required for its operation shall be free from defects in workmanship and material under normal use and service. If within twenty-four months from the date of Substantial Completion the installed equipment is found to be defective in operation, workmanship or materials, Contractor shall replace, repair, or adjust the defect at no cost to Owner.
 2. Corrective software and/or hardware modifications made during warranty service periods shall be updated on all user documentation and on user and manufacturer archived software disks.
 - a. Modifications made which are corrective to one piece of MEP Equipment will be replicated to all MEP Equipment for consistency in programming.
 - b. User documentation will be updated in all locations, including but not limited to hard copies, Control Panel hard copies, O&Ms, and PDF copies accessible via download inside the BAS system.
 - c. Maintain revision control (i.e., v1_05) to indicate which is the latest version of all documentation, software, and programming.
 3. Owner reserves the right to make changes to the BAS during the Warranty Period. Such changes do not constitute a waiver of warranty. Contractor shall warrant parts and installation work regardless of any changes made by Owner unless Contractor provides clear and convincing evidence that a specific problem is the result of such changes to the BAS.
 4. At no cost to Owner, during the Warranty Period, Contractor shall provide maintenance services for software including all current software updates, firmware, and hardware. Prior to the closeout of the warranty period, Contractor shall meet with Owner to address any questions or concerns and offer ongoing services to Owner.
 5. Electronic Actuators: Parts and labor for 5 years from the date of substantial completion.
 6. Air and Water Flow Meters: Parts and labor for 3 years from the date of substantial completion.
- F. Training
1. Provide four hours of training for Owner personnel, and/or maintenance contractor, on the operation and maintenance of the BAS.
 2. Provide four hours of training for Owner personnel, and/or maintenance contractor, on the operation and maintenance of the BAS, 90 to 180 days after Substantial Completion.

1.5 CODES AND REFERENCE STANDARDS

- A. Comply with all current federal, state, and local codes, requirements, ordinances, and regulations, in accordance with the authority(ies) having jurisdiction (AHJ).
- B. Comply with the National Electric Code (NEC).
- C. Comply with all manufacturer guidelines and requirements.
- D. Comply with all Owner rules, guidelines, procedures and requirements, including Owner IT.
- E. The latest published edition of a reference shall be applicable to the Project unless identified by a specific edition date.
- F. All materials, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references:
 - 1. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - 2. American National Standards Institute (ANSI)
 - 3. UL 916: Energy Management Systems
 - 4. LonMark International

1.6 COORDINATION OF WORK AND INTEGRATION

- A. Certain LonMark, BACnet, Modbus, and other products, systems, and interface devices, may be provided by other trades via MEP Equipment. Examine the Contract Documents to ascertain the requirements to install, wire, program, commission, and/or interface to these systems. Particular attention must be paid towards the interface boards submitted by the various MEP Equipment providers. It is Contractor's responsibility to verify the submitted interfaces will integrate properly into the BAS. Report any discrepancies to Owner. Discrepancies brought to Owner's attention after the procurement of that piece of MEP Equipment will be integrated at no additional cost to Owner. Contractor will provide additional interface(s) needed to integrate piece of MEP Equipment.
- B. Contractor shall review MEP Equipment for compliance with control diagrams, Sequence of Operation, and points lists. Report any discrepancies to Owner.
- C. Wherever work interconnects with work of other trades, coordinate with other trades and with Owner to ensure that all trades have the information necessary so that they may properly install all the necessary connections and equipment.
- D. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation. Verify all locations with Owner and/or General Contractor prior to installation.
- E. Coordinate sources of 120V power with the Electrical Contractor and Owner. Extend power from source(s) as needed.
- F. Coordinate location of data ports/drops to the LAN/WAN with the Electrical Contractor and Owner.
- G. Coordinate shipping of BAS Components to another Contractor or manufacturer for factory-installation.

1.7 SPARE PARTS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- B. Provide one replacement for each unique actuator, Controller, thermostat, wall module, or any other BAS Component provided.

1.8 QUALITY ASSURANCE

- A. The BAS and BAS Components shall be listed by Underwriters Laboratories (UL 916) as an Energy Management System.
- B. Control Panels, both new and modified, shall comply with UL 508A.
- C. Electrical Components, Devices, and Accessories: UL listed and labeled as defined in NFPA 70.

1.9 CONTRACTOR QUALIFICATIONS

- A. Qualifications may be requested from Contractor prior to the bidding process. Owner reserves the right to not allow Contractors to bid if they do not meet the qualifications or provide them in a timely manner. Qualifications will be provided for all items below in an orderly format for review by Owner.
- B. Contractor shall have a successful history in the design and installation of the BAS being provided that consists of web-browser monitoring and control of LonWorks, BACnet, and/or Modbus Device Controllers. These projects must be on-line and functional such that Owner can observe the BAS in full operation. Include proper references, contact names, emails, and phone numbers of these reference projects, with a minimum of five projects similar to this Project.
- C. Contractor shall demonstrate experience in BAS installations for not less than five years, in BAS installation projects with point counts equal to this Project, and systems of the same character as this Project.
- D. Contractor shall have specialized in and be experienced with the installation of the proposed product line for not less than five years, on at least ten projects of similar size and complexity.
- E. Contractor shall be factory authorized by manufacturer of product line and be in good standing with the manufacturer.
- F. Contractor shall be located within 50 miles of Project.
- G. Contractor shall be a Certified Tridium Systems Integrator.
- H. Contractor shall have a minimum of three, Niagara Technical Certification Program (TCP) certified personnel.
- I. Contractor shall have a minimum of three personnel who are certified in LonWorks, BACnet, and/or Modbus line(s) of controls to be installed as part of this project.
- J. Be of sufficient size to provide service, including both routine maintenance and emergency support within 24 hours upon receipt of request.

1.10 ACTION SUBMITTALS

- A. Product Data Submittal
 - 1. Submit manufacturer's technical product data for each BAS Component, including but not limited to Controller, sensor, actuator, relay and panel, indicating dimensions, capacities, performance, electrical characteristics, and material finishes. Also include installation and start-up instructions.
 - a. When manufacturer's product datasheets apply to a product series rather than a specific product model, clearly indicate, mark-through, and highlight only applicable information.

- b. Generic submittals will be automatically rejected.
2. Submit documentation indicating LonMark, NICs, and/or BTL compliance and include Protocol Implementation Conformance (PIC) Statements.
- B. Shop Drawings Submittal
- 1. Submit shop drawings. Shop drawings will include:
 - 2. Bill of Materials (BOM): indicating equipment served, quantity, manufacturer, point range (i.e. 0-10 in. w.c.), sensor range (i.e. 0-10V), and model number for all BAS Components being provided.
 - a. Disconnect Schedule: additionally, indicating MCA, MOP, voltage, # of phases, size, NEMA rating, # of poles, and neutral (Y/N).
 - b. Starter Schedule: additionally, indicating horsepower, voltage, # of phases, size, NEMA rating, and bypass.
 - c. VFD Schedule: additionally, indicating horsepower, voltage, # of phases, size and NEMA rating, bypass (Y/N), number of contactors (if bypass), disconnect (Y/N), and disconnect type (fused/non-fused).
 - d. Hydronic Valves (Pressure-Dependent): additionally, indicating gpm, line size, calculated Cv and design pressure drop, actual Cv and actual pressure drop, close-off pressure, type (ball/globe/butterfly), connection, valve size, 2/3-way, mixing/diverting (if 3 way), service (2-position/modulating), and fail position.
 - 1) Actual pressure drop will correct for any line-size to valve-size restrictions per the manufacturer's data.
 - 2) Actuator will be scheduled with the valve per the standard BOM.
 - e. Air Flow Metering Stations (AMFS): additionally, indicating duct size, output, network capable (LonWorks/BACnet), and number of probes/sensors.
 - f. Damper Schedule: additionally indicating, duct size, blade type, leakage, and construction.
 - g. VAV schedule: indicating VAV type, K factor, and max/min/reheat flows.
 - 3. Schematic Flow Diagram: schematic representation of MEP Equipment. Diagram will show all BAS Components on schematic, point name, and point number (i.e. UI-1). Where MEP Equipment varies slightly, schematic will be clearly diagramed to indicate any differences between each piece of MEP Equipment. Stating the schematic as "typical" is not acceptable.
 - 4. Wiring Diagram: indicating power, signal, and control wiring. Where terminal blocks are provided, provide indication where wiring terminates to terminal block.
 - 5. Sequence of Operation: Any modifications proposed to the Sequence of Operation will be clearly marked up as part of the shop drawings or submitted as an annotated Microsoft Word document in addition to the shop drawings. A default Contractor Sequence of Operation, included without regard to the Contract Document's Sequence of Operation, will result in a rejected submittal.
 - 6. Control Panel Diagrams: indicating panel faces, with layouts of any BAS Components to be installed in the panel face, BAS Component locations inside panel, and labeling of BAS Components.

7. One-line diagram for all controllers showing the network layout. Where Project is to connect with an existing BAS, indicate how the new network will integrate with the new and/or existing BAS Components.
8. Indicate anticipated device ID, Network number, MAC Addressing, and Max Masters for all BACnet devices. Provide logical schema for BACnet addressing.
9. Individual floor plans with device (controllers, routers, sensors, etc.) locations with all interconnecting wiring routing including space sensors, Device and Building-Level Network wiring, power wiring, and low voltage power wiring.
10. Additional Requirements:
 - a. Point names will be consistent between the schematics and wiring diagrams.
 - b. Misc. Points List: where controllers being provided for other purposes are also used to control a miscellaneous point, such as an exhaust fan or lighting contactor, provide a list of those miscellaneous points in a concise format for quick identification of their location and associated Controller.
 - c. Provide a complete list of any deviations of submitted products to the specification in this document.
 - d. Where existing BAS Components are being reused, such as controllers or sensors, clearly indicate (via coloring, line type, etc) the BAS Components being reused as “existing” and new components as “new.”

C. Graphics Submittal

1. Provide screen captures of graphical user interfaces developed by Contractor on previous projects. These screen shots shall represent actual work performed by Contractor and not generic work from the line of controls which Contractor represents. Screenshots will be applicable to the MEP systems as part of this project. “Generic” screenshots of MEP systems will not be accepted. Provide client contact information for Owner to validate. Any comments from the submittal process will be incorporated into the actual graphics for the project.
2. Follow Owner’s graphics standards.
3. Zoning Map
 - a. Provide submittal of graphic floorplans for markup by Owner to identify required zoning to use for scheduling. Floorplan markup will be used by Contractor to segment equipment that satisfies the identified zones.

D. Point-Naming Submittal

1. Points shall be named consistently. Provide list of point names and point conventions.
2. Point naming shall be consistent with an existing standard, such as Project Haystack.

E. IP Drop Request Submittal

1. Provide list of BAS Component(s) which need an IP drop to the LAN/WAN.
2. Provide location, quantity (if multiple per Control Panel/location), and IP address requirements (DHCP, fixed, etc), and total number of IP address reservations, including room for future growth.

3. Provide list to a minimum of ten business days' notice prior to needing the drop.
- F. Schedule/Sequence of Construction Submittal
1. Provide schedule and sequence of construction, as it pertains to the installation of the BAS, for review.
- G. Functional Performance Testing (FPT) Submittal
1. Provide FPT agendas and testing procedures for review.
 2. FPT should include at a minimum Sequence of Operation, point-to-point verification to graphical interface, historical data logging, and alarms testing procedures.

1.11 START-UP AND ASSOCIATED TESTING SUBMITTALS

- A. Point-to-Point Testing/Checkout Sheets Submittal
1. Prior to startup of MEP Equipment, Contractor will provide checkout sheets for each piece of MEP Equipment.
 2. Checkout sheets will contain at a minimum:
 - a. Equipment name and location.
 - b. Associated Controller address (MAC or Node ID), name, type, and instance number.
 - c. Point name, type (resistance, amperage, voltage, etc), and range (i.e., -5 to +5 in w.g.).
- B. Start-Up Testing Submittal
1. As part of the startup of MEP Equipment, Contractor will provide start-up testing sheets for each piece of MEP Equipment.
 2. Start-up testing sheets will contain at a minimum:
 - a. Equipment name and location.
 - b. Sequence of Operation and step-by-step procedure used to check programming and configuration.
 - c. Any modifications required to Sequence of Operation for MEP Equipment performance.
 - d. Final graphical screens.
 - e. PID tuning parameters for each loop.
- C. Adjusting and Calibration Submittal
1. As part of the startup of MEP Equipment, Contractor will provide a calibration submittal for each piece of MEP Equipment.
 2. Calibration submittal will contain at a minimum:
 - a. Equipment name and location.
 - b. Point name, type, and range.
 - c. Sensor type and manufacturer's stated accuracy.

- d. Calibration type (single point, two point, etc).
- e. Checking, adjusting, and calibration data.
- f. Sensor installed accuracy.
- g. Sensor pass, fail, replaced, etc.
- h. Calibration equipment used and associated certificates of calibration, including expiration dates.

1.12 CLOSE-OUT SUBMITTALS

A. Operating and Maintenance Manuals

- 1. Provide all documentation as required in the submittal processes to-date, updated to as-built conditions.
- 2. In addition, provide the following:
 - a. Include control response, settings, set points, throttling ranges, gains, reset schedules, adjustable parameters, and limits.
 - b. A table (or similar) of all Testing, Adjusting and Balancing (TAB) values for each piece of MEP Equipment and BAS-calibrated equipment, such as airflow metering stations (AFMS).
 - c. Any O&Ms for equipment not originally included in the submittal, in addition to product data.
 - d. Accurately record actual set points, calibrations/offsets, and settings of controls, final Sequence of Operation, including changes to programs made after submission and approval of shop drawings and including changes to programs made during specified testing.
 - e. Database of all point names.

B. As-Built Shop Drawings

- 1. Provide PDF of shop drawings which have been corrected to reflect the as-built state.
 - a. Incorporate any redlines made in field during installation.
 - b. Update Sequence of Operation to reflect MEP Equipment operation as changed during installation, commissioning, and/or functional performance testing.
 - c. Provide reference to being “as-built” version on each sheet of the shop drawings.
- 2. Provide hard copy of appropriate shop drawing page(s) inside each Control Panel.

C. Software Closeout

- 1. Provide all usernames, passwords, software, GUI, databases, licenses, and application programming tool(s) to Owner.
- 2. Provide software backup of entire BAS and associated components on digital media for Owner record. Coordinate file location of automatic backup of software with Owner.

D. Reference 3.11 Closeout for additional requirements.

1.13 MATERIALS AND EQUIPMENT

- A. All materials shall meet or exceed all applicable referenced standards, federal, state, and local requirements, referenced standards, and conform to codes and ordinances of the AHJ.
- B. Materials shall be new, the best of their respective kinds without imperfections or blemishes and shall not be damaged in any way. Used equipment shall not be used in any way for the permanent installation except where Contract Documents specifically allow existing materials to remain in place.
- C. To the extent practical, all equipment of the same type serving the same function shall be identical and from the same manufacturer.

1.14 COLORS AND LABELING

- A. Where requirements in 230553 conflict with the requirements below, Contractor will comply with the most stringent requirement.
- B. Provide BAS Components consistent with the Johnston County School District color requirements.
 - 1. Ethernet/Fiber Cable - Consistent with color of primary communication protocol.
- C. Provided BAS Components with the following labeling requirements.
 - 1. Controllers
 - a. Vinyl or nylon label, 1/2 inch or greater in height, black text on white background, adhesive backed, printed with MEP Equipment served by Controller, permanently mounted.
 - 2. Control Panels
 - a. Two-layer engraved phenolic or engraver's plastic tag, 1 inch or greater in height, adhesive backed, engraved with MEP Equipment served by panel, permanently mounted.
 - 3. Input/Output Wiring
 - a. Nylon or self-laminated wire-wrap label, 1/2 inch or greater in height, black text on white background, adhesive backed, printed with BAS Component connected to cable and cable number, permanently mounted at termination to terminal block in Control Panel on cable jacket.
 - b. Premade labels or wire marker tape is not allowed.
 - 4. BAS Component
 - a. Vinyl or nylon label, 1/2 inch or greater in height, black text on white background, adhesive backed, printed with MEP Equipment served and BAS Component purpose (ex. AHU-1 SF Start/Stop), permanently mounted.

PART 2 PRODUCTS

2.1 MANUFACTURERS AND VENDORS

- A. Subject to the Specifications and requirements herein, the BAS will be provided by (listed in alphabetical order):
 - 1. Schneider Electric TAC I/A Series by Schneider Electric
 - 2. Trane

3. Engineered Control Solutions
 4. CMS Controls
 5. Johnson Controls Inc.
- B. Products by the manufacturer listed shall be used for Device and Building Controllers. Sensors, actuators, valves, dampers, and other BAS Components may be manufactured by others as indicated.
1. Schneider Electric , Tridium
 2. Cylon Auto-Matrix
 3. Distech, Tridium
 4. Honeywell
 5. Johnson Controls Inc., Tridium
 6. Trane.

2.2 GENERAL

- A. Owner shall receive ownership of all job-specific configuration documentation, data files, software and/or code developed for the Project. This shall include all custom, job-specific software code, databases, and documentation for all configuration and programming that is generated for the Project and/or configured for use with the Device and Building Controllers or Building and Enterprise Supervisors, and any related LAN, WAN, Intranet, and Internet connected routers and devices.
- B. Any and all required IDs and passwords for admin and programming-level access to any BAS Component or software program shall be provided to Owner.
- C. All Device and Building Controllers installed for the project shall not be limited in their ability to communicate with a specific brand/Manufacturer or Vendor of the BAS. They shall also be constructed in a modular fashion to permit the next generation and support components to be installed in replacement of, or in parallel with, existing components.
- D. Device and Building Controllers shall have the ability to perform energy management routines via preprogrammed function blocks or template programs.
- E. Browser-based access: A remote/local user using a standard browser will be able access all BAS facilities and graphics via the LAN or direct connection, with proper username and password. Only HTML5 browser-based graphical user interfaces (GUI) is acceptable. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer, Edge, Firefox, or Chrome.
- F. Remote data access: The system shall support browser-based remote access over the Internet to the building data.
1. The Contractor shall coordinate with Owner IT to ensure all remote browser access is protected with the latest BAS software updates.
 2. The Contractor shall coordinate with Owner IT to ensure a VPN (Virtual Private Network) is installed to protect Owner from cyber-attacks.
- G. Systems Configuration Database: The system architecture shall support maintaining the systems configuration database on a Supervisor server on the LAN. User tools for BLN and/or DLN management shall

be provided and licensed to Owner and shall allow unrestricted configuring, updating, maintaining, and expanding of all current devices, configurations and settings.

- H. Database Schema shall be published and provided to Owner to facilitate easy access to BLN and DLN data.
- I. Owner shall be the named license holder of all software associated with any and all incremental work on the project. Contractor will coordinate with Owner IT for any requirements regarding software/hardware licensing.
- J. Where multiple pieces of Niagara equipment exist, use single-JACE sign-on. Coordinate with Owner on requirements.

2.3 DEVICE COUNT AND SOFTWARE MAINTENANCE AGREEMENTS

- A. All Device Controllers, Building Controllers, and Supervisors which have a license structure to where only a certain quantity of BAS Components or devices can connect to it shall be selected such that there is a minimum 25% capacity for future BAS Component or device connections. (i.e. if there are 80 connected devices, the license shall allow for $80 \times 1.25 = 100$ potential device connections (20 extra device connections possible).
- B. All Building Controllers and Supervisors which have a license structure requiring a Software Maintenance Agreement (SMA) shall be for a period of five years.

2.4 SYSTEM PERFORMANCE

- A. Description: The BAS shall comply with the following minimum performance requirements. Performance requirements are based on a fully functioning BAS with all trends and alarms enabled:
 - 1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
 - 2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
 - 3. Object Command: Reaction time of less than 2 seconds between operator command of a binary object and device reaction.
 - 4. Object Scan: Transmit change of state and change of analog values to control units or workstation within 6 seconds.
 - 5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.

2.5 SYSTEM ARCHITECTURE

- A. The system architecture provided shall incorporate hardware and software resources sufficient to meet the functional requirements of these Specifications. The Building and Device-Level Network shall be based on industry standard open platforms as specified herein, and utilize commonly available operation, management, and application software. All software packages and databases shall be licensed to Owner to allow unrestricted maintenance and operation of the BAS. Contractor shall include all items not specifically itemized in these Specifications that are necessary to implement, maintain, and operate the system in compliance with the functional intent of these Specifications.
- B. Reference 4.1 Network Diagram for diagram of System Architecture layout.
- C. The system architecture shall consist of a Wide Area Network (WAN), a Local Area Network (LAN), a Building-Level Network (BLN), and one or more Device-Level Network(s) (DLN), as well as an Enterprise Supervisor, a Building Supervisor, Building Controller(s), and Device Controller(s), as applicable.

1. Wide Area Network (WAN): WAN infrastructure provided by Owner. Contractor will coordinate with Owner IT for configuration (ports, firewall, etc) for a successful BAS installation.
 - a. The WAN infrastructure shall be used to connect the Enterprise Supervisor to the Building Supervisor and/or Building Controller(s).
2. Local Area Network (LAN): LAN infrastructure provided by Owner. Contractor will coordinate with Owner IT for configuration (ports, firewall, etc) for a successful BAS installation.
 - a. The LAN infrastructure shall be the connection point to the WAN for the BAS, and also serve as the BLN.
3. Building-Level Network (BLN): BLN shall be a segmented network on the Owner's LAN.
 - a. The BLN shall be used for connection of Building Controller(s) and/or Building Supervisor only. No Device Controller(s) shall be connected to the BLN.
4. Device Level Network (DLN): DLN infrastructure provided by Contractor.
 - a. DLN will be BACnet TCP/IP (Ethernet).
 - b. Contractor will provide one or more DLNs to maintain network speeds as specified herein.
 - c. Additional DLNs of a different protocol than listed may be added to integrate unique pieces of equipment not provided by Contractor, however all Contractor-provided equipment shall be consistent with the DLN above.
5. The LAN will be under construction and not necessarily complete prior to work commencing. As such, a temporary BLN will be provided by Contractor for functionality of the BAS. This may include wireless access points, switches, or other temporary hardware for full functionality. Upon completion of the LAN, which will also serve as the BLN, Contractor shall remove the temporary equipment and provide final installation of devices to the permanent BLN. Testing of the system will be provided to ensure functionality is the same as on the temporary system.

2.6 SYSTEM ARCHITECTURE, ADDITIONAL REQUIREMENTS

- A. Prior to bid, where a modification to the System Architecture is desired, Contractor will obtain permission for the proposed System Architecture. Contractor will provide documentation with proposed modifications and how they will improve the System Architecture as specified. If not approved, Contractor will provide the System Architecture as specified.
- B. Prior to the bid, Contractor may request for additional connections to the WAN/LAN beyond the ones specified herein. Should those connections be disallowed, Contractor shall provide additional BLN(s) or DLN(s) at no additional cost to Owner.
- C. Capacity of any BLN or DLN shall be limited to 70% of the allowable device count to allow for future minor modifications or expansions to the network. Provide calculations on request.
- D. Device Controllers shall communicate on a hardwired network.
- E. Twisted-Pair Based Device Level and/or Building Level Networks (DLN/BLN):
 1. BACnet MS/TP networks where the baud rate for equipment is "fixed" and cannot be changed shall be segmented from the main DLN(s). The main DLN(s) will not be slowed to accept Device Controllers with slower baud rates than the majority of the Device Controllers can achieve.

2. ARCnet and/or Token-Ring based DLNs shall not be acceptable.
 3. The communication speed between Device Controllers shall be sufficient to ensure fast system response time under any loading condition. At a minimum, network speed shall be minimally 78K bits per second (LonWorks FTT-10A), 19.2K bits per second (Modbus RTU), 76,800 baud (BACnet MS/TP).
 - a. Where speeds must be reduced, provide justification to Owner for approval.
 4. Provide a maximum of 40 LonWorks FTT-10A controllers per segment. Provide a maximum of 25 BACnet MS/TP controllers per segment. Provide a maximum of 25 Modbus RTU controllers per segment.
 - a. Controller counts may be increased where specifically recommended/approved by the Manufacturer and system performance will be achieved as specified. If network performance suffers due to excessive controllers, Contractor shall provide additional BLN(s) or DLN(s) at no additional cost to Owner.
- F. Ethernet Based Device Level and/or Building Level Networks (DLN/BLN):
1. Where DLN is an ethernet-based network (vs traditional copper twisted-pair network), the requirements of the BLN shall also apply to the DLN.
 2. Ethernet-based BLN or DLN shall be consistent with Owner IT standards and requirements, and at a minimum IEEE 802.3 Ethernet over Fiber or Category 6 cable with switches and routers that support 1000base-T gigabit Ethernet throughput. Provide all routers, switches, and other hardware for functionality.

2.7 DEVICE CONTROLLERS

- A. Provide a Device Controller for each piece of MEP Equipment, or as specifically identified.
- B. General
1. Device Controllers shall fundamentally communicate with the protocol as specified in the System Architecture for the DLN. Device Controllers which communicate over a different protocol and then convert to the specified protocol via a protocol converter, router, or gateway are not acceptable.
 2. All Device Controllers shall be able to communicate peer-to-peer without the need for a Building Controller and shall be capable of assuming all responsibilities typically assumed by a Building Controller.
 3. Any Device Controller 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. So called "Slave Controllers" are not acceptable.
 4. A dedicated Device Controller will be provided for each piece of MEP Equipment. Controller "sharing," where one Controller does one or more pieces of MEP Equipment, is not allowed, unless specifically approved by Owner.
 5. Each Device Controller shall have a minimum of 10% spare capacity for each point type for future point connection, rounded up to the nearest whole number.
 6. Performance

- a. Each Device Controller shall have a minimum of 64KB of RAM and 384KB of non-volatile flash memory.
 - b. Each Device Controller shall have a 32-bit microprocessor operating at a minimum of 68 MHz.
 - c. Real time clock with rechargeable battery and 20 days power backup.
7. The control program shall be resident within the same enclosure as the input/output circuitry, which translates the sensor signals. The control program shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained.
8. Provide single Device Controllers with the physical and software resource count for standalone operation of each piece of MEP Equipment. The Sequence of Operation and required points for control shall reside on a single Device Controller.
- a. Remote I/O modules (via a field-wired communications bus designed for remote I/O purposes) are acceptable for points required to achieve the Sequence of Operation.
 - 1) BACnet, LonWorks, Modbus, and any other communication protocol designed for Device Controller to Building Controller communication is not acceptable for remote I/O communication.
 - 2) Expansion I/O modules plugged directly into the Controller are acceptable for points required to achieve the Sequence of Operation.
 - 3) Additional Device Controllers connected via the DLN are not acceptable for points required to achieve the Sequence of Operation.
9. Device Controllers with integral sensors or devices (i.e., a VAV terminal unit controller with integral damper actuator and pressure sensor), shall comply with the specification requirements for those sensors if they were submitted separately. If the Controller's sensors or devices do not comply, the sensors or devices will be provided separately.
10. BACnet Device Controller Specific Requirements:
- a. Each BACnet Controller on the BACnet MS/TP communications trunk shall provide a loading characteristic of 1/8th load.
 - b. Provide BACnet Controllers that are BACnet Testing Laboratory (BTL) listed (v14 or later). Controllers will be marked with the BTL certified logos. Controllers must be within the following categories:
 - 1) BACnet Building Controller (B-BC)
 - 2) BACnet Advanced Application Controller (B-AAC)
 - 3) BACnet Application Specific Controller (B-ASC)
11. LonWorks Device Controller Specific Requirements:
- a. Provide LonWorks Device Controllers that conform to LonMark Certified Interoperability Standards. Components will be marked with the LonMark certified logos.
12. Modbus Device Controller Specific Requirements:

- a. Provide Modbus Device Controllers that conform to the Modbus Conformance Testing Program and be independently verified by an approved third-party for conformance.
- C. Configurable Device Controllers
 - 1. Shall contain an application-specific control program which can be configured to meet the Sequence of Operation.
 - 2. Where a configurable Controller cannot be configured to meet the Sequence of Operation, a Programmable Controller will be used. Alternatively, Contractor may submit a request to modify the Sequence of Operation so that a Configurable Controller may be used in lieu of a Programmable Controller.
- D. Programmable Device Controllers
 - 1. Shall be fully programmable and the programming software shall have a library of pre-built, tested, and user re-definable control sequences for a wide range of typical HVAC applications.
- E. Additional Requirements for Device Controllers with Ethernet
 - 1. Provide with a 2-port or greater unmanaged integrated switch.
 - 2. Controllers should be able to be “daisy chained” to eliminate multiple dedicated ethernet drops for each Controller.

2.8 BUILDING CONTROLLERS

- A. Provide Building Controller(s) with sufficient expansions to integrate DLNs while maintaining network speed, point count requirements, spare capacity, and other requirements as specified.
- B. Building Controller(s) shall be JACE 8000 series.
 - 1. Provide with all required expansions for LonWorks FTT-10A, RS485, etc. to achieve the necessary quantity of DLN(s).
- C. Provide sufficient quantity of Building Controllers to maintain average processing power at 70% or less. Where Building Controllers are running above 70% consistently, additional Building Controllers will be provided and DLNs rewired at no cost to the Owner.

2.9 BUILDING SUPERVISORS

- A. Where there is a single Building Controller, no Building Supervisor is required.
- B. In lieu of a Building Supervisor, use Enterprise Supervisor.
 - 1. No computer will be installed onsite as part of the Project.
 - 2. For graphics that spread over multiple Building Controllers, build inside Enterprise Supervisor and link to corresponding Building Controller(s) (ex., master floorplan graphic inside Enterprise Supervisor, with hyperlinks to IPs for Building Controllers in each wing).

2.10 ENTERPRISE SUPERVISORS

- A. Integrate Building Supervisor and/or Building Controller(s) to the existing Enterprise Supervisor.

2.11 CONTROL PANELS AND ENCLOSURES

- A. Control Panels are an assembly composed of an enclosure and one or more BAS Component(s). Control Panels will be provided for:
 - 1. All MEP Equipment which requires a Device Controller(s) and does not have an Enclosure for a Device Controller(s) included as part of the MEP Equipment.
 - 2. All Building Controller(s).
- B. Reference 1.9 Quality Assurance for Control Panel rating requirements.
 - 1. All Control Panels provided for MEP Equipment shall be assembled and installed in accordance with UL508A. Field wiring to the Control Panel shall be terminated to a field wiring terminal as indicated on the required drawings provided with the Control Panel. Control Panels which are modified after UL508A listing by adding BAS Component(s) not shown on the UL508A panel drawings are 1) not allowed, or 2) require UL508A recertification from an authorized UL508A inspector. In short, 'generic' UL508A Control Panels which have power prewired but contain no BAS Component(s) as listed are not allowed.
- C. Controller(s) installed inside of MEP Equipment shall only be done so in spaces/enclosures designed for a Controller to be installed (i.e. a VAV controls enclosure). The fact a Controller fits inside the space does not constitute being designed for a Controller to be installed. Controller shall not be installed on the outside of any MEP Equipment or in a plenum, even if Controller is plenum rated.
- D. Enclosures shall have continuously welded and ground smooth seams, have doors that open 180 degrees, concealed and continuous hinge, and ground studs on door and body.
- E. Indoor/inside enclosures shall be NEMA/UL Listed Type 1. Enclosure shall be powder-coated steel, consistent with color chart herein. Outdoor/outside Enclosures shall be NEMA/UL Listed 3R or 4X. Enclosure shall be power-coated steel consistent with color chart herein or stainless steel.
- F. All enclosures will be provided with a removable backplate to which BAS Components will be fastened. No BAS Components will be fastened to the enclosure body. BAS Components, such as pilot lights and switches, displays, and operator interfaces may be mounted to the enclosure door, so long as they are designed to do so. No component will sacrifice or downgrade the NEMA rating of the enclosure.
- G. Control Panels will be sized (width, height, and depth) so that all BAS Components, including but not limited to Controllers, relays, power supplies and transformers, fit inside neatly and in an organized fashion. Provide cable tray for all wire to rest in and fasten to backplate. Cable tray shall be sufficiently sized for future expansion and/or service loop for field-wiring.
- H. Control Panels which have more than one BAS Component are required to be provided prewired to numbered terminal blocks. All BAS Components and terminal blocks will be fastened to the removable backplate and wired between the BAS Components and terminal block at Contractor's panel shop. The terminal block will serve as the demarcation point between factory/shop wiring and field wiring. At no point shall field wiring cross the terminal block and be wired directly to a factory/shop-installed BAS Component. Any BAS Component that was intended to be in the field, such as a relay, will not be installed inside the Enclosure in the field.
 - 1. Exception: Enclosures which house only one BAS Component, such as a Controller, are not required to have numbered terminal blocks, and may have field wiring terminated directly to the BAS Component.
- I. Maintain separation between Class 2 wiring and other wiring, such as power, for both field and factory connections.
- J. The design intent of the Control Panels is to have the ability to, in the future, disconnect all field wiring from the terminal blocks, remove the backplate with old control components, install new backplate with new control components and reconnect wire to the terminal blocks. Contractor will maintain design intent with their panel

design and installation.

- K. Where the Specification conflicts with Control Panel requirements in Division 26, Contractor will comply with the most stringent requirement.

2.12 CABLE, WIRING, TUBING, AND ACCESSORIES

- A. Comply with 230512 and Division 26.
- B. BAS cable for input and outputs shall comply to the color chart herein and have “BAS CABLE” (or equivalent) physically written on the cable from the cable manufacturer at regular intervals.
- C. BAS cable for LonWorks shall comply to the color chart herein and have “LONMARK” physically written on the cable from the cable manufacturer at regular intervals. BAS cable for BACnet shall comply with the color chart herein and have “BACNET” physically written on the cable from the cable manufacturer at regular intervals. BAS cable for other protocols will have the appropriate protocol written on the cable.
- D. All control wiring and tubing shall be plenum rated, no riser cable or tubing is allowed. Conform with NFPA 262 Flame Test for approved plenum use without conduit.
- E. Provide with integral ripcord.
- F. Treat cable with a lubricant to increase cable pulling productivity and efficiency and to decrease the risk of cable damage due to excessive pulling strengths. A non-staining lubricant shall be applied to coat the full length of the cable during the manufacturing process. The lubricant shall produce a low coefficient of friction on the cable jacket material that reduces pulling friction by up to 70%. The lubricant shall continue to reduce friction after it has dried; remaining as a slippery film that retains lubricity for months after use. The cable lubricant shall comply with the physical and performance requirements of Telcordia Standard, TR-NWT-002811, and Generic Requirements for Cable Placing Lubricants. The lubricant shall not contain solvents nor have a flash point.
- G. BACnet and Modbus cable will be continuously shielded. LonWorks cable must be shielded into and out of VFDs, or any other noise-generating piece of equipment. Input/output (I/O) cable need not be shielded.
- H. Ethernet cable shall comply with the color chart herein and be consistent with Owner IT standards and requirements, and at a minimum IEEE 802.3 Category 6 cable.
- I. Tubing for air pressure sensors shall be polyethylene, approved for plenum installations, have high stress-crack resistance and be resistant to ultraviolet light.

2.13 TRANSFORMERS AND DC POWER SUPPLIES

- A. Control Transformers
 - 1. Class 2, sized and rated for application. Circuit breaker overcurrent protection; fused or internal overcurrent protection is not allowed. Transformers shall be sized so that connected load does not exceed 75 percent of rating. Functional Devices TR series or approved equal.
- B. DC Power Supplies
 - 1. Class 2, sized and rated for application. Overcurrent protection with auto-reset; fused or internal overcurrent protection is not allowed. Transformers shall be sized so that connected load does not exceed 75 percent of rating. IDEC PS5R-V Series or approved equal.

2.14 SURGE PROTECTION

- A. Provide any power supply surge protection, filters, etc. as necessary for proper operation and protection of all BAS Components.
- B. All BAS Components shall be capable of handling voltage variations 10% above or below measured nominal value, with no effect on hardware, software, communications, and data storage.
- C. Provide Control Panel surge protection for:
 - 1. Building Controllers and/or their associated Control Panels
 - 2. Control Panels with 11 or more hardwired input/output points entering/exiting the panel.
 - 3. Control Panels with network routers, switches, and/or other network/interface devices.
 - 4. Location(s) required by Owner based on submitted controls architecture.
 - 5. Manufactured by Ditech DTK-120HW or approved equal.
- D. Provide surge protection for DLN and/or BLN at every point network enters or leaves the building enclosure.
 - 1. Manufactured by Ditech DTK-2MHLP series or approved equal for copper twisted-pair networks.
 - 2. Manufactured by Ditech DTK-110C6A series or approved equal for ethernet networks.

2.15 SWITCHES

- A. Provide network switches inside Control Panels as required for BLN and/or DLN communications.
- B. Manufactured by Contemporary Controls Skorpion Switch Series or approved equal.

2.16 SOFTWARE

- A. {NONTRIDIUM-REPLACE}Provide one copy of Tridium Niagara Workbench software.
- B. Provide one copy of ALL programming tools for all Device Controllers. Provide multiple versions of Software as required. Software will be fully licensed and not a “partial” or “light/lite” software version. Any functionality the Manufacturer and/or Vendor has available to them will also be provided to the Owner.
- C. Install software on Owner-chosen computer. Coordinate with Owner on processing, memory, operating system, and other computer requirements.

PART 3 EXECUTION

3.1 PREPARATION

- A. Examine areas and conditions under which BAS is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Owner and Contractor. Report any issues to Owner and/or General Contractor.
- B. These Specifications call out certain duties of Contractor and any subcontractor(s). They are not intended as a material list of all items required by the Project.

3.2 INSTALLATION

- A. Provide related items and work indicated in the Contract Documents, as specified or not specified, necessary to provide a complete and fully functioning BAS, including but not limited to:

1. All incidentals, equipment, appliances, services, hoisting, scaffolding, supports, tools, supervision, labor, consumable items, fees, licenses, etc.
 2. All BAS Components, devices, power supplies, transformers, fittings, sensors, controllers, wiring, accessories, etc.
 3. All wiring, including communication network, analog points, digital points, low voltage power, line voltage power, emergency power, etc.
 4. All associated power and low voltage connections.
 5. All conduit, junction boxes, fittings, panels, enclosures, hardware, etc.
- B. Utilize licensed electricians for all electrical distribution systems.
- C. The Contract Documents show the general arrangement of the respective systems. Follow as closely as actual building construction and the work of other trades will permit.
- D. Maintain redlines of shop drawings throughout installation process. Redlines will be used to generate O&Ms, and any other closeout documentation as specified herein. Shop drawings for O&Ms which are submitted unchanged from the Action Submittal phase will be required to be as-built to actual constructed conditions at no cost to Owner.

3.3 PRODUCT DELIVERY, STORAGE, HANDLING, PROTECTION, AND CLEANING

- A. All products and materials shall be new, clean, and free of defects, damage, and corrosion.
- B. Ship and store products and materials in a manner which will protect them from damage, weather, and entry of debris until final acceptance.
- C. Where BAS Components are required to be factory-mounted on MEP Equipment by others, arrange for shipping of BAS Components to MEP Equipment manufacturer.

3.4 SITE CLEAN-UP

- A. At conclusion of each day's work, and at the request of Owner, clean up and remove from the site all rubbish, debris, and trash accumulated during the day as a result of work of Contractor.
- B. Marks on walls and/or ceiling tiles caused by Contractor shall be cleaned by Contractor.
- C. Ceiling tiles, drywall, carpet, paint, and all architectural finishes damaged by Contractor shall be replaced by Contractor.

3.5 POWER WIRING, CONTROL WIRING, AND CONTROL TUBING

- A. Comply with 230512 and Division 26.
- B. Extend 120V power circuits from points provided to control voltage transformers. Where dedicated junction boxes have been provided, coordinate the exact locations with the Electrical Contractor. Where they have not, coordinate the spare circuit breakers to be used with the Electrical Contractor and/or Owner.
- C. Install all wiring and tubing in conduit.
- D. Install wire, cable, and accessories with sufficient slack and flexible connections to allow for vibration of piping and equipment.

- E. Wire safeties and limit controls to prevent operation of MEP Equipment in any selector position (off-hand-auto).
- F. Provide sleeves and conduit for passage of wiring through structural masonry, concrete walls and floors, and elsewhere for the proper protection of the BAS. Seal as required.
- G. Splices are not permitted within the BLN or DLN communication cables. Only continuous network topologies or continuous homeruns are allowed for these networks. Splices identified, including damage to cable, will result in cable being re-pulled at no additional cost to Owner.
- H. Limit DLN and BLN cable lengths to no longer than 70% of the longest dimension published by the manufacturer of the cable or Controller, between the most remote network nodes/Controllers.
- I. Shielded wiring will have shields twisted together and taped against jacket of cable. No exposed shields will be allowed. Ground shield at one end of cable.
- J. LonWorks communication network shall transition from unshielded to shielded at device prior to VFD(s), be shielded into and out of the VFD(s), and transition back to unshielded at device after VFD(s).
- K. Power wiring, control wiring, and wiring accessories (i.e. conduit) shall be consistent with color chart herein.
- L. Power wiring, control wiring, and wiring accessories shall comply with Division 26. Where the Specification conflicts with Division 26, Contractor will comply with the most stringent requirement.
- M. Install control transformers and DC power supplies inside Control Panels. Transformers randomly installed in plenum, or connected to junction box via nipple mount, is not allowed.
- N. Install surge protection for wiring as required. Surge protection for 120V shall be installed exterior to Control Panel. Surge protection for communication network will be installed in close proximity to grounding locations and bars. Route communication network such that surge protection can be installed in accordance with manufacturer's instructions. Excessive grounding wiring runs and/or grounding to structural steel for surge protection is not permitted.
- O. Maintain all bend radius requirements with control tubing. Do not kink tubing. Do not use tees, elbows, or other fittings in tubing.
- P. I/O wiring shall be labeled in accordance with 1.15 Colors and Labeling. Wire number shall correspond to wire number shown on Closeout Documentation.
- Q. I/O cabling will be sized in accordance with the load and distance traveled. Input wiring will be minimally 22AWG. Output wiring will be minimally 18AWG.

3.6 NETWORK MANAGEMENT FUNCTIONAL REQUIREMENTS

- A. Contractor shall thoroughly and completely program and configure BAS Components, software, supplemental software, application programming, network communications, operator workstations, computers, printer, and network communications to permit the functional requirements of the BAS herein specified. The setup shall include as a minimum the following network management procedures:
 - 1. Automatic backup of the BAS database to appropriate media.
 - 2. Program, load, and debug all software installations, including integration of third-party applications (i.e., analytics and energy management).
 - 3. Network user auditing routine.

3.7 POINT-TO-POINT TESTING/CHECKOUT

- A. As a part of installation, provide checkout (also called point-to-point testing) of all BAS Components.
- B. Prior to start-up of any MEP Equipment, ensure all points have been properly set up, including but not limited to sensor type and range.
- C. Ensure BAS Component is accessible for maintenance.
- D. Ensure sensors and devices have been installed in the correct location in accordance with actual field conditions and modifications made to the flow diagram in the Contract Documents. Ensure sensors and devices have the proper flow direction, orientation, insertion depth, and any other applicable requirements.
- E. Provide means to increase or decrease sensed value and ensure the BAS responds accordingly.
- F. Checkout will be performed via Owner's final graphic screens. If checkout is performed within the programming function of the BAS, it shall be repeated when the final graphic screens are complete and available for use.
- G. Check operation of valve/damper-actuator combination to confirm that actuator modulates valve/damper smoothly throughout stroke to both open and closed positions. Check valve for proper close off.
- H. Provide documentation of the checkout process for each piece of MEP Equipment.

3.8 START-UP TESTING

- A. At the conclusion of point-to-point testing/checkout, provide start-up testing of all BAS Components.
- B. Provide start-up of all MEP Equipment. Perform start-up in conjunction with any applicable trades.
- C. Provide start-up testing to ensure all configuration and programming conforms with Sequence of Operation.
- D. Start-up testing will be performed via Owner's final graphic screens. If start-up testing is performed within the programming function of the BAS, it shall be repeated when the final graphic screens are complete and available for use.
- E. Tune PIDs to provide reasonable speed response to change in variables while having stable operation.
- F. Provide documentation of the start-up testing process, including any modifications made to the Sequence of Operation, for each piece of MEP Equipment.

3.9 ADJUSTING AND CALIBRATION

- A. Adjust and calibrate all points on the BAS as follows.
- B. Prior to calibration, complete all point-to-point testing/checkout and start-up testing to ensure the BAS is fully functioning.
- C. {NONTRIDIUM-REMOVE}Calibrations shall be made inside the Niagara wire sheet. Do not calibrate sensors inside the device controller.
- D. Calibrated instrument shall be minimally twice as accurate as the sensor's installed accuracy.
- E. Using calibrated instruments, document actual value (per calibrated instrument) and indicated sensor reading (per the BAS). Adjust using a single point offset or a double-point calibration. Document calibration value(s).

- F. If sensor reading is within the manufacturer's stated accuracy, do not calibrate the sensor. Document actual value and sensor reading.
- G. If sensor is greater than manufacturer's stated accuracy, investigate installation of sensor (i.e., 5-10 pipe/duct diameters downstream, etc), programming of sensor (i.e., SVNTs, range, voltage instead of mA and resistance causing high voltage drop, etc.), transient issues (i.e., turbulence, diffuser blowing on sensor). If investigation uncovers potential source of error, correct sensor installation.
- H. If no errors are found and sensor's accuracy is between 100 and 200% of manufacturer's stated accuracy, provide:
 - 1. Single-point offset for sensors whose readings will vary less than 20% (ex., room temperature).
 - 2. Two-point calibration for sensors whose readings will vary greater than 20%.
 - 3. Document actual value, sensor reading, and offset/calibration values.
- I. If no errors are found and sensor's accuracy is greater than 200% of manufacturer's stated accuracy, replace sensor. Alternatively, provide documentation for approval as to why sensor's error is more than 200% of manufacturer's stated accuracy.
- J. Work with Testing and Balance (TAB) Contractor to input calibrations performed within TAB Contractor's scope of work. Provide dedicated personnel to assist TAB Contractor during their work, provide a fully functioning TAB graphical screen on the BAS for TAB Contractor use, or provide means to adjust TAB via wall module. Assist TAB Contractor with questions regarding TAB graphical screen.
- K. Do not calibrate any sensor which has a guaranteed installed accuracy, such as airflow monitoring stations (AFMS) or water flow sensors.

3.10 FUNCTIONAL PERFORMANCE TESTING (FPT) PROCEDURE

- A. Perform point-to-point testing/checkout, start-up testing, adjusting/calibration testing, configuration, and programming on all MEP Equipment and the BAS as a whole to provide a complete and fully functioning BAS.
- B. BAS shall be complete and fully functioning prior to any Functional Performance Testing (FPT). Assist Owner and/or Owner Representatives, which may include but is not limited to the Engineer, Architect, Commissioning Agent (CxA), and/or Testing and Balance (TAB) Firm, with FPT, which may include but is not limited to verification, commissioning, and/or Graphical User Interface (GUI) acceptance testing. Provide dedicated personnel to those activities as specified herein or as requested by Owner.
- C. Provide documentation as specified to prove the BAS is complete and fully functional prior to FPT activities.
- D. At a minimum, perform the following FPT procedures. The following may be achieved within a Commissioning Plan or another FPT as required within the Contract Documents.
 - 1. Provide Owner an agenda and schedule of FPT activities for approval and coordination as part of Action Submittals.
 - 2. Complete all necessary installation to have a complete and fully functional BAS. Provide written notice that BAS is ready for FPT.
 - 3. Demonstrate BAS systems to Owner. Perform FPT including but not limited to Sequence of Operation, point-to-point verification to graphical interface, historical data logging, and alarms.
 - 4. Owner to provide detailed punch list to Contractor.

5. Contractor to repair issues on Owner punch list within five business days.

3.11 CLOSEOUT

- A. Upon completion of Functional Performance Testing (FPT), Contractor provides all requirements as specified in 1.13 Close-Out Submittals to Owner.
- B. Contractor trains Owner on all aspects of the BAS including architecture, devices, software, and final Sequences of Operation.
- C. Owner issues letter to Contractor declaring that system is Substantially Complete. Date of this letter starts the Warranty Period.
- D. Final Acceptance. Owner issues letter to Contractor accepting system. Final pay app can be issued for release of any remaining contingency funds.

3.12 CONTROL PANELS

- A. Install Control Panels at locations in accordance with the Contract Documents and/or Owner. Ensure proper service clearances will be achieved at the end of construction. Control Panels without proper service clearances will be relocated at no cost to Owner.
- B. For any Control Panel that exceeds 16 inches in any dimension, provide a trough above/below Control Panel. Trough shall be separated into high and low voltage. Provide a high and low voltage conduit or nipple between trough and Control Panel, sized appropriately for the high and low voltage wiring. All other conduit that serves the Control Panel shall enter/exit the trough. Do not terminate any other conduit(s) to the Control Panel outside of two conduits/nipples identified.
- C. Provide a service loop for all controls wiring. Service loop will be installed in trough (where provided) or inside Control Panel cable tray (where allowed).
- D. Contractor shall extend power to the Control Panel from a junction box or an acceptable location (coordinate with Owner and/or Division 26).

3.13 GRAPHICS/OPERATOR INTERFACE

- A. The graphics shall comply with the Owner's requirements and Master Plan.

3.14 RETROFIT WORK, ADDITIONAL REQUIREMENTS

- A. Control Panels
 1. Where existing control panels are to be reused, provide control panel design which facilitates the reuse of wiring without needed to be extended (ex: install terminal blocks across top of control panel backplate to allow for minimal need for extending wiring).
 2. Where wiring must be extended to reach, wiring will be spliced in a permanent fashion (i.e., solder and heat shrink). Wire nuts in the control panel are not allowed.
 3. Where the existing control panel does not facilitate an installation that otherwise would require excessive extending of wire, the existing panel can be used as a "patch panel" via terminal blocks.
 4. Where there is no existing trough or control panel, comply with specifications and install a new control panel and/or trough.
- B. General

1. Damaged wire, splices from previous work, or any other rework required will be performed as part of the base bid.

END OF SECTION 23 09 23.13

**SECTION 23 09 23.14
AIRFLOW INSTRUMENTS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Duct and plenum airflow measurement device (AMD) with temperature measurement and remote transmitter.

1.2 REFERENCES

- A. UL-873, Temperature Reading and Indicating Equipment
- B. UL 60730-1, 60730-2-9, Automated Electrical Controls
- C. FCC Part 15

1.3 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product being used, including:
 - 1. Equipment schedule.
 - 2. Product overview and technical specifications.
 - 3. Operations and maintenance manual.
 - 4. Wiring diagrams.
 - 5. Product placement guide.
 - 6. Sensor density table.
- B. Independent Test Reports: Provide a copy of each of the following test reports:
 - 1. NIST Report of Airflow Calibration
 - 2. UL Certificate Report
 - 3. FCC Part 15 compliance report.
 - 4. BTL Certification Report.
- C. Quality Assurance
 - 1. Manufacturer Qualifications: Company specializing in manufacturing thermal dispersion airflow measurement devices with minimum ten years documented experience.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store products in an environment that is protected from rain, snow and/or condensing moisture.
- C. Handle with care during installation.

- D. Protect sensors from construction debris and remove all debris that may enter the air distribution system prior to system startup.

1.5 SYSTEM STARTUP AND VERIFICATION

- A. Startup and verify products in accordance with manufacturers procedures in the operations and maintenance manual.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS AND EXCLUSIONS

- A. Provide one thermal airflow measuring device (AMD) for each location indicated on plans, schedules and/or control diagrams. Fan inlet measurement devices shall not be substituted for duct or plenum measurement devices indicated on the plans.
- B. Each AMD shall use the principal of thermal dispersion to determine the actual or mass airflow rate of the airstream. Differential pressure-based devices, including pitot tubes, pitot arrays, piezo-rings and devices measuring the pressure drop across a louver, damper or obstruction are not acceptable.
- C. Each AMD shall be provided with one or more sensor probes having one or more sensor nodes per probe.
- D. Each sensor node shall consist of two hermetically sealed bead-in-glass thermistors. The airflow of each sensor node shall be determined using one self-heated and ambient temperature sensing thermistor. Devices using indirectly heated thermistors to determine the airflow rate are not acceptable. Devices using chip thermistors of any type or packaging are not acceptable. Devices using platinum wire RTDs or similar "hot wire" devices are not acceptable.
- E. Thermistors shall be potted in an engineering thermoplastic assembly using water-proof, marine epoxy and shall not be damaged by moisture, direct contact with water or exposure to atmospheric acids. Provide a copy of an independent laboratory report to verify compliance with this requirement.
- F. All connections to internal wires in the probe tube shall be solder joints or welds. Connectors of any type in the probe tube are not acceptable.
- G. Each thermistor shall be independently calibrated to NIST traceable temperature standards to establish the resistance-temperature characteristics for the determination of airflow and temperature. Devices using interchangeable, curve-matched, thermistors are not acceptable.
- H. Each sensor node shall be independently processed by the transmitter prior to averaging and output.
- I. Transmitters shall be microprocessor-based and operate automatically after brownouts and/or transient power interruptions.
- J. Remote transmitters shall have an LCD and four-button user interface.
- K. Remote transmitters shall be mounted in a location protected from moisture, rain and snow with an ambient temperature between -20 and 120 °F and a humidity range between 5 and 95% RH (non-condensing). Provide a weatherproof enclosure and mount away from direct sunlight when outdoor mounting is required.
- L. Probes with remote transmitters shall be "plug and play", not require matching to the transmitter, and be provided with a UL listed, FEP jacketed, plenum rated cable and connector plug. Devices using PVC jacketed cables to connect sensor probes to the transmitter are not acceptable.
- M. All components of each AMD shall be RoHS2 compliant.

- N. Each AMD shall be UL/cUL listed as a final assembly.
- O. Each AMD shall be FCC-Part 15 compliant. Compliance shall be demonstrated by an independent test laboratory.
- P. Devices with a BACnet network connection shall be BTL tested and listed.

2.2 DUCT AND PLENUM AMD WITH TEMPERATURE AND HUMIDITY MEASUREMENT AND REMOTE TRANSMITTER

- A. Each AMD shall be suitable for installation in ducts and plenums; including air handling equipment cabinets and outdoor air intakes to determine the airflow rate, velocity-weighted temperature and humidity of the airstream. Humidity and enthalpy shall be calculated using the velocity weighted temperature, humidity and on-board pressure sensor.
- B. Provide one to four gold anodized polished 316 stainless steel probes and one remote transmitter.
- C. Probes shall have integral 304 stainless steel mounting brackets for insertion, internal or standoff mounting.
- D. Each sensor node shall be individually wind-tunnel calibrated to NIST traceable airflow standards and have an accuracy of $\pm 2\%$ of reading over the entire operating range. Provide a copy of the NIST calibration report for the reference standard used to calibrate the production tunnels used to calibrate individual sensor nodes. Reference standards calibrated to third-party NIST traceable labs are not acceptable. Devices claiming AMCA certification are not acceptable.
- E. Provide up to 16 sensing nodes per measurement location as required for the opening size and published sensor density tables to achieve an installed airflow accuracy of $\pm 3\%$ of reading ($\pm 5\%$ of reading on close coupled outdoor air intakes) between 0 and 5,000 fpm over a temperature range of -20 to 160 °F and a humidity range between 0 and 100% RH (non-condensing).
- F. Provide the velocity weighted temperature of the airstream with an accuracy of ± 0.15 °F.
- G. Provide low and high airflow alarms with a user defined setpoint and tolerance.
- H. The airflow rate, temperature, humidity, enthalpy or dewpoint, airflow alarm and system status alarm shall be visible on the transmitters display.
- I. Transmitters with analog output signals shall provide:
 - 1. One linear output signal for airflow.
 - 2. One linear output signal for velocity-weighted temperature or one binary signal for the airflow alarm or system status alarm.
- J. Transmitters with network capability shall provide the airflow, velocity-weighted temperature, velocity-weighted-humidity, velocity-weighted-enthalpy, dewpoint, airflow alarm status, individual sensor node airflow and temperature data and device fault status.
- K. Each AMD shall be powered by 24 VAC.

END OF SECTION 23 09 23.14

**SECTION 23 09 33
VARIABLE FREQUENCY DRIVE**

PART 1 GENERAL

1.1 DESCRIPTION

- A. This specification covers variable frequency drives (VFDs) designated on the drawing schedules to be variable speed. All standard and optional features shall be included within the VFD panel.
- B. The VFD shall be NEMA Type 1 or NEMA Type 12 as required on the schedule.
- C. The VFD shall have been evaluated by UL and found acceptable for mounting in a plenum or other air handling compartment.
 - 1. Manufacturer shall supply a copy of the UL plenum evaluation upon request.
- D. The VFD shall be tested to UL UL 61800-5-1
 - 1. The appropriate UL label shall be factory applied. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment. <https://www.ncosfm.gov/codes/state-electrical-division/qualified-testing-laboratories>.
- E. VFD shall be manufactured in ISO 9001, 2000 certified facilities.
- F. The VFD shall be CE marked and conform to the European Union ElectroMagnetic Compatibility directive.
- G. The VFD shall be UL listed for a short circuit current rating of 65 kAIC and labeled with this rating. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment. <https://www.ncosfm.gov/codes/state-electrical-division/qualified-testing-laboratories>.
- H. To ensure adequate technical and factory support, VFDs manufactured by others and brand labeled shall not be acceptable.
- I. The VFD manufacturer shall supply the VFD and all necessary controls as herein specified.
- J. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of twenty years.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. ABB
- B. Danfoss
- C. Eaton
- D. Honeywell
- E. Schneider
- F. Siemens

- G. Yasakawa
- H. Or Approved Equal

2.2 DESCRIPTION

- A. The VFD shall convert incoming fixed frequency three-phase AC power into an adjustable frequency and voltage for controlling the speed of three-phase AC motors.
- B. The motor current shall closely approximate a sine wave.
- C. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for the driven load and to eliminate the need for motor derating.
- D. When properly sized, the VFD shall allow the motor to produce full rated power at rated motor voltage, current, and speed without using the motor's service factor.
- E. VFDs utilizing sine weighted/coded modulation (with or without 3rd harmonic injection) must provide data verifying that the motors will not draw more than full load current during full load and full speed operation.
- F. The VFD shall include an input full-wave bridge rectifier and maintain a fundamental (displacement) power factor near unity regardless of speed or load.
- G. The VFD shall have a dual 5% impedance DC link reactor on the positive and negative rails of the DC bus to minimize power line harmonics and protect the VFD from power line transients. The chokes shall be non-saturating.
 - 1. Swinging chokes that do not provide full harmonic filtering throughout the entire load range are not acceptable.
- H. VFDs with saturating (non-linear) DC link reactors shall require an additional 3% AC line reactor to provide acceptable harmonic performance at full load, where harmonic performance is most critical.
- I. The VFD's full load output current rating shall meet or exceed NEC Table 430-150.
- J. The VFD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 135% of rated torque for up to 0.5 second while starting.
- K. The VFD shall provide full motor torque at any selected frequency from 20 Hz to base speed while providing a variable torque V/Hz output at reduced speed.
 - 1. This is to allow driving direct drive fans without high speed derating or low speed excessive magnetization, as would occur if a constant torque V/Hz curve was used at reduced speeds.
- L. A programmable automatic energy optimization selection feature shall be provided standard in the VFD. This feature shall automatically and continuously monitor the motor's speed and load to adjust the applied voltage to maximize energy savings.
- M. The VFD must be able to produce full torque at low speed to operate direct drive fans.
- N. The VFD must be capable of connection and disconnection to motor while the VFD is under load.
 - 1. This switching shall be accomplished without interlocks or damage to the VFD.
- O. An automatic motor adaptation algorithm shall measure motor stator resistance and reactance to optimize performance and efficiency.

1. It shall not be necessary to run the motor or de-couple the motor from the load to perform the test.
- P. Galvanic isolation shall be provided between the VFD's power circuitry and control circuitry to ensure operator safety and to protect connected electronic control equipment from damage caused by voltage spikes, current surges, and ground loop currents.
 1. VFDs not including either galvanic or optical isolation on both analog I/O and discrete digital I/O shall include additional isolation modules.
- Q. VFD shall minimize audible motor noise through the use of an adjustable carrier frequency.
 1. The carrier frequency shall be automatically adjusted to optimize motor and VFD operation while reducing motor noise.
 2. VFDs with fixed carrier frequency are not acceptable.
- R. All VFDs shall contain integral EMI filters to attenuate radio frequency interference conducted to the AC power line.

2.3 PROTECTIVE FEATURES

- A. A minimum of Class 20 I2t electronic motor overload protection for single motor applications shall be provided.
 1. Overload protection shall automatically compensate for changes in motor speed.
- B. The Contractor shall provide an auxiliary input from any downstream disconnecting means, to the permissive interlock of the VFD, to stop the VFD if the downstream disconnecting means is opened while the load is being powered. Coordinate with division 26 to ensure downstream disconnecting means is provided with auxiliary contacts.
- C. Protection against input transients, loss of AC line or load phase, output short circuit, output ground fault, over voltage, under voltage, VFD over temperature and motor over temperature.
 1. The VFD shall display all faults in plain language. Codes are not acceptable.
- D. Protect VFD from input phase loss.
 1. The VFD should be able to protect itself from damage and indicate the phase loss condition. During an input phase loss condition,
 2. The VFD shall be able to be programmed to either trip off while displaying an alarm, issue a warning while running at reduced output capacity, or issue a warning while running at full commanded speed.
 3. This function is independent of which input power phase is lost.
- E. Protect from under voltage.
 1. The VFD shall provide full rated output with an input voltage as low as 90% of the nominal.
 2. The VFD will continue to operate with reduced output, without faulting, with an input voltage as low as 70% of the nominal voltage.
- F. Protect from over voltage.

1. The VFD shall continue to operate without faulting with a momentary input voltage as high as 130% of the nominal voltage.
- G. The VFD shall incorporate a programmable motor preheat feature to keep the motor warm and prevent condensation build up in the motor when it is stopped in a damp environment by providing the motor stator with a controlled level of current.
- H. VFD shall include a "signal loss detection" algorithm with adjustable time delay to sense the loss of an analog input signal.
 1. It shall also include a programmable time delay to eliminate nuisance signal loss indications.
 2. The functions after detection shall be programmable.
- I. VFD shall function normally when the keypad is removed while the VFD is running.
 1. No warnings or alarms shall be issued as a result of removing the keypad.
- J. VFD shall catch a rotating motor operating forward or reverse up to full speed without VFD fault or component damage.
- K. Selectable over-voltage control shall be provided to protect the drive from power regenerated by the motor while maintaining control of the driven load.
- L. VFD shall include current sensors on all three output phases to accurately measure motor current, protect the VFD from output short circuits, output ground faults, and act as a motor overload.
 1. If an output phase loss is detected, the VFD will trip off and identify which of the output phases is low or lost.
- M. If the temperature of the VFD's heat sink rises to a critical level, the VFD shall automatically reduce its carrier frequency to reduce the heat sink temperature.
 1. It shall also be possible to program the VFD so that it reduces its output current limit value if the VFD's temperature becomes too high.
- N. In order to ensure operation during periods of overload, it must be possible to program the VFD to automatically reduce its output current to a programmed value during periods of excessive load. This allows the VFD to continue to run the load without tripping.
- O. The VFD shall have temperature controlled cooling fan(s) for quiet operation, minimized losses, and increased fan life.
 1. The drive fan speed can be preprogrammed at preset speeds or run in Auto mode.
 2. At low loads or low ambient temperatures, the VFD may even turn the fan(s) off even when the VFD is running.
- P. The VFD shall store in memory the last 10 alarms.
 1. A description of the alarm, and the date and time of the alarm shall be recorded.
 2. The VFD shall include graphing capability for the last 2 alarms to provide additional diagnostic analysis.
- Q. When used with a pumping system, the VFD shall be able to detect no-flow situations, dry pump conditions, and operation off the end of the pump curve.

1. It shall be programmable to take appropriate protective action when one of the above situations is detected.

2.4 INTERFACE FEATURES

- A. Hand, Off and Auto keys shall be provided to start and stop the VFD and determine the source of the speed reference.
 1. It shall be possible to either disable these keys or password protect them from undesired operation.
- B. There shall be an "Info" key on the keypad.
 1. The Info key shall include "on-line" context sensitive assistance for programming and troubleshooting.
- C. The VFD shall be programmable to provide a digital output signal to indicate whether the VFD is in Hand or Auto mode.
 1. This is to alert the Building Automation System whether the VFD is being controlled locally or by the Building Automation System.
- D. Password protected keypad with alphanumeric, graphical, backlit display can be remotely mounted.
 1. Two levels of password protection shall be provided to guard against unauthorized parameter changes.
- E. All VFDs shall have the same customer interface.
 1. The keypad and display shall be identical and interchangeable for all sizes of VFDs.
- F. To set up multiple VFDs, it shall be possible to upload all setup parameters to the VFD's keypad, place that keypad on all other VFDs in turn and download the setup parameters to each VFD.
 1. To facilitate setting up VFDs of various sizes, it shall be possible to download from the keypad only size independent parameters.
 2. Keypad shall provide visual indication of copy status.
- G. A red FAULT light, a yellow WARNING light and a green POWER-ON light shall be provided.
 1. These indications shall be visible both on the keypad and on the VFD when the keypad is removed.
- H. A quick setup menu with factory preset typical HVAC parameters shall be provided on the VFD.
 1. The VFD shall also have individual Fan, Pump, and Compressor menus specifically designed to facilitate start-up of these applications.
- I. A three-feedback PID controller to control the speed of the VFD shall be standard.
- J. This controller shall accept up to three feedback signals.
 1. It shall be programmable to compare the feedback signals to a common setpoint or to individual setpoints and to automatically select either the maximum or the feedback signal as the controlling signal.
 2. It shall also be possible to calculate the controlling feedback signal as the average of all feedback signals or the difference between a pair of feedback signals.

- K. The VFD shall be able to apply individual scaling to each feedback signal.
- L. For fan flow tracking applications, the VFD shall be able to calculate the square root of any or all individual feedback signals so that a pressure sensor can be used to measure air flow.
- M. The VFD's PID controller shall be able to actively adjust its setpoint based on flow.
 - 1. This allows the VFD to compensate for a pressure feedback sensor which is located near the output of the pump rather than out in the controlled system.
- N. The VFD shall have three additional PID controllers which can be used to control damper and valve positioners in the system and to provide setpoint reset.
- O. Floating point control interface shall be provided to increase/decrease speed in response to contact closures.
- P. Five simultaneous meter displays shall be available.
 - 1. They shall include at a minimum, frequency, motor current, motor voltage, VFD output power, VFD output energy, VFD temperature in degrees, among others.
- Q. Programmable Sleep Mode shall be able to stop the VFD.
 - 1. When its output frequency drops below set "sleep" level for a specified time, when an external contact commands that the VFD go into Sleep Mode, or when the VFD detects a no-flow situation, the VFD may be programmed to stop.
 - 2. When the VFD's speed is being controlled by its PID controller, it shall be possible to program a "wake-up" feedback value that will cause the VFD to start.
 - 3. To avoid excessive starting and stopping of the driven equipment, it shall be possible to program a minimum run time before sleep mode can be initiated and a minimum sleep time for the VFD.
- R. A run permissive circuit shall be provided to accept a "system ready" signal to ensure that the VFD does not start until dampers or other auxiliary equipment are in the proper state for VFD operation.
 - 1. The run permissive circuit shall also be capable of initiating an output "run request" signal to indicate to the external equipment that the VFD has received a request to run.
- S. VFD shall be programmable to display feedback signals in appropriate units, such as inches of water column (in-wg), pressure per square inch (psi) or temperature (°F).
- T. VFD shall be programmable to sense the loss of load.
 - 1. The VFD shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus.
 - 2. To ensure against nuisance indications, this feature must be based on motor torque, not current, and must include a proof timer to keep brief periods of no load from falsely triggering this indication.

2.5 STANDARD CONTROL AND MONITORING INPUTS AND OUTPUTS

- A. Four dedicated, programmable digital inputs shall be provided for interfacing with the systems control and safety interlock circuitry.
- B. Two terminals shall be programmable to act as either as digital outputs or additional digital inputs.

- C. Two programmable relay outputs, Form C 240 V AC, 2 A, shall be provided for remote indication of VFD status.
- D. Each relay shall have an adjustable on delay / off delay time.
- E. Two programmable analog inputs shall be provided that can be either direct-or-reverse acting.
- F. Each shall be independently selectable to be used with either an analog voltage or current signal.
- G. The maximum and minimum range of each shall be able to be independently scalable from 0 to 10 V dc and 0 to 20 mA.
- H. A programmable low-pass filter for either or both of the analog inputs must be included to compensate for noise.
- I. The VFD shall provide front panel meter displays programmable to show the value of each analog input signal for system set-up and troubleshooting,
- J. One programmable analog current output (0/4 to 20 mA) shall be provided for indication of VFD status.
 - 1. This output shall be programmable to show the reference or feedback signal supplied to the VFD and for VFD output frequency, current and power.
 - 2. It shall be possible to scale the minimum and maximum values of this output.
- K. It shall be possible through serial bus communications to read the status of all analog and digital inputs of the VFD.
- L. It shall be possible to command all digital and analog output through the serial communication bus.

2.6 OPTIONAL CONTROL AND MONITORING INPUTS AND OUTPUTS

- A. It shall be possible to add optional modules to the VFD in the field to expand its analog and digital inputs and outputs.
- B. These modules shall use rigid connectors to plug into the VFD's control card.
- C. The VFD shall automatically recognize the option module after it is powered up. There shall be no need to manually configure the module.
- D. Modules may include such items as:
 - 1. Additional digital outputs, including relay outputs
 - 2. Additional digital inputs
 - 3. Additional analog outputs
 - 4. Additional analog inputs, including Ni or Pt temperature sensor inputs
- E. It shall be possible through serial bus communications to control the status of all analog and digital outputs of the VFD.
 - 1. Standard programmable firefighter's override mode allows a digital input to control the VFD and override all other local or remote commands.

2. It shall be possible to program the VFD so that it will ignore most normal VFD safety circuits including motor overload.
 3. The VFD shall display FIREMODE whenever in firefighter's override mode.
 4. Fire-mode shall allow selection of forward or reverse operation and the selection of a speed source or preset speed, as required to accommodate local fire codes, standards and conditions.
- F. A real-time clock shall be an integral part of the VFD.
1. It shall be possible to use this to display the current date and time on the VFD's display.
 2. Ten programmable time periods, with individually selectable ON and OFF functions shall be available.
 3. The clock shall also be programmable to control start/stop functions, constant speeds, PID parameter setpoints and output relays. It shall be possible to program unique events that occur only during normal work days, others that occur only on non-work days, and others that occur on specific days or dates.
 4. The manufacturer shall provide free PC-based software to set up the calendar for this schedule.
- G. All VFD faults shall be time stamped to aid troubleshooting.
- H. It shall be possible to program maintenance reminders based on date and time, VFD running hours, or VFD operating hours.
- I. The real-time clock shall be able to time and date stamp all faults recorded in the VFD fault log.
- J. The VFD shall be able to store load profile data to assist in analyzing the system demand and energy consumption over time.
- K. The VFD shall include a sequential logic controller to provide advanced control interface capabilities. This shall include:
1. Comparators for comparing VFD analog values to programmed trigger values
 2. Logic operators to combine up to three logic expressions using Boolean algebra
 3. Delay timers
 4. A 20-step programmable structure
 5. The VFD shall include a Cascade Controller which allows the VFD to operate in closed loop set point (PID) control mode one motor at a controlled speed and control the operation of additional constant speed motor starters.

2.7 SERIAL COMMUNICATIONS

- A. The VFD shall include a standard EIA-485 communications port and capabilities to be connected to the following serial communication protocols at no additional cost and without a need to install any additional hardware or software in the VFD:
1. BACnet IP
 2. Option board only
- B. Option boards for the following protocols shall be available:
-

1. BACnet Expanded
 2. Ethernet
 3. LonWorks Free Topology (FTP) certified to LonMark standard 3.3
- C. VFD shall have standard USB port for direct connection of Personal Computer (PC) to the VFD.
1. The manufacturer shall provide no-charge PC software to allow complete setup and access of the VFD and logs of VFD operation through the USB port.
 2. It shall be possible to communicate to the VFD through this USB port without interrupting VFD communications to the building management system.
- D. The VFD shall have provisions for an optional 24 V DC back-up power interface to power the VFD's control card. This is to allow the VFD to continue to communicate to the building automation system even if power to the VFD is lost.

2.8 ADJUSTMENTS

- A. The VFD shall have a manually adjustable carrier frequency to allow the user to select the desired operating characteristics. The VFD shall also be programmable to automatically reduce its carrier frequency to avoid tripping due to thermal loading.
- B. Four independent setups shall be provided.
- C. Four preset speeds per setup shall be provided for a total of 16.
- D. Each setup shall have two programmable ramp up and ramp down times. Acceleration and deceleration ramp times shall be adjustable over the range from 1 to 3,600 seconds.
- E. Each setup shall be programmable for a unique current limit value.
1. If the output current from the VFD reaches this value, any further attempt to increase the current produced by the VFD will cause the VFD to reduce its output frequency to reduce the load on the VFD.
 2. If desired, it shall be possible to program a timer which will cause the VFD to trip off after a programmed time period.
- F. If the VFD trips on one of the following conditions, the VFD shall be programmable for automatic or manual reset: external interlock, under-voltage, over-voltage, current limit, over temperature, and VFD overload.
- G. The number of restart attempts shall be selectable from 0 through 20 or infinitely and the time between attempts shall be adjustable from 0 through 600 seconds.
- H. An automatic "start delay" may be selected from 0 to 120 seconds. During this delay time, the VFD shall be programmable to either apply no voltage to the motor or apply a DC braking current if desired.
- I. Four programmable critical frequency lockout ranges to prevent the VFD from operating the load at a speed that causes vibration in the driven equipment shall be provided. Semi-automatic setting of lockout ranges shall simplify the set-up.

2.9 OPTIONAL FEATURES

- A. All optional features shall be built, mounted and tested by the VFD manufacturer.

1. The VFD manufacturer's warranty shall apply to the entire assembly as shipped.
 2. Packages built by third parties and do not carry the VFD manufacturer's warranty shall not be allowed.
 3. All options shall carry a UL / C-UL Enclosed Industrial Control Panel label.
 4. All panels shall be marked for 100,000 amp short circuit current rating.
- B. The enclosure rating of the VFD w/ options shall be consistent with the VFD rating of either NEMA/UL type 1 or NEMA/UL type 12, as required for the installation location and/or as called for on the schedule.
1. The package shall include ALL optional devices and shipped as a complete factory tested assembly.
- C. Three Contactor bypass shall be provided that allows operation of the motor via line power in the event of a failure of the VFD.
1. Motor control selection shall be through either a VFD output contactor or a bypass contactor that is electrically interlocked to ensure that both contactors are not energized simultaneously.
 2. A third contactor, the drive input contactor, shall be supplied as standard.
 3. This allows the powering of the VFD with the motor off or operating in bypass mode for testing, programming and troubleshooting purposes.
- D. The Three Contactor bypass shall include the following interface and control features:
1. Mode selection via a four position DRIVE/OFF/BYPASS/TEST switch.
 2. DRIVE Mode: Both the drive input and output contactors are closed and the motor is operated via VFD power
 3. OFF mode: DRIVE input, drive output and bypass contactors are all open.
 4. Bypass mode: Bypass contactor is closed and motor is operating from line power. Both the drive input and drive output contactors are open for servicing of the VFD without power.
 5. Test mode: Bypass contactor is closed and the motor is operated from line power. The drive input contactor is closed but the drive output contactor is open. This allows for the testing and programming of the VFD while the motor is operated via line power.
- E. Contactors shall operate from a 24vdc power supply that shall function off of any two legs of the AC line and shall maintain power on the loss of any one of the AC lines.
- F. A Bypass pilot light is supplied to indicate that the motor is operating from line power.
- G. Common start/stop command when operating in either Bypass or VFD mode.
- H. Selectable Run Permissive logic shall operate in either VFD or bypass operation.
1. When activated, any command to start the motor, in either Hand Bypass, Remote Bypass, Hand VFD or Remote VFD shall not start the motor, but instead close a relay contact that is used to initiate operation of another device, such as an outside air damper.
 2. A contact closure from this device shall confirm that it is appropriately actuated and the motor shall then start.

- I. Bypass package shall include an External Safety interlock that will disable motor operation in either bypass or VFD when open.
- J. Fire-mode bypass operation shall be standard.
 - 1. When activated via a contact closure, the motor shall transfer to bypass (line power) regardless of the mode selected.
 - 2. All calls to stop the motor shall be ignored.
 - 3. These include the opening of the start command, an external safety trip or the tripping of the motor overload.
 - 4. Fire-mode operation will take precedence over all other commands.
- K. The bypass must include a selectable time delay of 0 to 60 seconds before the initiation of bypass operation.
 - 1. When transferring from VFD to bypass modes, the time delay starts after the motor has decelerated to zero speed.
 - 2. This delay allows the BAS to prepare for bypass operation.
 - 3. Bypass packages that do not include a time delay, or do not include a selectable delay period, will not be acceptable.
- L. Automatic bypass shall be selectable.
 - 1. When active, the motor shall be transferred to line power on a VFD fault condition.
 - 2. The bypass time delay shall be activate prior to this transfer to line power to allow the VFD time to attempt to recover from the fault condition prior to running in bypass.

2.10 PROTECTIVE FEATURES

- A. Main input disconnect shall be provided that removes power from both the bypass and VFD.
- B. Main input motor rated fuses that protect the entire package.
- C. VFD only fast acting input fuses shall be provided. Packages that include only main input motor rated fusing or circuit breaker are not acceptable.
- D. Overload protection shall be supplied in bypass mode.
- E. This overload shall supply minimum class 20 protection as well as wide adjustable current setting for complete motor protection when operating on line power.
 - 1. Those overloads that are not class 20 or current selectable will not be acceptable.
- F. Overload protection shall include phase loss and phase imbalance protection.
- G. For 460V/600V units 75 Hp and below and 208V/230V units 40 Hp and below, low voltage contactor operation shall be maintained down to 70% of the unit's nominally rated voltage, to ensure VFD operation.
- H. For 460V/600V units 75 Hp and below and 208V/230V units 40 Hp and below, the VFD shall be able to operate the motor at a reduced load with the loss of any one of the three phases of power.

1. Contactors shall remain closed regardless of which phase is lost to ensure VFD operation.

2.11 LINE/LOAD CONDITIONERS

- A. VFDs that do not include 5% DC link impedance shall include 5% AC line reactors in the options enclosure. Lower levels of impedance will not be acceptable.

2.12 SERVICE CONDITIONS

- A. Ambient temperature, continuous, full speed, full load operation:
 1. 14 to 113°F on Non-Bypass units
 2. 14 to 104°F on Bypass units
 3. 5 to 95% relative humidity, non-condensing.
 4. Elevation to 3,300 feet without derating.
 5. AC line voltage variation, -10 to +10% of nominal with full output.
 6. All power and control wiring shall be from the bottom.
 7. All VFDs shall be plenum rated.

2.13 QUALITY ASSURANCE

- A. To ensure quality, the complete VFD shall be tested by the manufacturer. The VFD shall drive a motor connected to a dynamometer at full load and speed and shall be cycled during the automated test procedure.
- B. All optional features shall be functionally tested at the factory for proper operation.

PART 3 EXECUTION

3.1 START-UP SERVICE

- A. The manufacturer shall provide start-up commissioning of the VFD and its optional circuits by a factory certified service technician who is experienced in start-up and repair services.
- B. Sales personnel and other agents who are not factory certified shall not be acceptable as commissioning agents.
- C. Start-up services shall include checking for verification of proper operation and installation for the VFD, its options and its interface wiring to the building automation system.
- D. Harmonic filtering.
 1. The VFD supplier shall, with the aid of the buyer's detailed electrical power single line diagram showing all impedances in the power path to the VFDs, perform an analysis to initially demonstrate the supplied equipment will meet the IEEE recommendations after installation.
 2. If, as a result of the analysis, it is determined that additional filter equipment is required to meet the IEEE recommendations, then the cost of such equipment shall be included in the drive supplier quotation.

3.2 WIRING

- A. All wiring from the load size of VFDs to the motor terminals shall be VFD cable.
- B. Cable shall have the following characteristics:
 - 1. UL listed to 1277 and 2277
 - 2. Type RHH/RHW-2 insulation, 90 deg C
 - 3. Three phase conductors and one green ground with yellow stripe cross linked insulation. Size equal to phase conductor.
 - 4. 600 Volt
 - 5. Shielding: 100% coverage Alum/Mylar/Alum Foil, overall 85% coverage tinned copper braid
 - 6. Jacket: Black thermoplastic elastomer TPE
- C. Manufacturers:
 - 1. Southwire
 - 2. General Cable
 - 3. Belden

3.3 WARRANTY

- A. The complete VFD shall be warranted by the manufacturer for a period of 36 months from date of shipment.
 - 1. The warranty shall include parts, labor, travel costs and living expenses incurred by the manufacturer to provide factory authorized on-site service.
 - 2. The warranty shall be provided by the VFD manufacturer and not a third party.
 - 3. A written warranty statement shall be provided with the submittals.

END OF SECTION 23 09 33

**SECTION 23 11 23
FACILITY NATURAL-GAS PIPING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe, pipe fittings, valves, and connections for natural gas piping systems.

1.2 REFERENCE STANDARDS

- A. ANSI Z21.18/CSA 6.3 - Gas Appliance Pressure Regulators; 2019.
- B. ANSI Z21.80/CSA 6.22 - Line Pressure Regulators; 2019.
- C. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2021.
- D. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.
- E. ASME B31.1 - Power Piping; 2022.
- F. ASME B31.9 - Building Services Piping; 2020.
- G. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- H. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2023a.
- I. MSS SP-78 - Gray Iron Plug Valves, Flanged and Threaded Ends; 2011.
- J. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .

1.3 SUBMITTALS

- A. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
- B. Welder Certificate: Include welders certification of compliance with ASME BPVC-IX.
- C. Shop Drawings: For non-penetrating rooftop supports, submit detailed layout developed for this project, with design calculations for loadings and spacings.

1.4 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.
- D. Identify pipe with marking including size, ASTM material classification, and ASTM specification.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.1 NATURAL GAS PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M, Schedule 40 black.
 - 1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
 - 2. Joints: Threaded (2 inch and under only) or welded to ASME B31.1.

2.2 FLANGES, UNIONS, AND COUPLINGS

- A. Unions for Pipe Sizes 2 Inches and Under:
 - 1. Ferrous pipe: Class 150 malleable iron threaded unions.
- B. Flanges for Pipe Size Over 2 Inch:
 - 1. Ferrous Pipe: Class 150 forged steel slip-on flanges; preformed neoprene gaskets.
- C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.3 PIPE HANGERS AND SUPPORTS

- A. Provide hangers and supports that comply with MSS SP-58.
 - 1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
 - 2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
 - 3. Trapeze Hangers: Welded steel channel frames attached to structure.
 - 4. Vertical Pipe Support: Steel riser clamp.

2.4 BALL VALVES

- A. Manufacturers:
 - 1. Conbraco Industries, Inc
 - 2. Grinnell Products, a Tyco Business
 - 3. Milwaukee Valve Company
 - 4. Nibco, Inc

5. Viega LLC
 6. Apollo
 7. Or pre-approved equal
- B. Construction, 4 Inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze or ductile iron body, 304 stainless steel ball, regular port, Teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, threaded or grooved ends with union.

2.5 PLUG VALVES

- A. Construction 2-1/2 Inches and Larger: MSS SP-78, 175 psi CWP, cast iron body and plug, pressure lubricated, Teflon or Buna N packing, flanged or grooved ends. Provide lever operator with set screw.

2.6 STRAINERS

- A. Manufacturers:
1. Armstrong International, Inc
 2. Green Country Filter Manufacturing
 3. WEAMCO
 4. Or pre-approved equal
- B. Size 2 inch and Under:
1. Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
 2. Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
- C. Size 1-1/2 inch to 4 inch:
1. Class 125, flanged iron body, Y pattern with 1/16 inch stainless steel perforated screen.

2.7 LINE PRESSURE REGULATORS AND APPLIANCE REGULATORS INDICATORS

- A. Manufacturers:
1. Actaris Metering Systems (A brand of ITT Controls)
 2. Dungs Combustion Controls
 3. Maxitrol Company
 4. Or pre-approved equal
- B. Compliance Requirements:
1. Appliance Regulator: ANSI Z21.18/CSA 6.3.
 2. Line Pressure Regulator: ANSI Z21.80/CSA 6.22.
- C. Materials in Contact With Gas:

1. Housing: Aluminum, steel (free of non-ferrous metals).
 2. Seals and Diaphragms: NBR-based rubber.
- D. Maximum Inlet Operating Pressure: 10 psi.
1. Appliance Regulator: 10 psi.
 2. Line Pressure Regulator: 10 psi.
- E. Maximum Body Pressure: 10 psi.
- F. Output Pressure Range: 1 inch wc to 80 inch wc.

PART 3 EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- D. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- G. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- H. Install valves with stems upright or horizontal, not inverted.
- I. Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.
- J. Sleeve pipes passing through partitions, walls and floors.
- K. Pipe Hangers and Supports:
 1. Install in accordance with ASME B31.9.
 2. Place hangers within 12 inches of each horizontal elbow.
 3. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.3 APPLICATION

- A. Install unions downstream of valves and at equipment or apparatus connections.
- B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- C. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

3.4 SCHEDULES

- A. Pipe Hanger Spacing:
 - 1. Metal Piping:
 - a. Pipe Size: 1/2 inches to 1-1/4 inches:
 - 1) Maximum Hanger Spacing: 6.5 ft.
 - 2) Hanger Rod Diameter: 3/8 inches.
 - b. Pipe Size: 1-1/2 inches to 2 inches:
 - 1) Maximum Hanger Spacing: 10 ft.
 - 2) Hanger Rod Diameter: 3/8 inch.
 - c. Pipe Size: 2-1/2 inches to 3 inches:
 - 1) Maximum Hanger Spacing: 10 ft.
 - 2) Hanger Rod Diameter: 1/2 inch.
 - d. Pipe Size: 4 inches to 6 inches:
 - 1) Maximum Hanger Spacing: 10 ft.

END OF SECTION 23 11 23

**SECTION 23 21 13
HYDRONIC PIPING****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Hydronic system requirements.
- B. Heating water piping, above grade.
- C. Chilled water piping, buried.
- D. Chilled water piping, above grade.
- E. Equipment drains and overflows.
- F. Pipe hangers and supports.
- G. Unions, flanges, mechanical couplings, and dielectric connections.

1.2 REFERENCE STANDARDS

- A. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2021.
- B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.
- C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- D. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- E. ASME B31.9 - Building Services Piping; 2020.
- F. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- G. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2023a.
- H. ASTM B32 - Standard Specification for Solder Metal; 2020.
- I. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2020.
- J. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- K. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2021a.
- L. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series); 2020.
- M. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2023.
- N. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80; 2020.

- O. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2020.
- P. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 1992 (Reapproved 2022).
- Q. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications; 2007 (Reapproved 2019).
- R. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2019.
- S. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2022).
- T. AWWA C606 - Grooved and Shouldered Joints; 2015.
- U. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).

1.3 SUBMITTALS

- A. Welders Certificate: Include welders certification of compliance with ASME BPVC-IX.
- B. Product Data:
 - 1. Include data on pipe materials, pipe fittings, valves, and accessories.
 - 2. Indicate valve data and ratings.
 - 3. Show grooved joint couplings, fittings, valves, and specialties on drawings and product submittals, specifically identified with the manufacturer's style or series designation.
- C. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
- D. Submit Flushing and Cleaning Plan:
 - 1. All new hydronic piping shall be flushed and cleaned
 - 2. Submit pipe flushing/cleaning plan for piping systems (chilled water, heating hot water, etc.) for approval. The plan shall include detailed methods for compliance with requirements of this section, including:
 - a. Flushing and cleaning procedure narratives.
 - b. Size, power source, and connection points of contractor provided pumps that will be used for flushing and cleaning. Use of new or existing building pumps for flushing/cleaning systems will NOT be permitted.
 - c. At all new coils, provide temporary flushing bypass lines.
 - d. For existing coils on other areas of the floor, contractor shall provide a means to bypass coils to ensure system can be flushed clean. This may involved isolating individual coils for initial flush of mains, followed by individual flush at strainer blowdowns for secondary flush.
 - e. Remove critical components (control valves, water meters, etc.) that could be damaged and provide temporary spool pieces in piping and provide temporary bypass around coils which could be damaged by circulating debris.

- f. Flushing schedule and drawings or diagrams to be used shall be signed off by Engineer, CxA, and Owner.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section with minimum five years of experience.
- C. Welder Qualifications: Certify in accordance with ASME BPVC-IX.
 - 1. Provide certificate of compliance from authority having jurisdiction, indicating approval of welders.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation. Duct tape will NOT be considered suitable pipe end protection.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.6 FIELD CONDITIONS

- A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.1 HYDRONIC SYSTEM REQUIREMENTS

- A. Comply with ASME B31.9 and applicable federal, state, and local regulations.
- B. Piping: Provide piping, fittings, hangers, and supports as required, as indicated, and as follows:
 - 1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
 - 2. Use only long radius elbows having centerline radii of 1.5 pipe diameters unless otherwise indicated.
 - 3. Where size for a pipe segment is not indicated, the pipe segment shall be equal to the largest pipe segment to which it is connected. Transition to smaller size shall occur on the side of the fitting where smaller size is indicated.
 - 4. Unless otherwise indicated, fittings and accessories connected to pipe shall be of the same material as the pipe.
 - 5. Use non-conducting dielectric connections whenever joining dissimilar metals.
 - a. On 2" piping and smaller, it is permissible to use ball valves in lieu of dielectric unions.

- C. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.
- D. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.
 - 1. Where grooved joints are used in piping, provide grooved valve/equipment connections if available; if not available, provide flanged ends and grooved flange adapters.
- E. Valves: Provide valves where indicated:
 - 1. Provide drain valves where indicated, and if not indicated provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use 3/4 inch ball valves with cap; pipe to nearest floor drain.
 - 2. Isolate equipment using butterfly valves with lug end flanges or grooved mechanical couplings.
 - 3. For shut-off and to isolate parts of systems or vertical risers, use ball or butterfly valves.
- F. Welding Materials and Procedures: Comply with ASME BPVC-IX.

2.2 HEATING WATER PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M, Type E for pipe getting welded, Schedule 40, black, using one of the following joint types:
 - 1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
 - 2. Threaded Joints: ASME B16.3, malleable iron fittings. 2 inch and under only.
- B. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), hard drawn, using one of the following joint types:
 - 1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.
 - a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
 - b. Braze: AWS A5.8M/A5.8 BCuP copper/silver alloy.
 - 2. Copper tube may be used on 2" pipe size and under.

2.3 CHILLED WATER PIPING, BURIED

- A. Pre-insulated Steel Piping System. All pre-insulated pipe, fittings, insulating materials, and technical support shall be provided by the Pre-insulated Piping System manufacturer.
- B. Carrier Piping: Steel ASTM A-53, Grade B., ERW (Type E) or seamless (Type S), standard weight for sizes 2" and larger, and shall be ASTM A-106/ A-53, seamless, standard weight for sizes 1-1/2" and smaller (Std. Wt. is the same as Sch. 40 through 10"). When practical, piping shall be provided in 40-foot double-random lengths. All carbon steel pipe shall have ends cut square and beveled for butt-welding. Straight sections of factory insulated pipe shall have 6" of exposed pipe at each end for field joint fabrication and welding.
- C. Insulation: Insulation shall be polyurethane foam either spray applied or injected with one shot into the annular space between carrier pipe and jacket. Insulation shall be rigid, 90% minimum closed cell polyurethane with a minimum 2.0 lbs per cubic foot density, compressive strength of 30 psi, and coefficient of thermal conductivity (K-Factor) of not higher than 0.18 @ 75°F per ASTM C-518. Maximum operating temperature shall not exceed 250°F. Insulation thickness shall be minimum 2".

- D. Jacketing material shall be extruded, black, high density polyethylene (HDPE), having a wall thickness not less than 100 mils for jacket sizes less than or equal to 12", 125 mils for jacket sizes larger than 12" to 24", and 150 mils for jacket sizes greater than 24". No tape jacket allowed. The inner surface of the HDPE jacket shall be oxidized by means of corona treatment, flame treatment, or other approved methods. This will ensure a secure bond between the jacket and foam insulation preventing any ingress of water at the jacket/ foam interface.
- E. Straight run joints shall be field-insulated per the manufacturer's instructions, using polyurethane foam poured in an HDPE sleeve and sealed with heat shrink sleeve. All joint closures and insulation shall occur at straight sections of pipe. All insulation and jacketing materials shall be furnished by the piping system manufacturer.
- F. Fittings are shall be factory pre-fabricated and pre-insulated fittings with poly-urethane foam to the thickness specified and jacketed with a one-piece seamless molded HDPE fitting cover, a butt fusion welded, or an extrusion welded and mitered HDPE jacket. Carrier pipe fittings shall be butt-welded, except sizes smaller than 2" shall be socket-welded. (At the Engineer's option, fittings can be pre-fabricated/ pre-engineered.) Fittings include expansion loops, elbows, tees, reducers, and anchors. Elbows, loops, offsets, or any other direction changes shall conform to the standards set by ASME B31.1, Code for Power Piping.
- G. Expansion/ contraction compensation will be accomplished utilizing factory pre-fabricated and pre-insulated expansion elbows, Z-bends, expansion loops, and anchors specifically designed for the intended application. External expansion compensation utilizing flexible expansion pads (minimum one inch thickness), extending on either side, both inside and outside the radius of the fittings are used with all fittings having expansion in excess of 3/4".
- H. Underground systems shall be buried in a trench of not less than 24 inches deeper than the top of the pipe jacket and not less than 18" wider than the combined O.D. of all piping systems. Back-fill should be tamped compactly in place. No rock shall be used in the first foot of back-fill. Twenty-four (24) inches from top of jacket to grade of compacted fill will meet H-20 highway loading.
- I. Manufacturers:
 - 1. Energy Task Force
 - 2. Insul-Tek
 - 3. Thermacor

2.4 CHILLED WATER PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M, Type E for pipe getting welded, Schedule 40, black; using one of the following joint types:
 - 1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
 - 2. Threaded Joints: ASME B16.3, malleable iron fittings. Only for 2 inch and under.
- B. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), hard drawn; using one of the following joint types:
 - 1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22, solder wrought copper fittings.
 - a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
 - b. Braze: AWS A5.8M/A5.8 BCuP copper/silver alloy.
 - 2. Copper tube may be used on 2" pipe size and under.

2.5 EQUIPMENT DRAINS AND OVERFLOWS

- A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn; using one of the following joint types:
 - 1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings; ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
 - 2. Copper pipe shall be used for all condensate and other drains, except condensing boiler drains.
- B. PVC Pipe: ASTM D1785, Schedule 40, or ASTM D2241, SDR 21 or 26.
 - 1. Fittings: ASTM D2466 or D2467, PVC.
 - 2. Joints: Solvent welded in accordance with ASTM D2855.
 - 3. PVC pipe shall only be used for condensing boiler and condensing furnace drains.

2.6 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
 - 1. Cooper B-Line
 - 2. Anvil International
 - 3. PHD
- B. All hangers, supports, and hardware shall have hot-dip galvanized finish complying with ASTM A123 or ASTM A153. Epoxy plated or coated hardware will NOT be accepted.
- C. Comply with Federal Specification WW-H-171E & A-A-1192A.
- D. Hangers shall be UL Listed and FM Approved.
- E. Refer to the Structural Drawngs and Details for the limitations and applications of each type of hanger and weight when attaching to bar joists, trusses, or other building Structural elements. The Contractor shall be responsible for providing additional miscellaenous steel, unistrut, and other components to span multiple joists as required by the Structural Drawings to distribute concentrated loads.
- F. Provide hangers and supports that comply with MSS SP-58 and MSS SP-69.
 - 1. Pipe Hangers for Hot and Chilled Water 6" and smaller: Cooper B3100, Anvil Fig. 260, or equivalent.
 - 2. Hangers for Hot Pipe 8" and larger: Adjustable steel yoke, cast iron roll, double hanger. Cooper B3110, Anvil Fig. 181, or equivalent.
 - 3. Riser Clamps: Cooper B3373, Anvil Fig. 40, or equivalent.
 - 4. Beam Clamps: Cooper B3050, Anvil Fig. 134, or equivalent.
 - 5. Offset Clamps: Cooper B3148, Anvil Fig. 103, or equivalent.
 - 6. Ceiling Plate: Cooper B3199, Anvil Fig. 610, or equivalent.
 - 7. Wall Brackets: Cooper B3067, Anvil Fig. 199, or equivalent.
 - 8. Rod Ceiling Plate: Cooper, Anvil Fig. 610, or equivalent.

9. Concrete Inserts: Cooper B2500, Anvil Fig. 95 or equivalent.
 10. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 11. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded. Cooper B3205, Anvil Fig. 146, or equivalent.
- G. All hangers, rods, and other hardware shall be hot-dip galvanized, except where copper plated for copper piping.
- H. Pipe Saddles:
1. Manufacturers
 - a. Buckaroos
 - b. GLT Products
 - c. PHD
 2. Length
 - a. 12" for piping up to 4"
 - b. 18" for 6"
 - c. 24" for piping up to 14"
 3. Comply with MSS SP-58
 4. Galvanized G-90 finish

PART 3 EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment using jointing system specified.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- E. After completion, fill, clean, and treat systems. See Section 23 25 00 for additional requirements.

3.2 PRESSURE TESTS

- A. Piping pressure tests shall be required on all new piping.
 1. Where connecting to existing systems, segregate new piping from existing system and provide isolation valves as required for testing.
- B. Coordinate pressure tests with the Engineer and Owner at least 72 hours in advance. Engineer, Owner, and CxA may choose to witness the pressure test. If Owner and Engineer decide not to witness a specific test, the Construction Manager/General Contractor shall witness the test and sign off.

-
- C. Conduct pressure tests prior to flushing and cleaning of piping systems.
 - D. Pressure tests may be made of isolated portions of the piping systems to facilitate general progress of the installation. Changes made in the piping system shall require retesting of the affected portions.
 - E. No system or part of the system shall be insulated until it has been successfully tested. If required for additional pressure load under test, provide temporary restraints at expansion joints or isolate them during test.
 - F. All hydronic piping shall be hydrostatically tested to 150 psi for a period of four (4) hours minimum.
 - 1. Use ambient temperature water as a testing medium unless there is a risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used if approved by the Engineer.
 - 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 - 3. Subject piping system to hydrostatic test pressure. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 - 4. RECORD THE INITIAL TEST PRESSURE AND THE FINAL PRESSURE AT END OF TEST PERIOD.
 - 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 - 6. No pressure drop shall occur during test period.
 - 7. Prepare written report of testing.
 - G. Provide pumps, appropriately scaled gauges, calibrated instruments and test equipment, temporary piping, and personnel for tests. Remove all test equipment and drain pipes after completion of testing.
 - H. If piping system is drained after testing and left empty or untreated for more than 3 days, add Nalco 2572 or equivalent at recommended dosages for dry system lay-up.

3.3 FLUSHING AND CLEANING OF PIPING SYSTEMS

- A. Notify Engineer and Owner/CxA at least four (4) days in advance. Do not flush any piping system or portion thereof without prior submission and approval of flushing and cleaning plan.
- B. General:
 - 1. All hydronic piping systems shall be tested and flushed. All temporary equipment, utilities, and materials, including water, required to perform the tests and flushing shall be the responsibility of the contractor. Tests and flushes shall be witnessed by the Engineer or Owner's representative. The contractor shall perform pre-testing so that the Engineer may witness the final test and flush only. If more than one test and flush are required, contractor shall schedule these with the Engineer's site observation schedule. Submit contractor's testing and flushing plan, indicating how the system will be divided for flushing, chemical injection points, temporary bypass piping, temporary drains, etc.
 - 2. Test fluid shall be clean water
 - 3. Flush fluid shall be clean water with listed cleaning chemicals

4. Fill fluid shall be clean water

C. Flushing and Fill:

1. Flush entire piping system until clean. Flush velocity shall be minimum of 5 fps through all sections of the system.
2. Contractor shall provide portable pumping apparatus. Provide temporary materials, valves, equipment, and infrastructure, required to create bypass(es) for a closed system to perform flush(es). Bypass permanent building pumps during flush. Remove any devices that could be clogged or damaged prior to flushing. Provide a grade 18-8 stainless steel screen with 3/16 inch diameter holes at 18 holes per square inch in system strainers. Install #100 mesh startup liner in system strainer with metal screen. Operate valves as necessary to ensure all sections of the system are flushed for the required time period.
3. Provide temporary piping to bypass coils, control valves, and other factory cleaned equipment, as wells as equipment subject to damage.
4. Dissolve the following chemicals in the system (listed in pounds per 1,000 gallons of system water):
 - a. EDTA 40 lbs
 - b. CITRIC ACID 35 LBS
 - c. SURFACTANT 4 ounces product: Tritan DF-16 or equivalent low-foaming surfactant
5. After initial 12 hours of flushing, screens and strainers shall be pulled, checked, and cleaned. Flushing shall then continue for another 12 hours. At the end of 24 hours, if strainers are still showing debris, continue flushing for 6 additional hours. System shall be flushed for a minimum of 24 hours and up to 30 hours as required.
6. After completion of cleaning solution flushing, the system shall be completely drained to sanitary sewer. Flush with clean water. If the system cannot be drained completely, put a bleed on system and add clean water until system test at a pH of 6.8 to 7.4.
7. Remove all temporary materials and bypass piping.
8. Apply corrosion control chemicals with 2-3 days of flushing and cleaning procedure. Submit reports confirming concentration.
9. Retesting and flushing
 - a. Any changes made to the piping systems after testing and/or flushing shall require retesting and flushing of the affected portions of the system. If any portion of the piping system is exposed to dirt or debris after the flush, it shall be re-flushed.
10. Contractor Certification
 - a. Provide a letter to the Engineer and Owner certifying the tests and flushes were performed in accordance with the specifications, what the final results were, and what the intermediate results were. The contractor's representative shall sign and date. A copy shall be placed in the O&Ms.
11. The Engineer or Owner/CxA shall review the test and flush results prior to opening a new portion of piping to a previously approved portion or an existing system. If the supporting documentation is not reviewed by the Engineer prior to opening, the entire system shall be flushed again.

3.4 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.
- C. Route piping in orderly manner, parallel to building structure, and maintain gradient.
- D. Install piping to conserve building space and to avoid interference with use of space.
- E. Group piping whenever practical at common elevations.
- F. Sleeve pipe passing through partitions, walls, and floors.
- G. Unless otherwise indicated, horizontal piping may be installed level or with a pitch up at 1" per 40' in direction of flow. Install manual air vents at all high points where air may collect. If vent is not in accessible location, extend air vent to nearest code acceptable drain location with vent valve located at nearest accessible location to pipe. Terminate vent valve within two feet above ceiling in accessible location.
- H. Main branches and runouts to terminal equipment shall be made at top (first choice) or top 45 degree (second choice), with drain valves suitably located for complete system drainage and manual air vents located as per above.
- I. Bottom connections to piping are not allowed under any circumstances, unless specifically approved by the Engineer on a case by case basis. If permitted by the Engineer, a line size Y-strainer with shutoff valve and blowdown valve shall be installed at branch connection.
- J. Mitered elbows, welded branch connections, notched tees, and "orange peel" reducers are not allowed. Unless specifically indicated, reducing flanges and reducing bushing are not allowed. Reducing bushings may be used for air vents and instrumentation connections.
- K. Contractor shall provide all manual air vents and drains (air vents at high points, drains at low points) in order to allow for appropriate air venting and to permit complete drainage of the entire system.
- L. Cut threads so that no more than 3 threads remain exposed after joint is made. Apply thread sealants to cleaned male ends. Assemble joint to appropriate depth and remove any excess pipe joint compound from tightened joint.
- M. Install valves, control valves, and piping specialties, including items furnished by others, as specified and/or detailed.
- N. Make connections to equipment installed by others where said equipment requires piping services indicated in this section.
- O. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified.
- P. Slope piping and arrange to drain at low points.
- Q. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. See Section 23 05 16.
- R. Welded Joints:
 - 1. Use weld material diameter as procedurally required for type and thickness of work being done.

2. Use sufficient argon pre-purge and argon post-purge for GTAW processes.
3. Clean tacks before welding out. Remove slag after each pass by grinding to avoid slag inclusion.
4. Weld reinforcement shall not exceed limits established in ASME B31.1
5. Brush each weld free of rust and paint with rust resistant product that matches surface color.

S. Inserts:

1. Provide inserts for placement in concrete formwork.
2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

T. Pipe Hangers and Supports:

1. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58.
2. Support horizontal piping as scheduled.
3. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Use hangers with 1-1/2 inches minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
8. Provide copper plated hangers and supports for copper piping.
9. Cut hanger rods to within 1" of nut.
10. At VAV boxes and other terminal units, piping shall be supported within 3 ft of connection to the equipment.
11. Prime coat exposed steel hangers and supports. See Section 09 9123. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

U. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. See Section 23 07 19.

V. Provide access where valves and fittings are not exposed. Coordinate access panel locations with Architect

- W. Install valves with stems upright or horizontal, not inverted.
- X. All trapeze hanger rods shall be cut to within 1" of the bottom nut.

END OF SECTION 23 21 13

**SECTION 23 21 14
HYDRONIC SPECIALTIES**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Expansion tanks.
- B. Air vents.
- C. Air separators.
- D. Strainers.
- E. Suction diffusers.
- F. Pump connectors.
- G. Combination pump discharge valves.
- H. Pressure-temperature test plugs.
- I. Balancing valves.
- J. Automatic flow control valves.
- K. Relief valves.

1.2 REFERENCE STANDARDS

- A. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2023.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.4 SUBMITTALS

- A. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description and model.
- B. Certificates: Inspection certificates for pressure vessels from authority having jurisdiction.
- C. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.1 EXPANSION TANKS

- A. Manufacturers:
 - 1. Amtrol Inc
 - 2. Armstrong
 - 3. ITT Bell & Gossett
 - 4. Nexus
 - 5. Taco, Inc
 - 6. Or Approved Equal
- B. Acceptance Volume Capacity: As indicated on drawings.
- C. Maximum Rated Working Pressure: 150 psi.
- D. Maximum Allowable Service Temperature: 240 degrees F.
- E. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, adjustable flexible EPDM diaphragm or bladder seal factory precharged to 12 psi, and steel support stand.
- F. Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced pressure double check backflow preventer, test cocks, strainer, vacuum breaker, and valved by-pass.
- G. Accessories: Provide air-charging fitting, bulls eye sight glass, pressure gauge, and tank drain ball valve.

2.2 AIR VENTS

- A. Manufacturers:
 - 1. American Wheatley
 - 2. Armstrong International, Inc
 - 3. ITT Bell & Gossett
 - 4. Taco, Inc
 - 5. Or Approved Equal

-
- B. Manual Air Vent: Short vertical sections of 2-inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.
 - C. Float Air Vent:
 - 1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.
 - D. Provide where shown, and high points in system, and wherever air traps might occur in the piping system. All down feed water risers shall have air vents. Provide access to all air vents.
 - E. Maximum Fluid Pressure: 150 psi.
 - F. Maximum Fluid Temperature: 250 degrees F.

2.3 AIR SEPARATORS

- A. Coalescing Air/Dirt Separators:
 - 1. Manufacturers:
 - a. American Wheatley
 - b. Armstrong International, Inc
 - c. Caleffi
 - d. ITT Bell & Gossett
 - e. Nexus
 - f. Spirotherm, Inc
 - g. Taco
 - h. Or Approved Equal
 - 2. Tank: Fabricated steel tank; tested and stamped in accordance with ASME BPVC-VIII-1 for maximum fluid service subject to application requirements and manufacturer's standard maximum operating conditions.
 - 3. Coalescing Medium: Provide structured copper or stainless steel medium filling the entire vessel to suppress turbulence and provide air elimination efficiency of 100 percent free air, 100 percent entrained air, and 99.6 percent dissolved air at the installed location.
 - 4. Air Vent: Integral float actuated air vent at top fitting of tank rated at 150 psi, threaded to top of separator.
 - 5. End Connections: Class 150 flanged for 2-1/2 inch and larger otherwise threaded.
 - 6. Blowdown Connection: Threaded.
 - 7. Size: Match system flow capacity.
 - 8. Maximum Fluid Service Pressure: 150 psi.

9. Maximum Fluid Service Temperature: 250 degrees F.

2.4 STRAINERS

A. Manufacturers:

1. American Wheatley
2. Armstrong International, Inc
3. Flexicraft Industries
4. Grinnell Products, a Tyco Business
5. The Metraflex Company
6. Victaulic Company of America
7. Or Approved Equal

B. Size 2 inch and Under:

1. Provide threaded or sweat brass or iron body for up to 175 psi working pressure, Y-pattern strainer with 1/32 inch stainless steel perforated screen.
2. Body Material by Fluid Service:
 - a. Cast Iron or Brass:
 - 1) Steam: Up to 250 psi at 450 degrees F.
 - 2) Liquids: Up to 400 psi at 150 degrees F.

C. Size 2-1/2 inch to 4 inch:

1. Provide flanged iron body for 175 psi working pressure, Y pattern with 1/16 inch #304 stainless steel perforated screen.

D. Size 5 inch and Larger:

1. Provide flanged iron body for 175 psi working pressure, basket pattern with 1/8 inch stainless steel perforated screen.

E. Accessories: Provide air vent, hanging tag, outlet ball valve, and PT test plug extension.

F. Each strainer shall be equipped with a short nipple and gate valve for blowdown.

2.5 SUCTION DIFFUSERS

A. Manufacturers:

1. Anvil International, Inc
2. Armstrong
3. Grinnell Products, a Tyco Business

-
4. ITT Bell & Gossett
 5. Keckley Company
 6. Taco
 7. Victaulic Company of America
 8. Watts
 9. Or Approved Equal
- B. Fitting: Angle pattern, cast-iron body, threaded for 2 inch and smaller, flanged for 2-1/2 inch and larger, rated for 175 psi working pressure, with inlet vanes, cylinder strainer with 3/16 inch diameter openings, disposable 5/32 inch mesh strainer to fit over cylinder strainer, 20 mesh startup screen, and permanent magnet located in flow stream and removable for cleaning.
- C. Performance: Suction diffusers shall be sized for a maximum 6 ft pressure drop at the design flow.
- D. Class 125:
1. Horizontally or vertically mounted angle-pattern fitting with integral-cast vanes, fine particle mesh stainless steel screen and magnetic drain plugs for particle removal without disassembly.
 2. Maximum Operating Service: 175 psi and 300 degrees F.
 3. Sizes, Material, and Connection:
 - a. 2 inch and Smaller: Cast iron body, threaded.
 - b. 2-1/2 to 12 inch: Ductile iron body, flanged.
- E. Accessories: Adjustable foot support, blowdown tapping in bottom, gauge tapping in side.

2.6 PUMP CONNECTORS

- A. Manufacturers:
1. Anvil International
 2. Ferguson Enterprises Inc
 3. The Metraflex Company
- B. Flexible Connectors: Flanged, braided type with wetted components of stainless steel, sized to match piping.
1. Accommodate the Following:
 - a. Axial Deflection in Compression and Expansion: 1.0 inch.
 - b. Lateral Movement: 0.5 inch.
 - c. Angular Rotation: 15 degrees.
 - d. Force developed by 1.5 times specified maximum allowable operating pressure.
 2. End Connections: Same as specified for pipe jointing.

3. Provide pump connector with integral vanes to reduce turbulent flow.
4. Provide necessary accessories including, but not limited to, swivel joints.

2.7 COMBINATION PUMP DISCHARGE VALVES

- A. Manufacturers:
1. Anvil International
 2. Crane Co.
 3. ITT Bell & Gossett
 4. Taco, Inc
 5. Victaulic Company of America
 6. Or Approved Equal
- B. Class 125:
1. Maximum Service Operation: 175 psi at 125 degrees F.
- C. Quarter-Turn Plug Type: Flanged cast-iron body with bolt-on bonnet, position indicator, stainless steel stem, backflow preventer, memory stop, metering connectors, bubble-tight shutoff, and wrench-adjustable plug flow regulator.
- D. Triple-Duty Globe Type: Grooved cast-iron angle pattern body with bolt-on bonnet, position indicator, non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, metering connectors, flow shutoff mechanism, and adjustable flow handle.
- E. Valves shall be sized with a maximum pressure drop of 5 feet at design flow rate and also allow a pressure drop of 25 feet when throttled.

2.8 PRESSURE-TEMPERATURE TEST PLUGS

- A. Manufacturers:
1. Ferguson Enterprises Inc
 2. Peterson Equipment Company Inc
 3. Sisco Manufacturing Company Inc
 4. Or Approved Equal
- B. Construction: Brass body designed to receive temperature or pressure probe with removable protective cap, and Neoprene rated for minimum 200 degrees F.
- C. Application: Use extended length plugs to clear insulated piping.

2.9 BALANCING VALVES

- A. Manufacturers:
1. Armstrong International, Inc

2. Caleffi
 3. Danfoss
 4. Griswold
 5. ITT Bell & Gossett
 6. Jomar
 7. Nexus
 8. Nibco
 9. Taco, Inc
 10. Victaulic
 11. Or Approved Equal
- B. Size 2 inch and Smaller:
1. Provide globe style with flow balancing, shut-off capabilities, memory stops, and minimum of two metering ports and female sweat, NPT threaded, press, or soldered connections.
 2. Metal construction materials consist of bronze.
 3. Non-metal construction materials consist of Teflon or EPDM.
 4. Maximum Service Operation: 300 psi at 250 degrees F.
- C. Size 2-1/2 inch and Larger:
1. Provide globe or butterfly style with flow balancing, shut-off capabilities, memory stops, and minimum of two metering ports and flanged or weld-end connections.
 2. Valve body construction materials consist of cast iron or ductile iron.
 3. Internal components construction materials consist of bronze.
 4. Maximum Service Operation: 175 psi at 250 degrees F.

2.10 CALIBRATED BALANCING VALVES

- A. Manufacturers:
1. Victaulic Company of America
 2. Armstrong International
 3. Tour & Anderson
 4. Grinnell
- B. All balancing valves shall be of globe style design to offer the widest range of adjustment accuracy in the flow rate. All balancing valves must offer a minimum of 720 degrees rotation of the handwheel for accurate adjustments and acceptable control range.

-
- C. All balancing valves shall exhibit accuracy in flow measurement of +/- 5% in the normal operating range of the valve.
 - D. All balancing valves shall have provisions for measuring differential pressure from both sides of the body, flow temperature, and flow rates. Also to include a 1/4" drain connection as an integral part of the valve body.
 - E. All balancing valves must offer 100% positive, leakproof shutoff against the same fluid pressure as the valve body pressure rating.
 - F. All balancing valves must offer a preset function with a locking device to prevent tampering and allow return to the original balanced setting after shutoff. This feature shall be hidden within the design of the valve.
 - G. All balancing valves 1/2" to 2" shall have a digital handwheel for display and presetting accuracy. A drain/fill connection with integral stop valve shall also be included on sizes up to 1 1/2". Sizes 2 1/2" to 12" shall have a ring scale sleeve under the handwheel for reading.
 - H. All balancing valves in sizes 1/2" to 2" shall be shipped in a container which shall be used as insulation after valve installation. The flame retardant insulation shall have an "R" value of 4.5 minimum.
 - I. All balancing valves in sizes 1/2" to 2" shall be manufactured in such a way which does not require dielectric fittings. Valves in sizes 2 1/2" to 12" shall be manufactured from ductile iron equivalent to ASTM-A536, GR-65, and 4542.
 - J. For valves 1/2" NPT to 12" grooved ends or flanged, the nominal ratings shall be 250 psig at 230 degrees F.
 - K. All balancing valves shall be sized so as to perform in a normal operating range of 50% to 100% of full open position.
 - L. Provide a portable meter kit within a durable case. Meter to have dual 4 1/2" diameter gauges with a range of 0-60 ft. W.G. differential. Accuracy to be +/- 3.0%. Provide in kit with hoses. Meter to become property of the Owner.
 - M. Provide a computerized balancing instrument (CBI) consisting of an electronic differential pressure gauge and a microcomputer programmed with the valve characteristics. This allows the direct reading of the flow and differential pressures. The CBI shall become the property of the Owner and have two main components:
 - 1. An instrument which contains a micro computer, (input touchpad, LCD display) and re-chargeable batteries with built-in charger.
 - 2. A sensor unit which contains a piezo-resistive pressure sensor, one measurement valve, and connecting hoses. The measurement valve has a safety function which protects the sensor from excessive differential pressure.

2.11 AUTOMATIC FLOW CONTROL VALVES

- A. Manufacturers:
 - 1. Armstrong International
 - 2. ITT Bell & Gossett
 - 3. Taco Inc
 - 4. Or Approved Equal
- B. Construction:

1. Brass, bronze, or iron body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet with blowdown/backflush drain.
2. Built-in lug-type outlet butterfly valve with 2-position handle.
- C. Calibration: Control flow within 10 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, minimum pressure 2 psi.
- D. Control Mechanism: Provide stainless steel or nickel-plated, brass piston or regulator cup, operating against stainless steel helical or wave formed spring or elastomeric diaphragm and polyphenylsulfone orifice plate.

2.12 RELIEF VALVES

- A. Manufacturers:
 1. American Wheatley
 2. Apollo Valves
 3. Armstrong International, Inc
 4. ITT Bell & Gossett
 5. Or Approved Equal
- B. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

2.13 REDUCERS

- A. Eccentric reducers shall be used on all water lines with top of reducer level.
- B. Concentric reducers shall be used wherever equipment connections do not conform to pipe sizes.

2.14 UNIONS

- A. Manufacturers:
 1. Anvil
 2. Victaulic
 3. Viking Gourp
 4. Ward
 5. Or Approved Equal
- B. Unions 2 inches and smaller shall be rated at 150 psi working pressure.
- C. Unions 2.5 inches and larger shall be gasketed flanged connections.
- D. Unions shall be ground joint with brass to iron seat. Gasket material shall be 1/16 inch compressed fiber gasket or approved equivalent.
- E. Flanged unions shall have welding ends.

- F. Unions or flanges for servicing and disconnect are not required in installations using grooved joint couplings. (The couplings shall serve as unions / disconnect points.)
- G. Provide dielectric unions or waterway fittings with appropriate end connections for the pipe materials in which installed, to isolate dissimilar metals.

2.15 ESCUTCHEONS

- A. Manufacturers:
 - 1. Crane
 - 2. Ferguson
 - 3. Ritter
- B. Escutcheons shall be provided wherever pipes pass through walls, floors, or ceilings.
- C. Escutcheons shall be of sufficient size to cover insulation.
- D. Escutcheons shall be split ring, cast brass, chromium plated type.
- E. Escutcheons shall be designed to cover pipe sleeve projection.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install specialties in accordance with manufacturer's instructions.
- B. Provide manual air vents at system high points and as indicated.
- C. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.
- D. Provide air separator on suction side of system circulation pump and connect to expansion tank.
- E. Provide valved drain and hose connection on strainer blowdown connection.
- F. Provide pump suction fitting on suction side of base-mounted centrifugal pumps where indicated. Remove temporary strainers after cleaning systems.
- G. Provide combination pump discharge valve on discharge side of base mounted centrifugal pumps where indicated.
- H. Support pump fittings with floor-mounted pipe and flange supports.
- I. Provide relief valves on pressure tanks, low-pressure side of reducing valves, heat exchangers, and expansion tanks.
- J. Pipe relief valve outlet to nearest floor drain.

END OF SECTION 23 21 14

**SECTION 23 21 23
HYDRONIC PUMPS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. In-line pumps.
- B. End-suction pumps.

1.2 REFERENCE STANDARDS

- A. IEEE 802.11 - IEEE Standard for Information Technology--Telecommunications and Information Exchange between Systems - Local and Metropolitan Area Networks--Specific Requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications; 2020 (Corrigendum 2022).
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. UL 778 - Standard for Motor-Operated Water Pumps; Current Edition, Including All Revisions.

1.3 SUBMITTALS

- A. Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.
- B. Indicate dimensions, weight, power and control wiring diagrams, piping connections, etc.
- C. Millwright's Certificate: Certify that base mounted pumps have been aligned.
- D. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacture, assembly, and field performance of pumps, with minimum three years of documented experience.
- B. Source limitation: All pumps shall be provided by a single manufacturer.
- C. Equipment provider shall be responsible for providing certified equipment start-up and, when noted, an in the field certified training session. New pump start-up shall be for the purpose of determining pump alignment, lubrication, voltage, and amperage readings. All proper electrical connections, pump's balance, discharge and suction gauge readings, and adjustment of head, if required. A copy of the start-up report shall be made and sent to both the contractor and to the Engineer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials in clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage. Cover open ends of all equipment to prevent dust from entering.
- B. Use all means necessary to protect equipment before, during, and after installation.

- C. All scratched, dented, and otherwise damaged units shall be repaired or replaced as directed by the Architect Engineer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Armstrong Pumps Inc
- B. Bell & Gossett, a Xylem Inc. brand
- C. Grundfos Pumps Corporation: www.grundfos.com/#sle.
- D. Patterson
- E. Taco

2.2 GENERAL

- A. Provide pumps that operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading throughout the complete curve of the selected impeller and nameplate motor horsepower, and operate within 25 percent of midpoint of published maximum efficiency curve.
- B. Electrical Requirements:
 - 1. Listed and classified by UL or testing agency acceptable to authority having jurisdiction as suitable for the purpose specified and indicated.
 - 2. Variable Frequency Drives (VFDs): Provide in accordance with Section 23 09 34, except for integral-VFDs.
 - 3. Enclosures: Provide unspecified product(s) required to fit motor:
 - a. Starter(s) inside enclosed controller as indicated on drawings; see Section 26 29 13.
 - b. VFD(s) inside enclosed controller as indicated on drawings; see Section 26 29 13.
- C. All pumps shall be provided with a motor starter or variable frequency drive (VFD) to match motor horsepower and electrical characteristics, refer to the schedule.
- D. All pumps shall be supplied with a triple duty valve or check valve, circuit setter, and isolation/balancing valve. All valves shall be sized such that the pressure drop does not exceed 5 ft at the design flow; not size on pump suction or discharge. Pumps shall be supplied with suction diffusers and flexible connections.
- E. All pumps controlled by VFDs shall be provided with inverter duty motors and shaft grounding rings.
- F. All equipment shall meet or exceed all requirements as described in the latest version of ASHRAE Standard 90.1 and the North Carolina Building Energy Code.
- G. Pumps shall comply with the DOE 10 CFM Parts 429 and 431 for Pump Energy Index (PEI) requirements.

2.3 IN-LINE PUMPS

- A. Closed-Coupled, Single-Stage Pump: Vertical pump with radially- or horizontally-split casing; rated for discharge pressures up to 175 psi.

- B. Split-Coupled, Multi-Stage: Vertical pump with radially-split casing, integral controls, bottom mount suction, and discharge pipe connections with gauge ports rated for discharge pressures up to 580 psi.
- C. Casing: Cast iron, with suction and discharge gage port, casing wear ring, seal flush connection, drain plug, flanged suction and discharge.
- D. The pump shall have a factory installed vent/flush line to ensure removal of trapped air and mechanical seal cooling. The vent/flush line shall run from the seal chamber to the pump discharge. A filter or sediment separator shall be provided in the vent/flush line.
- E. The pump casing shall be drilled and tapped for gauge ports at both the suction and discharge flanges and for drain port at the bottom of the casing.
- F. Impeller: Bronze, fully enclosed, keyed directly to motor shaft or extension.
- G. Shaft: Stainless steel with stainless steel impeller cap screw or nut and stainless steel sleeve.
- H. Seal: Mechanical seal, 225 degrees F maximum continuous duty temperature.
- I. Support Stand: For floor mounted pumps, provide optional factory support stand.
- J. Electrical:
 - 1. Motor: 1,750 rpm, open drip-proof (ODP); see Section 23 05 13.
 - 2. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.
 - 3. Integral Controls:
 - a. Variable Frequency Drive (VFD): Factory-fitted and tested with dedicated terminal box for power, instrumentation and related control wiring.
 - b. BAS, SCADA, or Other Integrated Automation Link: Wi-Fi in accordance with IEEE 802.11.

2.4 END-SUCTION PUMPS

- A. Close-Coupled Pump: Base-mounted, single-stage pump with horizontal shaft and radially- or horizontally-split casing rated for discharge pressures up to 360 psi.
- B. Casing: Cast iron or ductile iron with renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction, and discharge flanged connections with gauge ports.
- C. The pump shall have a factory installed vent/flush line to ensure removal of trapped air and mechanical seal cooling. The vent/flush line shall run from the seal chamber to the pump discharge. A filter or sediment separator shall be provided in the vent/flush line.
- D. The pump casing shall be drilled and tapped for gauge ports at both the suction and discharge flanges and for drain port at the bottom of the casing.
- E. Impeller: Stainless steel, balanced, fully enclosed, keyed to shaft.
- F. Bearings: Grease lubricated roller or ball bearings. Bearing assemblies shall be interchangeable in several size pumps.
- G. Shaft: Stainless steel with stainless steel shaft sleeve.

- H. Seal: Mechanical, 225 degrees F maximum continuous duty temperature.
- I. Bearing assembly with seal and impeller shall be removable without disturbing pipe connections or moving the motor. The base-mounted pumps shall be foot supported with center drop out spacer coupling for back pull-out.
- J. Drive: Flexible coupling with OSHA approved coupling guard.
- K. Baseplate: Cast iron or fabricated steel with integral drain rim.

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide one mechanical seal for each model type of pump.
- C. Provide temperature and pressure gauges where and as detailed or directed.
- D. Pumps shall be protected during construction. Keep moisture, refuse, dust, and other loose particles away from the pump and ventilating openings of the motor.
- E. Piping at all pumps shall be independently supported such that flanged connections are not unduly stressed with the entire weight of the piping system.
- F. Provide access space around pumps for service. Provide no less than minimum space recommended by manufacturer.
- G. On systems where pump seals require flushing water or cooling water for a heat exchanger kit, provide cooling water supply piping and connections as well as the return piping, if required. Piping should be of adequate size to pass required flow rate.
- H. Provide an adequate number of isolation valves for service and maintenance of the system and its components.
- I. All piping shall be brought to equipment and pump connections in such a manner so as to prevent the possibility of any loads or stresses being applied to the connections or piping. All piping shall be fitted to the pumps even though piping adjustments may be required after the pipe is installed.
- J. On components that require draining, contractor must provide piping to and discharging into appropriate drains.
- K. The Contractor is to ensure that pump nameplate data includes manufacturer's name, pump model number, pump serial number, capacity, head, horsepower, RPM and voltage.
- L. Provide line sized shut-off valve and strainer on pump suction, and line sized soft seat check valve and balancing valve on pump discharge.
- M. Provide drains for bases and seals, piped to and discharging into floor drains.
- N. Check, align, and certify alignment of base-mounted pumps prior to start-up.

- O. Install base mounted pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place. Refer to Section 03 30 00.
- P. Variable Speed Pumps: Pump and motor shall have the ability to operate at 5% over the scheduled speed using a VFD without affecting the warranty or causing damage to the pump or motor. Motors shall have shaft grounding ring.

END OF SECTION 23 21 23

**SECTION 23 23 00
REFRIGERANT PIPING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Piping.
- B. Moisture and liquid indicators.
- C. Valves.
- D. Strainers.
- E. Check valves.
- F. Filter-driers.
- G. Flexible connections.

1.2 REFERENCE STANDARDS

- A. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- B. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; 2022.
- C. ASME B31.9 - Building Services Piping; 2020.
- D. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2023.
- E. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2019.
- F. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).

1.3 SYSTEM DESCRIPTION

- A. Provide pipe hangers and supports in accordance with ASME B31.5 unless indicated otherwise.
- B. Filter-Driers:
 - 1. Use a filter-drier immediately ahead of liquid-line controls, such as thermostatic expansion valves, solenoid valves, and moisture indicators.

1.4 SUBMITTALS

- A. Product Data: Provide general assembly of specialties, including manufacturers catalogue information. Provide manufacturers catalog data including load capacity.
- B. Shop Drawings: Indicate schematic layout of system, including equipment, critical dimensions, and sizes.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store piping and specialties in shipping containers with labeling in place.

- B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.
- C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

- A. Comply with ASME B31.9 for installation of piping system.
- B. Products Requiring Electrical Connection: Listed and classified by UL, as suitable for the purpose indicated.

2.2 PIPING

- A. Copper Tube: ASTM B280, H58 hard drawn.
 - 1. Fittings: ASME B16.22 wrought copper.
 - 2. Joints: Braze, AWS A5.8M/A5.8 BCuP silver/phosphorus/copper alloy.
- B. Pipe Supports and Anchors:
 - 1. Provide hangers and supports that comply with MSS SP-58.
 - a. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
 - 2. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
 - 3. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 4. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
 - 5. Vertical Support: Steel riser clamp.
 - 6. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
 - 7. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
 - 8. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.3 MOISTURE AND LIQUID INDICATORS

- A. Manufacturers:
 - 1. Henry Technologies
 - 2. Parker Hannifin/Refrigeration and Air Conditioning
 - 3. Sporlan, a Division of Parker Hannifin
 - B. Indicators: Single port type, UL listed, with copper or brass body, flared or solder ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; for maximum temperature
-

of 200 degrees F and maximum working pressure of 500 psi.

2.4 VALVES

A. Manufacturers:

1. Hansen Technologies Corporation
2. Henry Technologies
3. Flomatic Valves

B. Diaphragm Packless Valves:

1. UL listed, globe or angle pattern, forged brass body and bonnet, phosphor bronze and stainless steel diaphragms, rising stem and handwheel, stainless steel spring, nylon seat disc, solder or flared ends, with positive backseating; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.

C. Packed Angle Valves:

1. Forged brass or nickel plated forged steel, forged brass seal caps with copper gasket, rising stem and seat with backseating, molded stem packing, solder or flared ends; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.

D. Ball Valves:

1. Two piece bolted forged brass body with teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psi and maximum temperature of 300 degrees F.

E. Service Valves:

1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or solder ends, for maximum pressure of 500 psi.

2.5 STRAINERS

A. Manufacturers:

1. Alco
2. Cash
3. Henry 896-S

B. Straight Line or Angle Line Type:

1. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass; for maximum working pressure of 430 psi.

2.6 CHECK VALVES

A. Manufacturers:

1. Hansen Technologies Corporation
-

2. Parker Hannifin/Refrigeration and Air Conditioning
3. Sporlan, a Division of Parker Hannifin
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Globe Type:

1. Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless steel spring, teflon seat disc; for maximum temperature of 300 degrees F and maximum working pressure of 425 psi.

2.7 FLEXIBLE CONNECTORS

A. Manufacturers:

1. Circuit Hydraulics, Ltd
2. Flexicraft Industries
3. Penflex

- B. Corrugated stainless steel hose with single layer of stainless steel exterior braiding, minimum 9 inches long with copper tube ends; for maximum working pressure of 500 psi.

PART 3 EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

- A. Install refrigeration specialties in accordance with manufacturer's instructions.
- B. The installation of piping and related items shall be made neatly and in such a manner as not to interfere with access to valves or equipment. Expansion, drainage and maintenance of installed piping shall be possible.
- C. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.
- D. Install piping to conserve building space and avoid interference with use of space.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Sleeves shall be provided wherever pipes pass through walls, floors and ceilings. Sleeves shall be Schedule 40, black steel, one-half inch in diameter larger than the pipe or insulation on the pipe. Sleeves through walls and ceilings shall be flush. Sleeves through floors shall extend one inch above finished floor. Sleeves through exterior walls shall be caulked and made watertight.
- G. Pipe Hangers and Supports:
 1. Install in accordance with ASME B31.5.

2. Support horizontal piping as indicated.
 3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 4. Place hangers within 12 inches of each horizontal elbow.
 5. Provide copper plated hangers and supports for copper piping.
- H. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.
- I. Provide clearance for installation of insulation and access to valves and fittings.
- J. Flood piping system with nitrogen when brazing.
- K. Fully charge completed system with refrigerant after testing.

3.3 FIELD QUALITY CONTROL

- A. Test refrigeration system in accordance with ASME B31.5.
- B. All refrigerant equipment not tested at the factory shall be shut off from the rest of the system and tested under a vacuum with no evidence of leakage. Piping systems shall be tested after installation, and before any insulation is applied. All controls and other apparatus that may be damaged by the test pressure shall be removed before tests are made.
- C. Refrigerant piping leak testing shall be as follows, unless equipment manufacturer mandates or recommends or more stringent procedure:
1. Connect the refrigerant manifold gauge hoses to the liquid side and gas side service ports on the equipment and connect the center hose to a nitrogen tank fitted with a pressure regulator.
 2. Fill the lines with nitrogen to 590 psi but no more than 595 psi.
 3. Monitor the pressure periodically for a minimum of 24 hours. If the pressure drops, use soapy water to check for leaks. Bubbles will occur if joints are not tight.
 4. Repair leaks. Repeat the previous steps until the pressure remains constant for 24 hours.
 5. Maintain 145 psi of pressure for 15 minutes and check for further leakage. If the pressure drops, check for leaks and repair. Repeat this step until 145 psi of pressure is maintained for 15 minutes.
 6. Remove hoses from service ports.
- D. Evacuation Procedure. After performing leak test, use a vacuum pump to triple evacuate the system as described below:
1. Use a vacuum pump with a check valve to prevent pump oil from flowing backward while the vacuum pump is closed. Completely close the liquid-vapor line service valves of the outdoor unit.
 2. Using vacuum-rated hoses, connect the manifold gauges to the liquid and suction (and high pressure, if applicable) gas pipes.
 3. Evacuate the system to 750 microns, hold for 5 minutes, and check for leaks. Repair and repeat as necessary until vacuum holds.

4. Break the vacuum by applying 10 psi of nitrogen.
5. Evacuate the system to 500 microns, hold for 5 minutes, and check for leaks. Repair and repeat as necessary until vacuum holds.
6. Break the vacuum by applying 10 psi of nitrogen.
7. Evacuate the system to 200 microns. Wait for 15 minutes. A rise of no more than 200 microns is acceptable. If over 400 microns, check for leaks, repair, and repeat.
8. If under 400 microns, continue holding vacuum for 2.5 hours. If vacuum exceeds 400 microns at end of period, check for leaks, repair, and repeat.
9. If system holds under 400 microns for 2.5 hours, system is ready for charging.

3.4 SCHEDULES

- A. Hanger Spacing for Copper Tubing.
1. 1/2 inch, 5/8 inch, and 7/8 inch OD: Maximum span, 5 feet; minimum rod size, 1/4 inch.
 2. 1-1/8 inch OD: Maximum span, 6 feet; minimum rod size, 1/4 inch.
 3. 1-3/8 inch OD: Maximum span, 7 feet; minimum rod size, 3/8 inch.
 4. 1-5/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 5. 2-1/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.

END OF SECTION 23 23 00

**SECTION 23 25 00
HVAC WATER TREATMENT**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Materials.
 - 1. System cleaner.
 - 2. Closed system treatment (water).
- B. By-pass (pot) feeder.

1.2 SUBMITTALS

- A. Product Data: Provide chemical treatment materials, chemicals, and equipment including electrical characteristics and connection requirements.
- B. Shop Drawings: Indicate system schematic, equipment locations, and controls schematics, electrical characteristics and connection requirements.
- C. Submit directly to Owner, Material Safety Data Sheets (MSDS) for all chemicals used in chemical treatment systems. Include with MSDS written notice of Owner's responsibility to notify its employees of the use of those chemicals.
- D. The Mechanical Contractor shall provide the water treatment subcontractor with a calculated water volume (gallons) of the hydronic system(s) for the cleaning and flushing procedure and the required flow rate (GPM) to remove debris, slag and/or surface corrosion byproducts. This data shall be included in the submittal.
- E. Certificate: Submit certificate of compliance from Authority Having Jurisdiction indicating approval of chemicals and their proposed disposal.
- F. Operation and Maintenance Data: Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum ten years of documented experience. Company shall have local representatives with water analysis laboratories and full time service personnel.

1.4 WATER ANALYSIS

- A. Submit complete water analysis and results of performance test of each system signed by manufacturer's service representative.
- B. Water analysis shall include the following:
 - 1. Hot Water and Chilled Water
 - a. Hardness
 - b. pH

- c. "M" alkalinity
- d. Inhibitor level
- e. Total dissolved solids
- f. Temperature

1.5 WATER QUALITY REQUIREMENTS

A. Minimum water quality requirements for closed hot and/or chilled water systems shall be as follows:

- 1. pH 8.0-9.0
- 2. TDS < 500 ppm
- 3. Hardness as CaCO₃ and Alkalinity < 120 ppm
- 4. Chlorides < 200 ppm
- 5. Sulphates < 200 ppm
- 6. Iron < 0.5 ppm
- 7. Dissolved Oxygen < 0.1 ppm
- 8. Ryznar Index > 6.0
- 9. Suspended solids < 10 micron
- 10. Bacteria Counts
 - a. Total aerobic bacteria counts < 100 cfu per mL
 - b. Total anaerobic bacteria counts < 10 cfu per mL

1.6 DESIGN CRITERIA

- A. Chemicals shall be suitable for pipe material, fluid medium, and intended treatment.
- B. Provide initial chemical treatment and equipment for all systems based on complete system fluid analysis including makeup water prior to installation.
- C. Initial supply of chemicals for treatment of each system shall be sufficient for start up and testing period, for the time the systems are operated by the Contractor for temporary heating and cooling, and for one year after start-up of system.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. AmSolv-Amrep, Inc
- B. Aqua-Chem
- C. Aqualine

- D. ChemTreat
- E. GE Water & Process Technologies
- F. Water Guard
- G. Nalco Company
- H. Or Approved Equal

2.2 MATERIALS

- A. System Cleaner:
 - 1. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products; sodiumtripoly phosphate and sodium molybdate.
 - 2. Biocide chlorine release agents such as sodium hypochlorite or calcium hypochlorite or microbiocides such as quarternary ammonia compounds, tributyltin oxide, methylene bis (thiocyanate).
- B. Closed System Treatment (Water):
 - 1. Sequestering agent to reduce deposits and adjust pH.
 - 2. Corrosion inhibitors; boron-nitrite, sodium nitrite and borax, sodium totyltriazole, low molecular weight polymers, phosphonates, sodium molybdate, or sulphites.
 - 3. Conductivity enhancers; phosphates or phosphonates.

2.3 BY-PASS (POT) FEEDER

- A. Manufacturers:
 - 1. Griswold Controls
 - 2. J. L. Wingert Company
 - 3. Neptune, a brand of the Dover Company
 - 4. Advantage Controls
 - 5. Or Approved Equal
- B. 5 gallon quick opening cap for working pressure of 175 psi.
- C. Provide cartridge filter.

PART 3 EXECUTION

3.1 PREPARATION

- A. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.
 - B. Place terminal control valves in open position during cleaning.
 - C. Verify that electric power is available and of the correct characteristics.
-

D.

3.2 CLEANING SEQUENCE

A. Concentration:

1. As recommended by manufacturer.

B. Hot Water Heating Systems (use the more stringent between the method below and manufacturer's recommended method):

1. Apply heat while circulating, slowly raising temperature to 160 degrees F and maintain for 12 hours minimum.
2. Remove heat and circulate to 100 degrees F or less; drain systems as quickly as possible and refill with clean water.
3. Circulate for 6 hours at design temperatures, then drain.
4. Refill with clean water and repeat until system cleaner is removed.

C. Chilled Water Systems (use the more stringent between the method below and manufacturer's recommended method):

1. Circulate for 48 hours, then drain systems as quickly as possible.
2. Refill with clean water, circulate for 24 hours, then drain.
3. Refill with clean water and repeat until system cleaner is removed.

D. Use neutralizer agents on recommendation of system cleaner supplier and approval of Engineer and Owner.

E. Remove, clean, and replace strainer screens.

F. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

G. After the precleaning is complete, test by the water treatment consultant shall confirm and a written report shall certify the completeness of the precleaning by meeting the following minimum requirements:

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Contractor shall install a BYPASS pipe wherever needed between the hydronic return & supply lines to recirculate the entire system using the hydronic pumps installed. The diameter of this pipe shall be at least 1/3 of the diameter of the main hydronic lines. The contractor shall also remove or cap the temporary BYPASS to a permanent configuration when flushing is complete and approved water chemistry is achieved.

C. Contractor shall remove all strainer screens prior to flushing all systems, including mud from the dirt legs. Contractor shall clean and replace/reinstall all strainer screens after the final cleaning and flushing procedure has passed the final test criteria noted herein.

D. Complete circulation must be achieved during the cleaning procedure. The Contractor shall develop a plan to achieve a minimum velocity of three feet per second (3 ft/s) in the pipes to ensure the cleaning chemicals will work properly. If necessary, isolate parts of the piping system to attain at least (3 ft/s) in piping being flushed.

All electric, pneumatic, and thermostatic operated valves shall be full open. All deadend runs shall be looped together with piping not less than one-third the size of the run.

3.4 CLOSED SYSTEM TREATMENT

- A. Provide one bypass feeder on each system. Install isolating and drain valves and necessary piping. Install around balancing valve downstream of circulating pumps unless indicated otherwise.
- B. Introduce closed system treatment through bypass feeder when required or indicated by test.
- C. Provide 3/4 inch water coupon rack around circulating pumps with space for 4 test specimens.

3.5 CLOSEOUT ACTIVITIES

- A. Training: Train Owner's personnel on operation and maintenance of chemical treatment system.
 - 1. Provide minimum of four hours of instruction for two people.
 - 2. Have operation and maintenance data prepared and available for review during training.
 - 3. Conduct training using actual equipment after treated system has been put into full operation.

END OF SECTION 23 25 00

**SECTION 23 31 00
HVAC DUCTS AND CASINGS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Metal ducts.
- B. Flexible ducts.
- C. Air plenums and casings.

1.2 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 23 01 30.51 - HVAC Air-Distribution System Cleaning: Post install duct cleaning.
- C. Section 23 07 13 - Duct Insulation: External insulation and duct liner.
- D. Section 23 33 00 - Air Duct Accessories.
- E. Section 23 36 00 - Air Terminal Units.
- F. Section 23 37 00 - Air Outlets and Inlets: Fabric air distribution devices.

1.3 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- B. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
- C. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2024.
- D. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
- E. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for duct materials.
- C. Shop Drawings: Indicate duct fitting types, gauges, sizes, welds, and configuration.
- D. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.5 QUALITY ASSURANCE

1.6 FIELD CONDITIONS

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

- B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Provide UL Class 1 ductwork, fittings, hangers, supports, and appurtenances in accordance with NFPA 90A and SMACNA (DCS) guidelines unless stated otherwise.
- B. Acoustical Treatment: Provide sound-absorbing liners and sectional silencers for metal-based ducts in compliance with Section 23 33 19.
- C. Duct Shape and Material in accordance with Allowed Static Pressure Range:
 - 1. Round: Plus or minus 2 in-wc of galvanized steel.
 - 2. Rectangular: Plus or minus 1/2 in-wc of galvanized steel.
 - 3. Flexible Duct (Fabric and wire): Plus or minus 1/2 in-wc; see Section 23 37 00.
- D. Duct Sealing and Leakage in accordance with Static Pressure Class:
 - 1. Duct Pressure Class and Material for Common Mechanical Ventilation Applications:
 - a. Supply Air: 1/2 in-wc pressure class, galvanized steel.
 - b. Outside Air Intake: 1/2 in-wc pressure class, galvanized steel.
 - c. Return and Relief Air: 1/2 in-wc pressure class, galvanized steel.
 - d. General Exhaust Air: 1/2 in-wc pressure class, galvanized steel.
 - 2. Low Pressure Service: From 2 in-wc to 3 in-wc:
 - a. Seal: Class B, apply sealing of transverse joints and longitudinal seams.
 - b. Leakage:
 - 1) Rectangular: Class 12 or 12 cfm/100 sq ft.
 - 2) Round: Class 6 or 6 cfm/100 sq ft.
- E. Duct Fabrication Requirements:
 - 1. Duct and Fitting Fabrication and Support: SMACNA (DCS) including specifics for continuously welded round and oval duct fittings.
 - 2. Use reinforced and sealed sheet-metal materials at recommended gauges for indicated operating pressures or pressure class.
 - 3. Construct tees, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide airfoil turning vanes of perforated metal with glass fiber insulation.
 - 4. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.

5. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
6. Provide turning vanes of perforated metal with glass fiber insulation when an acoustical lining is required.
7. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.2 METAL DUCTS

A. Material Requirements:

1. Galvanized Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.

2.3 FLEXIBLE DUCTS

A. Flexible Ducts: UL 181, Class 1, polyethylene film, mechanically fastened and rolled using galvanized steel to form spiral helix.

1. Pressure Rating: 10 in-wc positive and 5 in-wc negative.
2. Maximum Velocity: 5500 fpm.
3. Temperature Range: Minus 20 degrees F to 250 degrees F.
4. Manufacturers:
 - a. Flexmaster USA, a brand of Masterduct, Inc; Type 1: www.flexmasterusa.com/#sle.

2.4 AIR PLENUMS AND CASINGS

A. Fabricate in accordance with SMACNA (DCS) for indicated operating pressures indicated.

B. Minimum Fabrication Requirements:

1. Fabricate acoustic plenum or casing with reinforcing turned inward.
2. Provide 16-gauge, 0.059-inch sheet steel back facing and 22-gauge, 0.029-inch perforated sheet steel front facing with 3/32 inch diameter holes on 5/32 inch centers.
3. Construct panels 3 inches thick, packed with 4.5 pcf minimum glass fiber insulation media, on inverted channel of 16-gauge, 0.059-inch sheet steel.
4. Mount floor-mounted plenum or casings on 4-inch high concrete curbs. At floor, rivet panels on 8-inch centers to angles. Where floors are acoustically insulated, provide liner of galvanized 18-gauge, 0.052-inch expanded metal mesh supported at 12-inch centers, turned up 12 inches at sides with sheet metal shields.

C. Access Doors:

1. Install hinged access doors where indicated or required for access to equipment for cleaning and inspection.

2. Reinforce door frames with steel angles tied to horizontal and vertical plenum supporting angles.
3. Provide clear wire glass observation ports, minimum 6 by 6 inch size.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install, support, and seal ducts in accordance with SMACNA (DCS).
- B. Install products following the manufacturer's instructions.
- C. Comply with safety standards NFPA 90A and NFPA 90B.
- D. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering the ductwork system.
- E. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- F. Duct sizes indicated are precise inside dimensions. For lined ducts, maintain sizes inside lining.
- G. Provide openings in ductwork as indicated to accommodate thermometers and controllers. Provide pilot tube openings as indicated for testing of systems, complete with metal can with spring device or screw to insure against air leakage. For openings, insulate ductwork and install insulation material inside a metal ring.
- H. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- I. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with a crimp in the direction of airflow.
- J. Use double nuts and lock washers on threaded rod supports.
- K. Connect diffusers or light troffer boots to low-pressure ducts directly or with 5 feet maximum length of flexible duct held in place with strap or clamp.
- L. Louver Fit-out:
 1. Provide blank-out panels sealing available area of wall-mounted exterior-faced louver when connected ductwork is smaller than actual louver free area, and duct outlet is smaller than the louver frame.
 2. Use the same duct material painted black on the exterior side, then seal louver frame and duct.
- M. Plenums and Casings:
 1. Mount floor-mounted casings on 4 inch high concrete curbs.
 2. At floor, rivet panels on 8 inch centers to angles.
 3. Where floors are acoustically insulated, provide liner of galvanized 18-gauge, 0.052-inch expanded metal mesh supported at 12-inch centers, turned up 12 inches at sides with sheet metal shields.
- N. Fire Partitions: Provide firestopping sealing. See Section 07 84 00.
- O. Duct Accessories, Terminal Units, Inlets, and Outlets: Interconnect as indicated in Sections 23 33 00, 23 36 00, and 23 37 00.

P. Duct Insulation: Provide duct insulation. See Section 23 07 13.

3.2 CLEANING

- A. Clean thoroughly each duct system. See Section 23 01 30.51.
- B. Clean duct system by forcing air at high velocity through duct to remove accumulated dust. Clean half the system at a time to obtain sufficient air. Protect equipment that could be harmed by excessive dirt with temporary filters or bypass during cleaning.
- C. Clean duct systems with high-power vacuum machines. Protect equipment that could be harmed by excessive dirt with filters or bypass during cleaning. Provide adequate access to the ductwork for cleaning purposes.

END OF SECTION 23 31 00

**SECTION 23 33 00
AIR DUCT ACCESSORIES**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Air turning devices/extractors.
- B. Backdraft dampers - metal.
- C. Combination fire and smoke dampers.
- D. Duct access doors.
- E. Duct test holes.
- F. Fire dampers.
- G. Flexible duct connectors.
- H. Smoke dampers.
- I. Volume control dampers.
- J. Air measuring control dampers.
- K. Miscellaneous Products:
 - 1. Duct opening closure film.

1.2 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 23 31 00 - HVAC Ducts and Casings.
- C. Section 23 36 00 - Air Terminal Units: Pressure regulating damper assemblies.

1.3 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023c.
- B. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
- C. NFPA 92 - Standard for Smoke Control Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2024.
- E. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
- F. UL 33 - Safety Heat Responsive Links for Fire-Protection Service; Current Edition, Including All Revisions.
- G. UL 555 - Standard for Fire Dampers; Current Edition, Including All Revisions.
- H. UL 555S - Standard for Smoke Dampers; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide for shop-fabricated assemblies including volume control dampers, duct access doors, duct test holes, and hardware used. Include electrical characteristics and connection requirements.
- C. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers.
- D. Manufacturer's Installation Instructions: Provide instructions for fire dampers.
- E. Project Record Drawings: Record actual locations of access doors and test holes.

1.5 QUALITY ASSURANCE

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.1 AIR TURNING DEVICES/EXTRACTORS

- A. Manufacturers:
 - 1. Carlisle HVAC Products; Dynair Hollow Vane and Rail (Double Wall Vane): www.carlislehvac.com/#sle.
 - 2. Elgen Manufacturing Company, Inc; _____: www.elgenmfg.com/#sle.
 - 3. Krueger-HVAC, Division of Air System Components; _____: www.krueger-hvac.com/#sle.
 - 4. Ruskin Company; _____: www.ruskin.com/#sle.
 - 5. Titus HVAC, a brand of Johnson Controls; _____: www.titus-hvac.com/#sle.
- B. Multi-blade device with blades aligned in short dimension; steel construction; with individually adjustable blades, mounting straps.
- C. Multi-blade device with radius blades attached to pivoting frame and bracket, steel construction, with push-pull operator strap.

2.2 COMBINATION FIRE AND SMOKE DAMPERS

2.3 DUCT ACCESS DOORS

- A. Manufacturers:
 - 1. Acudor Products Inc, a Division of Nelson Industrial Inc; _____: www.acudor.com/#sle.
 - 2. Ductmate Industries, Inc, a DMI Company; _____: www.ductmate.com/#sle.
 - 3. Elgen Manufacturing Company, Inc; _____: www.elgenmfg.com/#sle.
 - 4. Nailor Industries, Inc; _____: www.nailor.com/#sle.

5. Ruskin Company; _____: www.ruskin.com/#sle.
6. SEMCO LLC; _____: www.semcohvac.com/#sle.

2.4 DUCT TEST HOLES

- A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

2.5 FIRE DAMPERS

- A. Horizontal Dampers: Galvanized steel, 22-gauge, 0.0299-inch frame, stainless steel closure spring, and lightweight, heat-retardant, non-asbestos fabric blanket.
- B. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream except for 1-inch pressure-class ducts up to 12 inches in height.
- C. Fusible Links: UL 33, separate at 160 degrees F with adjustable link straps for combination fire/balancing dampers.

2.6 FLEXIBLE DUCT CONNECTORS

- A. Manufacturers:
 1. Carlisle HVAC Products; Dynair Connector Plus G90 Steel Offset Seam Neoprene Fabric: www.carlislehvac.com/#sle.
 2. Ductmate Industries, Inc, a DMI Company; _____: www.ductmate.com/#sle.
 3. Elgen Manufacturing Company, Inc; _____: www.elgenmfg.com/#sle.
- B. Fabricate in accordance with SMACNA (DCS) and as indicated.
- C. Flexible Duct Connections: Fabric crimped into metal edging strip.

2.7 SMOKE DAMPERS

- A. Manufacturers:
 1. Louvers & Dampers, Inc, a brand of Mestek, Inc; _____: www.louvers-dampers.com/#sle.
 2. Nailor Industries, Inc; _____: www.nailor.com/#sle.
 3. Ruskin Company; _____: www.ruskin.com/#sle.
- B. Fabricate in accordance with NFPA 90A and UL 555S, and as indicated.
- C. Dampers: UL Class 1 airfoil blade type smoke damper, normally open automatically operated by pneumatic actuator.
- D. Electro Thermal Link: Fusible link melting at 165 degrees F; 120 volts, single phase, 60 Hz; UL listed and labeled.

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). See Section 23 31 00 for duct construction and pressure class.
- B. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust ducts in accordance with NFPA 96 Provide minimum 8 by 8 inch size access door for hand and shoulder access, or as indicated on drawings. Provide minimum 4 by 4 inch size access door for balancing dampers only. Review locations prior to fabrication.
- C. Provide duct test holes where indicated and required for testing and balancing purposes.
- D. Provide fire dampers, combination fire and smoke dampers, and smoke dampers at locations indicated, where ducts and outlets pass through fire-rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- E. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92.
- F. Demonstrate re-setting of fire dampers to Owner's representative.
- G. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.
- H. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.
- I. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION 23 33 00

**SECTION 23 34 23
HVAC POWER VENTILATORS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cabinet exhaust fans.

1.2 RELATED REQUIREMENTS

- A. Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
- B. Section 23 05 48 - Vibration and Seismic Controls for HVAC.
- C. Section 23 31 00 - HVAC Ducts and Casings.
- D. Section 23 33 00 - Air Duct Accessories: Backdraft dampers.
- E. Section 26 05 83 - Wiring Connections: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

- A. AMCA 311 - Certified Ratings Program Product Rating Manual for Fan Sound Performance; 2016.
- B. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
- C. UL 705 - Power Ventilators; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on fans and accessories, including fan curves with specified operating point plotted, power, rpm, sound power levels at rated capacity, and electrical characteristics and connection requirements.

PART 2 PRODUCTS

2.1 CABINET EXHAUST FANS

- A. Manufacturers:
 - 1. Carnes, a division of Carnes Company Inc: www.carnes.com/#sle.
 - 2. Greenheck Fan Corporation: www.greenheck.com/#sle.
 - 3. PennBarry, Division of Air System Components: www.pennbarry.com/#sle.
 - 4. Twin City Fan & Blower; T: www.tcf.com/#sle.
- B. Centrifugal Fan Unit: V-belt or direct driven with galvanized steel housing lined with acoustic insulation, resiliently mounted motor, gravity backdraft damper in discharge.
- C. Grille: Molded white plastic.

- D. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is reached with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Hung Cabinet Fans:
 - 1. Install fans with resilient mountings and flexible electrical leads, see Section 23 05 48.
 - 2. Install flexible connections between fan and ductwork; see Section 23 33 00. Ensure metal bands of connectors are parallel with minimum 1 inch flex between ductwork and fan while running.
- C. Provide backdraft dampers on outlet from cabinet and ceiling exhauster fans and as indicated.

END OF SECTION 23 34 23

**SECTION 23 37 00
AIR OUTLETS AND INLETS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Diffusers:
- B. Rectangular ceiling diffusers.
- C. Slot ceiling diffusers.
- D. Registers/grilles:
 - 1. Ceiling-mounted, exhaust and return register/grilles.
 - 2. Wall-mounted, supply register/grilles.
- E. Duct-mounted supply and return registers/louvers.
- F. Louvers:
- G. Gravity ventilators.

1.2 REFERENCE STANDARDS

- A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2023.
- B. AMCA 511 - Certified Ratings Program Product Rating Manual for Air Control Devices; 2021, with Editorial Revision (2022).
- C. AMCA 550 - Test Method for High Velocity Wind Driven Rain Resistant Louvers; 2022.
- D. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Air Inlets; 2023.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023c.
- F. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
- G. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2024.
- H. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.
- I. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
- J. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.
- K. UL 2518 - Standard for Safety Air Dispersion Systems; Current Edition, Including All Revisions.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location,

application, and noise level.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Carnes, a division of Carnes Company Inc: www.carnes.com/#sle.
- B. Krueger-HVAC: www.krueger-hvac.com/#sle.
- C. Price Industries: www.price-hvac.com/#sle.
- D. Titus, a brand of Air Distribution Technologies: www.titus-hvac.com/#sle.
- E. Tuttle and Bailey: www.tuttleandbailey.com/#sle.

2.2 RECTANGULAR CEILING DIFFUSERS TYPES A-D

- A. Manufacturers:
 - 1. Krueger-HVAC: www.krueger-hvac.com/#sle.
 - 2. Titus - HVAC
 - 3. Price Industries.
- B. Type: Provide rectangular and square formed adjustable, backpan stamped, core removable, and multi-louvered ceiling diffusers constructed to maintain 360 degree discharge air pattern with sectorizing baffles where indicated.
- C. Connections: Round.
- D. Frame: Provide surface mount, snap-in, inverted T-bar, and spline type. In plaster ceilings, provide plaster frame and ceiling frame.
- E. Fabrication: Steel with baked enamel finish.
- F. Color: As indicated.
- G. Accessories: Provide radial opposed blade, butterfly, and combination splitter volume control damper; removable core and equalizing grid with damper adjustable from diffuser face.

2.3 CEILING SLOT DIFFUSERS - TYPE E

- A. Manufacturers:
 - 1. Krueger-HVAC: www.krueger-hvac.com/#sle.
 - 2. Metalaire, a brand of Metal Industries Inc: www.metalaire.com/#sle.
 - 3. Price Industries.
- B. Type: Continuous 3/4 inch wide slot, three slots wide, with adjustable vanes for left, right, or vertical discharge; integral ceiling fire damper.
- C. Fabrication: Aluminum extrusions with factory clear lacquer finish.

- D. Color: As indicated.
- E. Color: To be selected by Architect from manufacturer's standard range.
- F. Plenum: Integral, galvanized steel, insulated.

2.4 DUCT-MOUNTED SUPPLY AND RETURN REGISTERS/LOUVERS - TYPE F AND TYPE 8

- A. Manufacturers:
 - 1. Krueger-HVAC: www.krueger-hvac.com/#sle.
 - 2. EHG, a DMI Company: www.ehgduct.com/#sle.
 - 3. Linx Industries, Inc, a DMI Company: www.li-hvac.com/#sle.
 - 4. Price Industries.
- B. Type: Duct-mounted, rectangular register with adjustable pivot-ended blades, end caps, built-in volume damper, and dual cover flanges to lay flush on duct surface regardless of diameter. Performance to match manufacturer's catalog data.
- C. Material: 22 gauge, 0.0299 inch.
- D. Color: As indicated on drawings.

2.5 CEILING EXHAUST AND RETURN REGISTERS/GRILLES

- A. Manufacturers:
 - 1. Krueger-HVAC: www.krueger-hvac.com/#sle.
 - 2. Price Industries.
 - 3. Titus.
- B. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with blades set at 45 degrees, vertical face.
- C. Frame: 1-1/4 inch margin with countersunk screw mounting.
- D. Fabrication: Steel with 20 gauge, 0.0359 inch minimum frames and 22 gauge, 0.0299 inch minimum blades, steel and aluminum with 20 gauge, 0.0359 inch minimum frame, or aluminum extrusions, with factory baked enamel finish.
- E. Color: As indicated.

2.6 LOUVERS

- A. Manufacturers:
 - 1. NCA, a brand of Metal Industries Inc: www.ncamfg.com/#sle.
 - 2. Ruskin Company: www.ruskin.com/#sle.
 - 3. Greenheck.

- B. Type: 4 inch deep frame with blades on 45 degree slope with center baffle and return bend, heavy channel frame, 1/2 inch square mesh screen over intake or exhaust end.
- C. Fabrication: 16 gauge, 0.0598 inch (1.52 mm) thick galvanized steel thick galvanized steel welded assembly, with factory prime coat finish.
- D. Color: As indicated on the drawings.

2.7 GRAVITY VENTILATORS

- A. Hood Intake Gravity Ventilator:
 - 1. Manufacturers:
 - a. American Coolair Corporation: www.coolair.com/#sle.
 - b. Greenheck Fan Corporation: www.greenheck.com/#sle.
 - c. Loren Cook Company: www.lorencook.com/#sle.
 - 2. General:
 - a. Performance ratings and factory testing in accordance with AMCA 511 and AMCA 550.
 - b. Equipment to bear permanently affixed manufacturer's nameplate listing model and serial number.
 - 3. Hood and Base:
 - a. Material: Aluminum.
 - b. Hood Construction: Precision formed, arched panels with interlocking seams.
 - c. Vertical End Panels: Fully locked into hood end panels.
 - 4. Birdscreen:
 - a. Construction: 1/2 inch Galvanized mesh.
 - b. Horizontally mounted across hood intake area.
 - 5. Options/Accessories:
 - a. Roof Curbs:
 - 1) Pitched Roofs: Welded, straight side curb with flashing flange and wood nailer.
 - 2) Material: Aluminum.
 - 3) Insulation Thickness: 1 inch.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

- B. Comply with SMACNA (ASMM) for flashing/counter-flashing of roof penetrations and supports for roof curbs and roof mounted equipment.
- C. Check location of outlets and inlets and make necessary adjustments in position to comply with architectural features, symmetry, and lighting arrangement.
- D. Install diffusers to ductwork with air tight connection.
- E. Provide balancing dampers on duct take-off to diffusers and grilles and registers, despite whether dampers are specified as part of diffuser, or grille and register assembly.
- F. Paint ductwork visible behind air outlets and inlets matte black, see Section 09 91 23.

END OF SECTION 23 37 00

**SECTION 23 51 00
BREECHINGS, CHIMNEYS, AND STACKS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Manufactured breechings.
- B. Double wall metal stacks.

1.2 REFERENCE STANDARDS

- A. NFPA 31 - Standard for the Installation of Oil-Burning Equipment; 2020, with Amendment (2023).
- B. NFPA 82 - Standard on Incinerators and Waste and Linen Handling Systems and Equipment; 2019.
- C. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances; 2024.
- D. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
- E. UL 103 - Factory-Built Chimneys for Residential Type and Building Heating Appliances; Current Edition, Including All Revisions.

1.3 DEFINITIONS

- A. Breeching: Vent connector.
- B. Chimney: Primarily vertical shaft enclosing at least one vent for conducting flue gases outdoors.
- C. Vent: That portion of a venting system designed to convey flue gases directly outdoors from a vent connector or from an appliance when a vent connector is not used.
- D. Vent Connector: That part of a venting system that conducts the flue gases from the flue collar of an appliance to a chimney or vent, and may include a draft control device.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data indicating factory built chimneys, including dimensional details of components and flue caps, dimensions and weights, electrical characteristics and connection requirements.
- C. Shop Drawings: Indicate general construction, dimensions, weights, support and layout of breechings. Submit layout drawings indicating plan view and elevations where factory built units are used.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. AMPCO by Hart & Cooley, Inc

- B. DuraVent
- C. Jeremias
- D. Heatfab
- E. Metal-Fab, Inc
- F. Schebler
- G. Security Chimneys International; Secure Stack Pro (CIX2)
- H. Selkirk Corporation
- I. Van-Packer
- J. Z-Flex U.S. Inc
- K. Or Approved Equal

2.2 BREECHINGS, CHIMNEYS, AND STACKS - GENERAL REQUIREMENTS

- A. Regulatory Requirements:
 - 1. Comply with applicable codes for installation of natural gas burning appliances and equipment.
 - 2. Comply with NFPA 31 for installation of oil burning appliances and equipment.
 - 3. Factory-built vents and chimneys used for venting natural draft appliances to comply with NFPA 211 and UL listed and labeled.
 - 4. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

2.3 MANUFACTURED BREECHINGS

- A. Provide factory-built, modular connector and manifold system, tested to UL 103 with positive pressure rating.
- B. Assembly to be UL listed for use with building equipment in compliance with NFPA 211.
- C. Fabricate with 1 inch minimum air space between walls and construct inner liner of 304, 316, or 444 stainless steel and outer jacket of 304 stainless steel or 316 stainless steel.
 - 1. Protect aluminized steel surfaces exposed to the elements with a minimum of one base coat of primer and one finish coat of corrosion resistant paint suitable for outer jacket skin temperatures of the application.
- D. Design, fabricate, and install gas-tight preventing products of combustion leaking into the building.
 - 1. Securely connect inner joints and seal with factory supplied overlapping V-bands and appropriate sealant in accordance with manufacturer's instructions.
 - 2. System design to compensate for all flue gas induced thermal expansion.

2.4 DOUBLE WALL METAL STACKS

- A. Provide double wall metal stacks, tested to UL 103 and UL listed with positive pressure rating, for use with building heating equipment, in compliance with NFPA 211.
- B. Fabricate with 1 inch minimum air space between walls and construct inner liner of 304 stainless steel and outer jacket of AL29-4C stainless steel.
 - 1. Protect aluminized steel surfaces exposed to the elements with a minimum of one base coat of primer and one finish coat of corrosion resistant paint suitable for outer jacket skin temperatures of the application.
- C. Accessories, UL Labeled:
 - 1. Ventilated Roof Thimble: Consists of roof penetration, vent flashing with spacers and storm collar.
 - 2. Exit Cone: Consists of inner cone, and outer jacket, to increase stack exit velocity 1.5 times.
 - 3. Stack Cap: Consists of conical rainshield with inverted cone for partial rain protection with low flow resistance.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions and NFPA 54.
- B. Install breechings with minimum of joints. Align accurately at connections, with internal surfaces smooth.
- C. Support breechings from building structure, rigidly with suitable ties, braces, hangers and anchors to hold to shape and prevent buckling. Support vertical breechings, chimneys, and stacks at 12 foot spacing, to adjacent structural surfaces, or at floor penetrations. Refer to SMACNA (DCS) for equivalent duct support configuration and size.
- D. Pitch breechings with positive slope up from fuel-fired equipment to chimney or stack.
- E. Assemble and install stack sections in accordance with NFPA 82, industry practices, and in compliance with UL listing. Join sections with acid-resistant joint cement. Connect base section to foundation using anchor lugs.
- F. Level and plumb chimney and stacks.
- G. Clean breechings, chimneys, and stacks during installation, removing dust and debris.
- H. At appliances, provide slip joints permitting removal of appliances without removal or dismantling of breechings, breeching insulation, chimneys, or stacks.

END OF SECTION 23 51 00

**SECTION 23 52 16
CONDENSING BOILERS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Manufactured units.
- B. Boiler construction.
- C. Boiler trim.
- D. Fuel burning system.
- E. Factory installed controls.

1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete.
- B. Section 23 21 14 - Hydronic Specialties.
- C. Section 23 21 23 - Hydronic Pumps.
- D. Section 23 25 00 - HVAC Water Treatment.
- E. Section 26 05 83 - Wiring Connections: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

- A. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); Current Edition.
- B. ANSI Z21.13 - American National Standard for Gas-Fired Low-Pressure Steam and Hot Water Boilers; 2022.
- C. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; 2023.
- E. NBBI Manufacturer and Repair Directory - The National Board of Boiler and Pressure Vessel Inspectors (NBBI); Current Edition.
- F. NFPA 54 - National Fuel Gas Code; 2021.
- G. SCAQMD 1146.1 - Emissions of Oxides of Nitrogen from Small Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters; 1990, with Amendment (2018).

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide data indicating general assembly, components, controls, safety controls, and wiring diagrams with electrical characteristics and connection requirements, and service connections.

- C. Manufacturer's Installation Instructions: Indicate assembly, support details, connection requirements, and include start up instructions.
- D. Manufacturer's Factory Inspection Report: Submit boiler inspection prior to shipment.
- E. Manufacturer's Field Reports: Burner manifold gas pressure, percent carbon monoxide (CO), percent oxygen (O), percent excess air, flue gas temperature at outlet, ambient temperature, net stack temperature, percent stack loss, percent combustion efficiency, and heat output.
- F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

- A. Factory assembled, factory fire-tested, self-contained, readily transported unit ready for automatic operation except for connection of water, fuel, electrical, and vent services.
- B. Unit: Metal membrane wall, water or fire tube, condensing boiler on integral structural steel frame base with integral fuel burning system, firing controls, boiler trim, insulation, and removable jacket, suitable for indoor application.

2.2 BOILER CONSTRUCTION

- A. Comply with the minimum requirements of ASME BPVC-IV and ANSI Z21.13 for construction of boilers.
- B. Assembly to bear the ASME "H" stamp and comply with the efficiency requirements of the latest edition of ASHRAE Std 90.1 I-P.
- C. Required Directory Listings:
 - 1. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); current edition at www.ahrinet.org.
 - 2. NBBI Manufacturer and Repair Directory - The National Board of Boiler and Pressure Vessel Inspectors (NBBI); current edition at www.nationalboard.org.
- D. Heat Exchanger: Construct with materials that are impervious to corrosion where subject to contact with corrosive condensables.
- E. Provide adequate tappings, observation ports, removable panels, and access doors for entry, cleaning, and inspection.
- F. Insulate casing with insulation material, protected and covered by heavy-gauge metal jacket.
- G. Factory apply boiler base and other components, that are subject to corrosion, with durable, acrylic, powder coated, painted, or weather-proofed finish.

2.3 BOILER TRIM

- A. ASME rated pressure relief valve.
- B. Flow switch.

- C. Electronic Low Water Cut-off: Complete with test light and manual reset button to automatically prevent firing operation whenever boiler water falls below safe level.
- D. Temperature and pressure gauge.
- E. Pressure Switches:
 - 1. High gas pressure.
 - 2. Low gas pressure.
 - 3. Air pressure.
- F. Manual reset high limit.
- G. Boiler Pump (where required by boiler design):
 - 1. Primary pump, factory supplied and sized for field installation to ensure minimum, continuous circulation through boiler.
 - 2. Where pump is not provided by boiler manufacturer, provide pump in accordance with boiler manufacturer's recommendations.
 - 3. Pump time delay.

2.4 FUEL BURNING SYSTEM

- A. Provide forced draft automatic burner or pulse combustion, integral to boiler, designed to burn natural gas, propane, and No. 2 fuel oil, and maintain fuel-air ratios automatically.
 - 1. Blower Design: Statically and dynamically balanced to supply combustion air; direct connected to motor.
 - 2. Forced Draft Design: Mixes combustion air and gas to achieve 90 percent combustion efficiency.
 - 3. Pulse Combustion Design: Self-aspirating, not requiring blower for combustion.
 - 4. Combustion Air Filter: Protects fuel burning system from debris.
- B. Gas Train: Plug valve, safety gas valve, gas-air ratio control valve, and pressure regulator controls air and gas mixture.
- C. Emission of Oxides of Nitrogen Requirements: Comply with SCAQMD 1146.1 for natural gas fired system, as applicable.
- D. Intakes: Combustion air intake capable of accepting free mechanical room air or direct outside air through a sealed intake pipe.

2.5 FACTORY INSTALLED CONTROLS

- A. Option for internal or external (0-10) VDC control.
- B. Temperature Controls:
 - 1. Automatic reset type to control fuel burning system on-off and firing rate to maintain temperature.

2. Manual reset type to control fuel burning system to prevent boiler water temperature from exceeding safe system water temperature.
 3. Low-fire start time delay relay.
- C. Electronic PI setpoint/modulation control system.
- D. Microprocessor-based, fuel/air mixing controls.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install boiler and provide connection of natural gas service in accordance with requirements of NFPA 54 and applicable codes.
- C. Install boiler on concrete housekeeping base, sized minimum of 4 inches larger than boiler base in accordance with Section 03 30 00.
- D. Coordinate provisions for water treatment in accordance with Section 23 25 00.
- E. Pipe relief valves to nearest floor drain.
- F. Install primary boiler pump in accordance with Section 23 21 23.
- G. Provide piping connection and accessories in accordance with Section 23 21 14.
- H. Provide for connection to electrical service in accordance with Section 26 05 83.

END OF SECTION 23 52 16

**SECTION 23 64 23
SCROLL WATER CHILLERS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Factory-assembled packaged chiller.
- B. Charge of refrigerant and oil.
- C. Controls and control connections.
- D. Chilled water connections.
- E. Electrical power connections.

1.2 REFERENCE STANDARDS

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate physical size, weight and location of major pieces of equipment to be installed. Notify Architect of any major deviations from the equipment originally specified prior to ordering equipment.

1.4 SUBMITTALS

- A. Product Data: Provide rated capacities, weights, specialties and accessories, electrical requirements and wiring diagrams.
- B. Shop Drawings: Indicate components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Indicate equipment, piping and connections, valves, strainers, and thermostatic valves required for complete system.
- C. Sustainable Design Documentation: Submit manufacturer's product data on refrigerant used, showing compliance with specified requirements.
- D. Operation and Maintenance Data: Include start-up instructions, maintenance data, parts lists, controls, and accessories; include trouble-shooting guide.
- E. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- B. When required, provide certification of inspection in compliance with the requirements of Authority Having Jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's written installation instructions for rigging, unloading, and transporting units.
- B. Deliver units to the job site completely assembled and charged with refrigerant and oil by manufacturer.

1.7 WARRANTY

- A. Manufacturer's Warranty: Provide minimum five year warranty to include coverage for materials and labor for compressor.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Carrier, a part of UTC Building and Industrial Systems, a unit of United Technologies Corp
- B. Trane, a brand of Ingersoll Rand
- C. York International Corporation/Johnson Controls, Inc
- D. Or pre-approved equal

2.2 CHILLERS

- A. Chillers: Factory assemble and test chiller consisting of compressor(s), compressor motor(s), evaporator, condenser, enclosure, refrigeration circuits(s) and specialties, interconnecting piping, starters, and microprocessor-based controls.
 - 1. Rating: AHRI 550/590 (I-P).
 - 2. Refrigerant: R-454B
 - 3. Safety: UL 1995 and ASHRAE Std 15.
 - 4. Construction & Testing: ASME BPVC-VIII-1 as applicable for construction type.
 - 5. Provide factory flow switch.
 - 6. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. or testing firm acceptable to the Authority Having Jurisdiction as suitable for the purpose specified and indicated.
 - 7. Energy Efficiency: ASHRAE Std 90.1-2013.
 - 8. Enclosures:
 - a. Frame:
 - 1) Heavy-gage steel.
 - 2) Factory apply air-dried paint finish.
 - b. Steel Chiller Cabinets:
 - 1) Factory apply baked on powder paint finish.
 - 2) Perform 500-hour minimum salt spray test in accordance with ASTM B117.
 - c. Electrical Equipment: NEMA 250 or UL 1995 as applicable.

2.3 COMPRESSORS AND EVAPORATOR

- A. Compressors: Hermetic scroll type.
1. Unit: Fully hermetic type with multiple, direct drive compressors with discharge and suction service valves.
 2. Vibration Control: Field installed external isolators.
 3. Oil Lubrication System: Initial oil charge, oil sump, heater, oil level, and sight glass.
 4. Capacity Reduction System: Compressor staging with control down to 12 percent of full load without the activation of hot gas by-pass.
 5. Motor: 3600 or 3500 rpm, suction gas-cooled, with thermal or current overload protection.
 6. Each compressor shall have crankcase heaters installed and properly sized to minimize the amount of liquid refrigerant present in the oil sump during off cycles.
- B. Evaporator: Provide brazed plate type.
1. Brazed plate type.
 - a. Plate Material: 316 stainless steel.
 - b. Refrigerant Working-Side Pressure Rating: 430 psig minimum.
 - c. Water Working-Side Pressure Rating: 150 psig minimum.
 - d. Provide with flanged connections.
 - e. Insulation for all cold surfaces.
 - 1) Insulation is field installed on evaporator, connections, and suction piping.
 - 2) 1-1/2 inches minimum thick, closed cell, expanded polyvinyl chloride, polyurethane, or Armaflex II insulation with a maximum k value of 0.28.
 - f. Provide field installed vents and water drain connections on piping.
 - g. Provide field installed fittings for temperature control sensors on evaporator or piping.
 - h. Freeze Protection for Outdoor Locations: Provide thermostatically controlled electric heater to protect from freezing at ambient temperatures down to minus 20 degrees F.

2.4 AIR-COOLED CONDENSER AND FANS

- A. Provide finned-tube, brazed one-piece, or flat tube-plate-manifold type.
1. Finned-tube type.
 - a. Mechanically bond aluminum fins to copper tubing and protect with corrosion resistant materials or coatings.
 - b. Clean, dehydrate and test.
 - c. Leak Test: 650 psig minimum.
 2. Brazed one-piece type.
-

-
- a. Construct of same material to avoid galvanic corrosion.
 - b. Braze coils and headers as one assembly.
 - c. Clean, dehydrate and test.
 - d. Leak Test: 650 psig minimum.
3. Flat tube-plate-manifold type.
 - a. Construct all components of same aluminum alloy to avoid galvanic corrosion.
 - b. Braze manifolds, flat tubes and fin-plates together to form single coil assembly.
 - c. Clean, dehydrate and test.
 - d. Leak Test: 656 psig minimum.
- B. Coil Coating: Coil shall have a flexible epoxy polymer e-coat uniformly applied to all coil surface areas without material bridging between fins.
1. Coating process shall ensure complete coil encapsulation and a uniform dry film thickness from 0.8-1.2 mil on surface areas including fin edges.
 2. Superior hardness characteristics of 2H per ASTM D3363-92A and a cross hatch adhesion of 4B-5B per ASTM B3359-93.
 3. Impact resistance shall be 160 in/lb per ASTM D2794-93.
 4. Humidity and water immersion resistance shall be up to a minimum 1000 and 260 hours respectively (ASTM D2247-92 and ASTM D870-02).
 5. Corrosion durability shall be confirmed through testing to no less than 5,000 hours salt spray per ASTM B117-90 using scribed aluminum test coupons.
 6. Coils subjected to ultraviolet exposure shall receive a spray-applied UV-resistant polyurethane topcoat to prevent UV degradation of the e-coat.
- C. Coil Guards: Provide corrosion proof, louvered panels, factory installed. Provide coil protection for shipping by enclosing entire condenser coil with heavy plastic to prevent coil damage during shipping or rigging.
- D. Fans and Motors:
1. Fans: Dynamically balance propeller type fans of reinforced polymer corrosion resistant construction equipped with sealed, permanently lubricated ball bearings.
 2. Discharge Fan Guards: Corrosion resistant, heavy gage, steel wire.
 3. Discharge Direction: Vertical.
 4. Motors: Direct drive, totally enclosed for outdoor use with current overload protection.
 5. Unit shall be capable of starting and running at outdoor ambient temperatures from 32F to 125F for all sizes.

2.5 REFRIGERATION CIRCUITS

- A. Provide multiple independent refrigeration circuit(s) with multiple compressor(s) per circuit.
- B. Provide liquid line shut-off valve, filter-drier, expansion valve, and refrigerant relief device for each independent circuit.

2.6 INTEGRATED MICROPROCESSOR BASED DDC CONTROLS PACKAGE

- A. Pre-wire, assemble, factory mount, and test operating and safety control system consisting of a digital display or gauges, on-auto-off switch, motor starters, disconnect switches, power and control wiring. The control panel shall have an SSCR rating of 65 kA. Provide controls, monitoring, programmable set-points, alarms, and BAS as defined below:
 - 1. Automatic Adjustable Operating Controls:
 - a. Temperature of chilled water leaving chiller.
 - b. Chiller system capacity control based on set-points and system load.
 - c. Compressor short-cycling prevention.
 - d. Lead/lag for multiple compressors.
 - e. Automatic reset on power source failure.
 - f. Load limiting.
 - g. Sequencing of condenser fans.
 - 2. Normal Operation Monitoring and Open Cover-less Displays:
 - a. Hours of operation.
 - b. Suction and discharge refrigerant pressures.
 - c. Automatic diagnostics.
 - d. Number of starts.
 - e. On/off compressor status.
 - f. Entering and leaving chilled water temperatures.
 - g. Status of operation.
 - h. Weekly purge cycle totalization if applicable.
 - i. Oil pressure.
 - 3. Set-Points:
 - a. Leaving chilled water temperature.
 - b. Date/time.
 - 4. Automatic Chiller Shut-Down Safety Controls and Alarm:
 - a. Automatic Reset:

- 1) Chilled water flow interlock.
 - 2) Voltage protection (over/under).
 - 3) Phase reversal protection.
 - b. Manual Reset:
 - 1) Evaporator low pressure.
 - 2) High motor winding temperature.
 - 3) Low chilled water temperature.
 - 4) Low chilled water flow.
 - 5) High condenser refrigerant discharge pressure.
 - 6) Motor current overload and phase loss.
 - 7) Low oil flow.
 - c. Remote Alarm: Activate remote, audible bell upon safety shutdown of chiller.
5. BAS interface:
- a. Each chiller shall be provided by BACnet or LON card. Coordinate protocol with BAS Controls Contractor prior to release.
6. Building Automation System (BAS) Communications via Shielded Cable:
- a. Minimum Data Transmission to BAS:
 - 1) All system operating conditions.
 - 2) Capacity control information.
 - 3) Safety shutdown conditions.
 - b. Minimum Operating Commands from BAS:
 - 1) Remote unit start/stop.
 - 2) Remote chilled water reset.
- B. The unit shall have a machine mounted control console in a weatherproof box containing the following:
1. System emergency stop switch.
 2. Oil failure switch (manual reset).
 3. Water freeze protection.
 4. High and low pressure cutouts.
 5. Pump down controls.

- 6. Water temperature control thermostat.
- C. Each unit shall include a positive acting timer to prevent short cycling of compressors and to delay restart of compressors after shutdown.
- D. On all units, source of control circuit power shall be completely independent of unit power source.
- E. The power and control cabinet shall be machine mounted in a weatherproof box containing the following:
 - 1. Circuit breaker with three phase protection.
 - 2. Starting contactors.
 - 3. Control terminal block.
 - 4. Power terminal block.
 - 5. Power wiring.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Align chiller package on steel or concrete foundations.
- C. The unit shall be set into place on a concrete pad with neoprene type vibration isolators, leveled, piped, wired, and controlled as shown on the plans and as required by the manufacturer. Connect all water piping so chiller and water circuits are serviceable.
- D. Furnish and install taps for thermometers and pressure gauges in water piping adjacent to inlet and outlet connections of evaporator. Make taps completely weatherproof yet accessible.
- E. Insulate evaporator and any other portion of machine required to prevent sweating and/or freezing under normal operating conditions.
- F. Furnish and install all necessary controls external to unit, including all interlock wiring and interface with the building control system.
- G. A factory representative shall be present at the job site for a period of two working days to supervise the testing, dehydrating, charging and start up of the chiller, and he shall instruct the Owner's representative in the operation of the chiller.
- H. Connect to electrical service.
- I. Connect to chilled water piping.
- J. Arrange piping for easy dismantling to permit tube cleaning and removal.

3.2 MANUFACTURER'S FIELD SERVICES

- A. Perform factory startup of the chiller by factory trained and authorized servicing technicians confirming equipment has been correctly installed prior to equipment becoming operational and covered under the manufacturer's warranty.

- B. Supply initial charge of refrigerant and oil if not completely factory charged.
- C. Demonstrate system operations and verify specified performance.

3.3 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate operation of system to Owner's personnel.
 - 1. Use operation and maintenance data as reference during demonstration.
 - 2. Briefly describe function, operation, and maintenance of each component.
- B. Commissioning: Refer to 23 08 00.
- C. Training: Train Owner's personnel on operation and maintenance of system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of one day of training.
 - 3. Instructor: Manufacturer's training personnel.
 - 4. Location: At project site.
- D. The Contractor, upon completion of the project, shall prepare an as-built control diagram on a non-fading paper. The diagram shall be installed in a glassed frame and hung on the mechanical room wall.

END OF SECTION 23 64 23

**SECTION 23 73 13
MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Casing construction.
- B. Fan section.
- C. Coil section.
- D. Filter and air cleaner section.
- E. Damper section.
- F. Airflow measurement.
- G. Total energy recovery wheel section.

1.2 RELATED REQUIREMENTS

- A. Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
- B. Section 23 05 48 - Vibration and Seismic Controls for HVAC.
- C. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.
- D. Section 23 07 19 - HVAC Piping Insulation.
- E. Section 23 33 00 - Air Duct Accessories: Flexible duct connections.
- F. Section 23 34 13 - Axial HVAC Fans.

1.3 REFERENCE STANDARDS

- A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015 (Reaffirmed 2020).
- B. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils; 2001, with Addenda (2011).
- C. AHRI 1060 (I-P) - Performance Rating of Air-to-Air Exchangers for Energy Recovery Ventilation Equipment; 2023.
- D. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program; 2015.
- E. AMCA 99 - Standards Handbook; 2016.
- F. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2016, with Errata (2018).
- G. AMCA 300 - Reverberant Room Method for Sound Testing of Fans; 2014.
- H. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2022.
- I. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating; 2018.

- J. AMCA 611 - Certified Ratings Program - Product Rating Manual for Airflow Measurement Stations; 2015.
- K. ASHRAE Std 62.1 - Ventilation for Acceptable Indoor Air Quality; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. ASTM B177/B177M - Standard Guide for Engineering Chromium Electroplating; 2011 (Reapproved 2021).
- N. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
- O. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
- P. UL 1812 - Ducted Heat Recovery Ventilators; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data:
 - 1. Published Literature: Indicate dimensions, weights, capacities, ratings, gauges and finishes of materials, and electrical characteristics and connection requirements.
- C. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
- D. Manufacturer's Instructions: Include installation instructions.
- E. Maintenance Data: Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.
- B. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.
- C. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.6 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Daikin Applied: www.daikinapplied.com/#sle.
- B. Trane Technologies, PLC: www.trane.com/#sle.

C. York, a brand of Johnson Controls International, PLC: www.york.com/#sle.

2.2 CASING CONSTRUCTION

A. Full Perimeter Base Rail:

1. Construct of galvanized steel.
2. Provide base rail of sufficient height to raise unit for external trapping of condensate drain pans.

B. Casing:

1. Construct of one piece, insulated, double wall panels.
2. Provide mid-span, no through metal, internal thermal break.
3. Construct outer panels of galvanized steel and inner panels of galvanized steel.
4. Casing Air Pressure Performance Requirements:
 - a. Able to withstand up to 8 in-wc positive or negative static pressure.
 - b. Not to exceed 0.0042 inches per inch deflection at 1.5 times design static pressure up to a maximum of plus 8 in-wc in positive pressure sections and minus 8 in-wc in negative pressure sections.

C. Access Doors:

1. Construction, thermal and air pressure performance same as casing.
2. Provide surface mounted handles on hinged, swing doors.

D. Unit Flooring: Construct with sufficient strength to support expected people and equipment loads associated with maintenance activities.

E. Casing Leakage: Seal joints and provide airtight access doors so that air leakage does not exceed one percent of design flow at the specified casing pressure.

F. Insulation:

1. Provide minimum thermal thickness of 12 R throughout.
2. Completely fill panel cavities in each direction to prevent voids and settling.
3. Comply with NFPA 90A.

G. Drain Pan Construction:

1. Provide cooling coil sections with an insulated, double wall, stainless steel drain pan complying with ASHRAE Std 62.1 for indoor air quality and sufficiently sized to collect all condensate.
2. Slope in two planes to promote positive drainage and eliminate stagnate water conditions.
3. Locate outlet of sufficient diameter at lowest point of pan to prevent overflow at normal operating conditions.

4. Provide threaded drain connections constructed of drain pan material, extended sufficient distance beyond the base to accommodate field installed, condensate drain trapping.
- H. Finish:
1. Indoor Units:
 - a. Provide exterior, galvanized steel panels without paint.
 - b. Provide exterior, galvanized steel panels with painted surface complying with ASTM B177/B177M.
 - c. Color: Manufacturer's standard color.

2.3 FAN SECTION

- A. Type: Forward curved, single width, single inlet, centrifugal plug fan, in accordance with AMCA 99. See Section 23 34 13
- B. Performance Ratings: Determined in accordance with AMCA 210 and labeled with AMCA Certified Rating Seal.
- C. Sound Ratings: AMCA 301; tested to AMCA 300 and label with AMCA Certified Sound Rating Seal.
- D. Bearings: Self-aligning, grease lubricated, with lubrication fittings extended to exterior of casing with plastic tube and grease fitting rigidly attached to casing.
- E. External Motor Junction Box: Factory mount NEMA 4 external junction box and connect to extended motor leads from internally mounted motors.
- F. Motor Wiring Conduit: Factory wire fan motor wiring to the unit mounted starter-disconnect, variable frequency drive, and external motor junction box.
- G. Fan Accessories:
- H. Flexible Duct Connections:
 1. For separating fan, coil, and adjacent sections.
- I. Drives:
 1. Comply with AMCA 99.
 2. Bearings: Heavy duty pillow block type, ball bearings, with ABMA STD 9 L-10 life at 50,000 hours.
 3. Shafts: Solid, hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.
 4. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, bored to fit shafts, and keyed. Variable and adjustable pitch sheaves for motors 15 hp and under selected so required rpm is obtained with sheaves set at mid-position; fixed sheave for 20 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.
 5. Belt Guard: Fabricate to SMACNA (DCS); 0.106 inch thick, 3/4 inch diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

2.4 COIL SECTION

- A. Casing: Provide access to both sides of coils. Enclose coils with headers and return bends exposed outside casing. Slide coils into casing through removable end panel with blank off sheets and sealing collars at connection penetrations.
- B. Drain Pans: 24 inch downstream of coil and down spouts for cooling coil banks more than one coil high.
- C. Eliminators: Three break of galvanized steel, mounted over drain pan.
- D. Air Coils:
 - 1. Certify capacities, pressure drops, and selection procedures in accordance with AHRI 410.
- E. Fabrication:
 - 1. Tubes: 5/8 inch OD seamless copper expanded into fins, brazed joints.
 - 2. Fins: Aluminum.
 - 3. Casing: Die formed channel frame of galvanized steel.
- F. Water Heating Coils:
 - 1. Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.
 - 2. Configuration: Drainable, with threaded plugs for drain and vent; serpentine type with return bends on smaller sizes and return headers on larger sizes.

2.5 FILTER AND AIR CLEANER SECTION

- A. General: Provide filter sections with filter racks, minimum of one access door for filter removal, and filter block-offs to prevent air bypass.
- B. Differential Pressure Gauge:
 - 1. Provide factory installed dial type differential pressure gauge, flush mounted with casing outer wall, and fully piped to both sides of each filter to indicate status.
 - 2. Maintain plus/minus 5 percent accuracy within operating limits of 20 degrees F to 120 degrees F.

2.6 DAMPER SECTION

- A. Mixing Section: Provide a functional section to support the damper assembly for modulating the volume of outdoor, return, and exhaust air.
- B. Damper Blades:
 - 1. Double-skin airfoil design with metal, compressible jamb seals and extruded-vinyl blade-edge seals on each blade.
 - 2. Self-lubricating stainless steel or synthetic sleeve bearings.
 - 3. Comply with ASHRAE Std 90.1 I-P for rated maximum leakage rate.
 - 4. Provide leakage testing and pressure ratings in compliance with AMCA 500-D test methods.

5. Arrange in parallel or opposed-blade configuration.

C. Barometric Relief Dampers:

1. Frame: Roll formed galvanized steel.
2. Blades: Roll formed galvanized steel.
3. Blade Seals: Extruded vinyl, mechanically attached to the blade edge.
4. Material:

2.7 AIRFLOW MEASUREMENT

A. Manufacturers:

1. Air Monitor, a brand of Onicon, Inc; _____: www.onicon.com/#sle.
2. Dwyer Instruments Inc; _____: www.dwyer-inst.com/#sle.

B. Airflow Measurement Station:

1. Provide factory installed, airflow measurement station tested in accordance with AMCA 611 and bearing the AMCA Ratings Seal for Airflow Measurement Performance.
2. Station Location: Install in outdoor and return opening(s) to measure airflow.
3. Damper Blades:
 - a. Galvanized steel or extruded aluminum construction.
 - b. Housed in galvanized steel or extruded aluminum frame and mechanically fastened to a rotating axle rod.
 - c. Comply with ASHRAE Std 90.1 I-P for rated maximum leakage rate.
4. Measurement Range: Minimum of 15 percent to 100 percent of unit nominal flow.
5. Operation: Provide low voltage signal corresponding to actual airflow for controlling and documenting airflow.
6. Accuracy: Plus/minus 5 percent.

2.8 TOTAL ENERGY RECOVERY WHEEL SECTION

A. Certified in accordance with AHRI 1060 (I-P) and UL 1812 for mechanical, electrical, and fire safety.

B. Wheel Construction:

1. Dessicant Properties:
 - a. Factory coated.
 - b. Washable using standard detergent or alkaline based coil cleaner.
 - c. Resistant to high levels of humidity.

2. Construct housing of stainless steel, aluminum, or galvanized steel.
 3. Factory set adjustable diameter seals and self-adjusting perimeter seals.
 4. Permanently sealed and lubricated wheel bearings.
 5. Motor:
 - a. Thermally protected.
 - b. Factory mounted.
- C. Maintenance and Access Features:
1. Access doors upstream and downstream of the wheel cassette.
 2. Removable wheel segments to facilitate maintenance and cleaning.
 3. Adequate space for cleaning, service, and maintenance.
- D. Controls:
1. Wheel Control: Damper control of recovery capacity to 40 percent of initial total recovery capacity.
 2. Frost Prevention Control: Provide outside air bypass, return air preheat, or variable speed method.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Bolt sections together with gaskets.
- C. Provide fixed sheaves required for final air balance.
- D. Make connections to coils with unions or flanges.
- E. Hydronic Coils:
 1. Hydronic Coils: Connect water supply to leaving air side of coil (counterflow arrangement).
 2. Provide shut-off valve on supply line and lockshield balancing valve with memory stop on return line.
 3. Locate water supply at bottom of supply header and return water connection at top.
 4. Provide manual air vents at high points complete with stop valve.
 5. Ensure water coils are drainable and provide drain connection at low points.

END OF SECTION 23 73 13

**SECTION 23 81 26.13
SMALL-CAPACITY SPLIT-SYSTEM AIR CONDITIONERS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Air cooled condensing units.
- B. Indoor air handling (fan and coil) units for ductless systems.
- C. Controls.

1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Mounting pad for outdoor unit.

1.3 REFERENCE STANDARDS

- A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2023.
- B. AHRI 520 - Performance Rating of Positive Displacement Condensing Units; 2004.
- C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2022, with Errata (2023).
- D. ASHRAE Std 23 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Compressor Units; 2022.
- E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
- F. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2024.
- G. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

PART 2 PRODUCTS

2.1 SYSTEM DESIGN

- A. Split-System Cooling Units: Self-contained, packaged, matched factory-engineered and assembled, pre-wired indoor and outdoor units; UL listed.
 - 1. Cooling: Outdoor electric condensing unit with evaporator coil in central ducted indoor unit.
 - 2. Provide refrigerant lines internal to units and between indoor and outdoor units, factory cleaned, dried, pressurized and sealed, with insulated suction line.
- B. Performance Requirements: See Drawings for additional requirements.

2.2 INDOOR AIR HANDLING UNITS FOR DUCTLESS SYSTEMS

- A. Manufacturers:
 - 1. Bosch Thermotechnology: www.bosch-thermotechnology.us/#sle.
 - 2. Rheem Manufacturing Company Inc: www.rheem.com/#sle.

3. Trane Inc: www.trane.com/#sle.
 4. Mitsubishi Electric.
- B. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, evaporator coil, and controls; wired for single power connection with control transformer.
- C. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.
1. Construction and Ratings: In accordance with AHRI 210/240 and UL 207.
 2. Manufacturer: System manufacturer.

2.3 OUTDOOR UNITS

- A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.
1. Comply with AHRI 210/240.
 2. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of zero and global warming potential (GWP) of less than 50.
 3. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Std 23 and UL 207.
- B. Air Cooled Condenser: Aluminum fin and copper tube coil, AHRI 520 with direct drive axial propeller fan resiliently mounted, galvanized fan guard.
1. Condenser Fans: Direct-drive propeller type.
- C. Coil: Air-cooled, aluminum fins bonded to copper tubes.
- D. Accessories: Filter drier, high-pressure switch (manual reset), low pressure switch (automatic reset), service valves and gauge ports, thermometer well (in liquid line).
1. Provide thermostatic expansion valves.
- E. Operating Controls:
1. Control by room thermostat to maintain room temperature setting.
 2. Low Ambient Kit: Provide refrigerant pressure switch to cycle condenser fan on when condenser refrigerant pressure is above 285 psig and off when pressure drops below 140 psig for operation to 0 degrees F.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrates are ready for installation of units and openings are as indicated on shop drawings.
- B. Verify that proper power supply is available and in correct location.

3.2 INSTALLATION

- A. Install in accordance with NFPA 90A and NFPA 90B.
- B. Install refrigeration systems in accordance with ASHRAE Std 15.

END OF SECTION 23 81 26.13

SECTION 23 82 00
CONVECTION HEATING AND COOLING UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Hydronic unit heaters.
- B. Electric unit heaters.
- C. Blower-coil units.

1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete.
- B. Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
- C. Section 23 07 16 - HVAC Equipment Insulation.
- D. Section 23 07 19 - HVAC Piping Insulation.
- E. Section 23 21 13 - Hydronic Piping.
- F. Section 23 21 14 - Hydronic Specialties.
- G. Section 26 05 83 - Wiring Connections: Electrical characteristics and wiring connections. Installation of room thermostats. Electrical supply to units.

1.3 REFERENCE STANDARDS

- A. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); Current Edition.
- B. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils; 2001, with Addenda (2011).
- C. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
- D. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide typical catalog of information including arrangements.
- C. Shop Drawings:
 - 1. Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations.
 - 2. Indicate air coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.
 - 3. Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.

4. Submit the following for blower-coil units indicating:
 5. Indicate mechanical and electrical service locations and requirements.
- D. Manufacturer's Instructions: Indicate installation instructions and recommendations.
- E. Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets required for access or valving.
- F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.
- G. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

PART 2 PRODUCTS

2.1 HYDRONIC UNIT HEATERS

- A. Manufacturers:
1. Modine Manufacturing Company: www.modineHVAC.com/#sle.
 2. Sterling Hydronics, a Mestek Company: www.sterlingheat.com/#sle.
 3. Trane Technologies, PLC: www.trane.com/#sle.
- B. Coils: Seamless copper tubing, silver brazed to steel headers, and with evenly spaced aluminum fins mechanically bonded to tubing.
- C. Perform factory run test under normal operating conditions, water, and steam flow rates.
- D. Casing: Minimum 18 gauge, 0.0478 inch thick sheet steel casing with threaded pipe connections for hanger rods for horizontal models and minimum 18 gauge, 0.0478 inch thick sheet steel top and bottom plates for vertical projection models.
- E. Finish: Factory applied baked primer coat.
- F. Fan: Direct drive propeller type, statically and dynamically balanced, with fan guard; horizontal models with permanently lubricated sleeve bearings; vertical models with grease lubricated ball bearings.
- G. Air Outlet: Adjustable pattern diffuser on vertical projection models and two- or four- way louvers on horizontal projection models.
- H. Control: Local solid state disconnect switch with electropneumatic thermostat.

2.2 ELECTRIC UNIT HEATERS

- A. Manufacturers:
1. INDEECO (Industrial Engineering and Equipment Company): www.indeeco.com/#sle.
 2. Modine Manufacturing Company: www.modineHVAC.com/#sle.
 3. Trane Technologies, PLC: www.trane.com/#sle.

- B. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to authority having jurisdiction as suitable for purpose indicated.
- C. Heating Element Assembly:
 - 1. Thermal safety cut-out within electric terminal box with automatically reset switch located near electric terminal box.
 - 2. Vertical Projection Units:
 - a. Finned tubular.
 - b. Nickel chromium resistance wire surrounded with magnesium oxide and sheathed in steel, spiral-finned tubes.
- D. Housing:
 - 1. Suitable for ceiling or high altitude mount using provided hardware appendages.
 - 2. Vertical Projection Units:
 - a. Construction materials to consist of heavy gauge steel with polyester powder coat or high gloss baked enamel.
 - b. Provide with mounting support brackets or provisions for mounting from ceiling or structure above.
 - c. Provisions for access to internal components for maintenance, adjustments, and repair.
- E. Air Inlets and Outlets:
 - 1. Inlets: Provide stamped louvers or protective grilles with fan blade guard.
 - 2. Outlets: Provide diffuser cones, directional louvers, or radial diffusers.
- F. Fan: Factory balanced, direct drive, axial type with fan guard.
- G. Motor: Totally enclosed, thermally protected, and provided with permanently lubricated bearings.
- H. Controls:
 - 1. Remoteline-voltage thermostat.

2.3 BLOWER-COIL UNITS - VERTICAL

- A. Manufacturers:
 - 1. Carrier Corporation: www.commercial.carrier.com/#sle.
 - 2. Johnson Controls International, PLC: www.johnsoncontrols.com/#sle.
 - 3. First Co ; [CHW-HWK] : www.firstco.com
 - 4. Trane Technologies, PLC; BCVD: www.trane.com/#sle.
- B. Performance Data and Safety Requirements:
 - 1. Coils rated and tested in accordance with AHRI 410.

2. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to authority having jurisdiction as suitable for purpose indicated.
 3. Comply with NFPA 90A for unit construction, including filters and related equipment, for protection of life and property from fire, smoke, and gases resulting from conditions having manifestations similar to fire.
- C. Unit Casing:
1. Fabricate from heavy gauge galvanized steel sheet.
 2. Insulate inside walls with 1 inch thick, fiberglass insulation for thermal and acoustical control.
 3. Provide access panels allowing servicing of coils, drain pan, fan, motor, and drive.
 4. Provide knockouts or hanger rod holes at all four corners for suspended units.
- D. Air Coils:
1. Aluminum fins mechanically expanded or bonded to copper tubes having standard sweat connections.
 - a. Water: Manual, automatic or self-venting, designed to a working pressure and temperature of not less than 250 psig and 200 degrees F.
- E. Fans: Forward curved, centrifugal blower, dynamically balanced, adjustable speed V-belt drive with fan shaft supported by heavy-duty, permanently sealed ball bearings.
- F. Drain Pan: Cleanable, one-piece construction of stainless steel; with drain connection and sloped for positive drainage.
- G. Filters: Fully accessible, flat filter rack with MERV 8 throw-away filters.
- H. Motors: Single speed with sleeve or ball bearings, 1,750 rpm, wired to unit junction box, and mounted on a resilient motor base.
- I. Electrical Controls:
1. 24-volt control circuit transformer.
 2. Motor circuit fusing.
 3. Fan contactor.
 4. Terminal strip for connection of field wiring.
 5. Disconnecting means for main incoming power.

2.4 HOSE KITS AND VALVES

- A. Manufacturers:
1. Griswold Controls: www.griswoldcontrols.com/#sle.
 2. Hays Fluid Controls: www.haysfluidcontrols.com/#sle.
 3. IMI Flow Design, a brand of IMI Hydronic Engineering Division of IMI PLC: www.flowdesign.com/#sle.
- B. Hoses:
-

1. Provide hoses for all units for connection to main water supply and return headers.
 2. Length: 2 feet.
 3. Material: Braided stainless steel rated to minimum 400 psi at 265 degrees F.
- C. Automatic Balancing Valves:
1. Brass body for shutoff and hydronic balancing.
- D. Ball Valves:
1. Brass body for shutoff and hydronic balancing.
 2. Provide memory, memory stop, and pressure/temperature ports.
- E. Y Strainers:
1. Bronze body.
 2. "Y" type configuration with brass cap.
 3. Maximum Operating Pressure: Minimum 450 psi.
 4. Screen: Stainless steel.
- F. Auto-flow regulators as indicated in the schedule.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are suitable for installation.
- B. Verify that field measurements are as indicated on drawings.

3.2 PREPARATION

- A. Provide 4" high housekeeping pads for blower coil units under provisions of Section 03 30 00.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's recommendations.
- B. Do not damage equipment or finishes.
- C. Unit Heaters:
 1. Hang from building structure, with pipe hangers anchored to building, not from piping or electrical conduit.
 2. Mount as high as possible to maintain greatest headroom unless otherwise indicated.
- D. Units with Hydronic Coils:
 1. Provide with shut-off valve on supply piping and tamper-proof, balancing valve with memory stop on return piping.

2. If not easily accessible, extend air vent to exterior surface of cabinet for ease of servicing.
 3. Provide float operated automatic air vents with stop valve for cabinet unit heaters, fan coil units, and unit heaters.
- E. Units with Cooling Coils: Connect drain pan to condensate drain.
- F. Units with Electric Heating Elements:
1. Install as indicated including electrical devices furnished by manufacturer but not factory installed.
 2. Install wiring in accordance with the manufacturer's wiring diagram submittal and Section 26 05 83.
- G. Blower-Coil Units:
1. Verify all surfaces and openings at unit location can suitably accommodate unit(s).
 2. Install in accordance with manufacturer's recommendations.
 3. Provide manual shut-off valve on hydronic supply side of coil and balancing valve with memory stop on return side.
 4. General piping installation requirements are specified in other Sections and drawings indicate general arrangement of piping, fittings, and specialties.
 5. Connect hydronic, condensate drain, and overflow drain piping to unit.

3.4 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 - Closeout Submittals for closeout submittals.

END OF SECTION 23 82 00

**DIVISION 26
ELECTRICAL**

**SECTION 26 00 01
ELECTRICAL ALTERNATES**

PART 1 GENERAL

1.1 LIST OF ALTERNATES

A. Refer to Architect's Division 01 Specification for Bid Alternates.

END OF SECTION 26 00 01 26 00 01

**SECTION 26 01 00
ELECTRICAL GENERAL PROVISIONS**

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. This Contractor shall provide all materials, equipment and labor necessary to install and set into operation the electrical equipment as shown on the Engineering Drawings and as contained herein.

1.2 QUALITY ASSURANCE

- A. See the General and Supplementary General Conditions and Architectural Divisions.
- B. All work shall be in accordance with the North Carolina State Building Code, which includes the 2020 edition of the National Electrical Code.
- C. The Contractor shall be responsible for obtaining all permits and shall notify inspection departments as work progresses.
- D. Wherever the words "Approved", "Approval", and "Approved Equal" appear, it is intended that items other than the model numbers specified shall be subject to the approval of the Engineer.
- E. "Provide" as used herein shall mean that the Contractor responsible shall furnish and install said item or equipment. "Furnish" as used herein shall mean that the Contractor responsible shall acquire and make available said item or equipment and that installation shall be by others. "Install" as used herein shall mean that the Contractor responsible shall make installation of items or equipment furnished by others.
- F. All personnel under this Contractor's supervision shall be qualified to perform those portions of the work assigned to them. Personnel (including project managers) deemed to be negative to the overall success of the project shall be removed from the project and replaced with qualified personnel who will be positive for the project. Upon written notification that particular personnel have been deemed negative to the overall success of the project, this Contractor shall immediately replace such particular personnel. The engineer shall be sole arbiter and any decision regarding fitness of this Contractor's personnel for this project shall not be subject to appeal.

1.3 SUBMITTALS

- A. See General and Supplementary General Conditions and Division 1.
- B. Within ten (10) days after notification of the award of the Contract and written notice to begin work, the Contractor shall submit for approval to the Architect/Engineer a detailed list of equipment and material which he proposes to use.
- C. The Contractor shall provide an electronic pdf copy of the submittal data on the products, methods, etc. proposed for use on the project. The submittal shall contain complete submittal data on all products, methods, etc. proposed for use on the project.
- D. Each submittal shall bear the approval of the Contractor indicating that he has reviewed the data and found it to meet the requirements of the specifications as well as space limitations and other project conditions. The submittals shall be clearly identified showing project name, manufacturer's catalog number and all necessary performance and fabrication data. Detailed submittal data shall be provided when items are to be considered as substitution for specified items. Acceptance for approval shall be in writing from the Engineer.

- E. The Contractor shall submit to the Engineer a set of accurately marked-up plans indicating all changes encountered during the construction. Final payment will be contingent on receipt of these as-built plans.
- F. The Contractor shall furnish an electronic copy of maintenance and operating instructions.
- G. The Contractor shall submit to the Engineer a duplicate set of final electrical inspection certificates prior to final payment.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. All material and equipment shall be delivered and unloaded by the Contractor within the project site as noted herein or as directed by the Owner.
- B. The Contractor shall protect all material and equipment from breakage, theft or weather damage. No material or equipment shall be stored on the ground.
- C. The material and equipment shall remain the property of the Contractor until the project has been completed and turned over to the Owner.
- D. Where equipment cannot be stored at the site due to exposure to the elements or lack of storage space, the contractor shall store all equipment in a bonded warehouse until the time of installation.

1.5 WORK CONDITIONS AND COORDINATION

- A. The Contractor shall review the entire set of plans to establish points of connection and the extent of electrical work to be provided in his Contract.
- B. The contractor is responsible for reviewing the complete set of contract documents. Coordinate all phasing requirements with architectural drawings. Coordinate equipment locations and utility routing with all trades to ensure code compliance and constructibility.
- C. This Contractor shall be responsible for all electrical work and make final connections to equipment installed in his Contract.
- D. Pipe, conduit and duct chases required for installation of work shall be provided by the General Contractor unless otherwise noted. This Contractor shall be responsible for coordinating the location of all required chases.
- E. All work shall be coordinated with other trades. Cutting of new work and subsequent patching shall be approved by Architect/ Engineer and shall be at the Contractor's expense with no extra cost to the Owner.

1.6 GUARANTEE

- A. See the General and Supplementary General Conditions.
- B. Where extended warranties or guarantees are available from the manufacturer, the Contractor shall prepare the necessary Contract Documents to validate these warranties as required by the manufacturer and present them to the Architect/Engineer.

PART 2 PRODUCTS

2.1 MATERIAL QUALITY

- A. Material and equipment shall be new, unless noted otherwise, of the highest grade and quality and free from defects or other imperfections. Material and equipment found defective shall be removed and replaced at the Contractor's expense.

2.2 EQUIPMENT LISTINGS

- A. All materials and equipment shall be third party listed by an agency accredited by the NCBC and NC Department of Insurance (NC DOI). The list of accredited agencies may be obtained on NCDOL's web site.

PART 3 EXECUTION

3.1 INSPECTION

- A. If any part of this Contractor's work is dependent for its proper execution or for its subsequent efficiency or appearance on the character or conditions of contiguous work not executed by him, the Contractor shall examine and measure such contiguous work and report to the Architect or Engineer in writing any imperfection therein, or conditions that render it unsuitable for the reception of this work. Should the Contractor proceed without making such written report, he shall be held to have accepted such work and the existing conditions and he shall be responsible for any defects in this work consequent hereon and will not be relieved of the obligation of any guarantee because of any such imperfection or condition.
- B. After the designer pre-final inspection and confirmation that the final punch list items have been completed. The contractor shall schedule a final electrical inspection with the local inspections department.

3.2 INSTALLATION

- A. All work shall be performed in a manner indicating proficiency in the trade.
- B. All conduit, pipes, ducts, etc., shall be either parallel to building walls or plumb where installed in a vertical position and shall be concealed when located in architecturally finished areas.
- C. Any cutting or patching required for installation of this Contractor's work shall be kept to a minimum. Written approval shall be required by the Architect/Engineer if cutting of primary structure is involved.
- D. All patching shall be done in such a manner as to restore the areas or surfaces to match existing finishes.
- E. The Contractor shall lay-out and install his work in advance of pouring concrete floors or walls. He shall furnish and install all sleeves or openings through poured masonry floors or walls above grade required for passage of all conduits, pipes or duct installed by him. The Contractor shall furnish and install all inserts and hangers required to support his equipment.
- F. The Contractor shall be responsible for removing all spray-on fireproofing overspray from all equipment, light fixtures, and all other materials provided as part of the electrical contract.

3.3 PERFORMANCE

- A. The Contractor shall perform all excavation and backfill operations necessary for installation of his work.
- B. Rock excavation shall be defined in the Supplementary General Conditions, Division 1 or Division 2. Unless specifically stated, neither rock excavation nor a unit price for rock excavation shall be required in the bid.

3.4 ERECTION

- A. All support steel, angles, channels, pipes or structural steel stands and anchoring devices that may be required to rigidly support or anchor material and equipment shall be provided by this Contractor.

3.5 FIELD QUALITY CONTROL

- A. The Contractor shall conform to the requirements of Division 3 for concrete testing.

- B. The Contractor shall test his entire installation and shall furnish the labor and materials required for these tests. Tests shall be performed in accordance with the requirements of the particular section of the specifications and in accordance with the requirements of the State Ordinances and Codes, and the National Electrical Code. The Contractor shall notify the Architect or Engineer of his readiness for such test. A final inspection by the Electrical Inspector or Local Authority Having Jurisdiction is required, and an inspection certificate is required prior to authorization of final payment.
- C. Testing required for compliance with the Contract shall be stated in subsequent sections.
- D. All tests specified shall be completely documented indicating time of day, date, temperature and all other pertinent test information including the entity conducting the test.
- E. All required documentation of readings required by each test shall be submitted to the Engineer prior to, and as one of the prerequisites for, final acceptance of the project.

3.6 ADJUST AND CLEAN

- A. All equipment and installed materials shall be thoroughly clean and free of all dirt, oil, grit, grease, etc.
- B. Factory painted equipment shall not be repainted unless damaged areas exist. These areas shall be touched up with a material suitable for the intended service. In no event shall nameplates be painted.
- C. At a scheduled meeting, the Contractor shall instruct the Owner or the Owner's representative in the operation and maintenance of all equipment installed under his Contract (in the presence of the Engineer).

3.7 MAINTENANCE AND OPERATING MANUAL

- A. The Contractor shall prepare an electronic submission of a manual describing the proper maintenance and system operation. This manual shall not consist of standard factory printed data intended for dimension or design purposes (although these may be included), but shall be prepared to describe this particular job. This manual shall include the following:
 - B. Data on all equipment as listed on the fixture and equipment schedules on the plans. Also data on all fire alarm, telephone system, public address system, security system, lighting control systems, CCTV, MATV, CATV, generator, battery backup system, etc. that are applicable for the project.
 - C. Warranties as required for each product.
 - D. A check list for periodic maintenance of all equipment requiring maintenance. (i.e., fire alarm system, security system, generator, battery backup system, etc.)
 - E. Maintenance and spare parts data for all equipment.
 - F. As-Built wiring for equipment containing field wired systems. (i.e., fire alarm, security, data system, CATV, telephone, public address, etc.)
 - G. The manuals shall be dated and signed by the Contractor when completed.
 - H. The operating and maintenance manuals shall be submitted to the Engineer for approval. When the manuals are considered complete by the Engineer, they will be turned over to the Owner for their permanent use.

END OF SECTION 26 01 00 26 01 00

**SECTION 26 05 05
ELECTRICAL DEMOLITION**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electrical demolition.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify field measurements and circuiting arrangements are as indicated.
- B. Report discrepancies to Architect before disturbing existing installation.

3.2 PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings to be removed.
- B. Coordinate utility service outages with utility company.
- C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
 - 1. Obtain permission from Owner at least 48 hours before de-energizing system.
- E. Fire alarm system shall be maintained to all occupied portions of the building.
 - 1. Notify Owner and Fire Marshall a least 48 hours before partially or completely disabling system.
 - 2. If the Fire alarm system cannot be maintained in the occupied portion of the building contractor shall provide a fire watch in accordance with NFPA 72 and local authority requirements.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Perform work for removal and disposal of equipment and materials containing toxic substances regulated under the Federal Toxic Substances Control Act (TSCA) in accordance with applicable federal, state, and local regulations. Lamps are to be disposed of in accordance with NC G.S. 130A - 310.60. Applicable equipment and materials include, but are not limited to:
 - 1. PCB-containing electrical equipment, including transformers, capacitors, and switches.
 - 2. PCB- and DEHP-containing lighting ballasts.

3. Mercury-containing lamps and tubes, including fluorescent lamps, high intensity discharge (HID), arc lamps, ultra-violet, high pressure sodium, mercury vapor, ignitron tubes, neon, and incandescent.
 - B. Remove, relocate, and extend existing installations to accommodate new construction.
 - C. Remove abandoned wiring to source of supply.
 - D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Where conduit cannot be removed from floors or walls, cut conduit flush with walls and floors, and patch surfaces.
 - E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.
 - F. Repair adjacent construction and finishes damaged during demolition and extension work.
 - G. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.
 - H. Remove all devices from walls or ceilings shown to be removed on the Architectural drawings whether shown on the electrical demolition plans or not.
 - I. Where existing downstream devices are to remain, extend existing branch circuit conduit and conductors to maintain service.

3.4 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment that remain or that are to be reused.

END OF SECTION 26 05 05

**SECTION 26 05 19
POWER CONDUCTORS AND CABLES**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Single conductor building wire.
- B. Underground feeder and branch-circuit cable.
- C. Wiring connectors.
- D. Electrical tape.
- E. Oxide inhibiting compound.
- F. Wire pulling lubricant.

1.2 REFERENCE STANDARDS

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2018).
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2023.
- C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010, with Editorial Revision (2020).
- D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2020).
- E. NFPA 70 - National Electrical Code; National Fire Protection Association, Including All Applicable Amendments and Supplements; 2020.

1.3 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
- B. Field Quality Control Test Reports.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- D. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing of exterior below grade conduit and associated hand holes or man holes..
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1.4 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.
- C. Product Listing Organization Qualifications: Third party agencies shall be amongst those accredited by the NCBC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.6 FIELD CONDITIONS

- A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

PART 2 PRODUCTS

2.1 CONDUCTOR AND CABLE APPLICATIONS

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
- C. Nonmetallic-sheathed cable is not permitted.
- D. Service entrance cable is not permitted.

2.2 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. All conductors shall be labeled two feet on centers indicating size, type, voltage, rating, and manufacturer's name.
- D. Provide new conductors and cables manufactured not more than one year prior to installation.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- F. Comply with NEMA WC 70.
- G. Conductor Material:
 - 1. Provide copper conductors only. Conductor sizes indicated are based on copper.
 - 2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors.
- H. Minimum Conductor Size: 12 AWG.
- I. Maximum Conductor Size: 500 kcmil

- J. Conductors for branch circuits shall be sized to prevent a voltage drop exceeding three percent (3%) at the farthest outlet of power, heating and lighting loads, or any combination of such loads. The maximum total voltage drop on both feeders and branch circuits to the farthest outlet shall not exceed five percent (5%).
1. Where the branch circuit conductor length from the panel to the first outlet on a 277 volt circuit exceeds 125 feet, the branch circuit conductors from the panel to the first outlet shall not be smaller than #10 AWG. Increase the branch circuit conductor size an additional wire size for reach 125' of additional length of the entire circuit. The ground conductor size shall be increased proportionately to the increase in the phase conductors per 2020 NEC 250.122(B).
 2. Where the conductor length from the panel to the first outlet on a 120 volt circuit exceeds 50 feet, the branch circuit conductors from the panel to the first outlet shall not be smaller than #10 AWG. Increase the branch circuit conductor size an additional wire size for reach 100' of additional length of the entire circuit. The ground conductor size shall be increased proportionately to the increase in the phase conductors per 2020 NEC 250.122(B).
- K. Conductor Color Coding:
1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
 2. Color Coding Method:
 - a. Conductors #10 AWG and smaller shall be factory color coded.
 - b. Conductors #3 and larger shall be factory color coded on the entire length.
 3. Color Code:
 - a. 480Y/277 V, 3 Phase, 4 Wire System:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - 4) Neutral/Grounded: Gray.
 - b. 208Y/120 V, 3 Phase, 4 Wire System:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - 4) Neutral/Grounded: White.
 - c. Equipment Ground, All Systems: Green.
 - d. 0 - 10V Dimming conductors: Violet and Grey

2.3 BUILDING WIRE

- A. Approved Manufacturers as listed below or approved equal:

1. Copper Building Wire:
 - a. Triangle
 - b. Okonite
 - c. Houston Wire and Cable
 - d. or approved equal
- B. Description: Single conductor insulated wire.
- C. Conductor Stranding:
 1. Feeders and Branch Circuits:
 - a. Size 10 AWG and Smaller: Solid.
 - b. Size 8 AWG and Larger: Class B Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation:
 1. Copper Building Wire: Type THHN/THWN or XHHW-2.
 2. Conductors routed on roofs or other exterior surface where raceway is exposed to direct sunlight shall be type XHHW-2 insulation.
 3. Aluminum Building Wire (only where specifically indicated or permitted for substitution): Type XHHW-2.

2.4 WIRING CONNECTORS

- A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
- B. Connectors for Grounding and Bonding: Comply with Section 26 05 26.
- C. Wiring Connectors for Splices and Taps:
 1. Splices or taps shall not be allowed for feeder conductors unless specifically noted on plans.
 2. Where a splice or tap for feeder conductors is noted on the plans, connectors shall be Blackburn insulated multi-tap or approved equal.
 3. Splices in branch circuit conductors shall be allowed in accessible junction boxes, troughs, or gutters.
 - a. Copper Conductors #10 AWG and smaller: Use twist-on insulated spring connectors.
 - b. Copper Conductors #8 AWG and larger: Use mechanical connectors with gum rubber tape or friction tape. Solderless mechanical connectors with UL listed insulating covers may be used at contractor's option.
 4. Use of split bolts is not allowed.
 5. "Sta-kon" or other permanent type crimp connectors shall not be used for branch circuit connections.

D. Wiring Connectors for Terminations:

1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.

E. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.

2.5 ACCESSORIES

A. Electrical Tape:

1. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
 - a. Product: Okonite 2000 or approved equal.
2. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.

B. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that work likely to damage wire and cable has been completed.
- C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
- D. Verify that field measurements are as indicated.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.3 INSTALLATION

- A. Circuiting Requirements:

1. Circuit routing indicated is diagrammatic.
 2. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
 3. 0 - 10V lighting dimming conductors may not be routed in the same raceway with line voltage conductors.
 4. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
 5. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
 6. A dedicated green equipment grounding conductor shall be provided for all raceways containing branch circuit or feeder conductors. Equipment ground conductor shall be sized in accordance with the NEC.
- B. Install products in accordance with manufacturer's instructions.
- C. Install conductors and cable in a neat and workmanlike manner. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- D. Installation in Raceway:
1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
 2. Pull all conductors and cables together into raceway at same time.
 3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
 4. Use suitable wire pulling lubricant for conductors #4 AWG or larger, except when lubricant is not recommended by the manufacturer.
- E. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- F. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
- G. Install conductors with a minimum of 12 inches of slack at each outlet.
- H. Neatly train conductors inside boxes, wireways, panelboards and other equipment enclosures. Conductors shall not be laced or bundled to avoid overheating.
- I. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- J. Make wiring connections using specified wiring connectors.
1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
 2. Do not remove conductor strands to facilitate insertion into connector.

- 3. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminants. Do not use wire brush on plated connector surfaces.
- K. Insulate ends of spare conductors using vinyl insulating electrical tape.
- L. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

3.4 FIELD QUALITY CONTROL

- A. All tests shall be completely documented indicating time of day, date, temperature and all pertinent test information. All required documentation shall be submitted to the Engineer prior to, and as a prerequisite for, final acceptance of the project. All test results shall be included in the Owner's operation and maintenance manual.
- B. Inspect and test in accordance with NETA ATS, Section 7.3.2.
 - 1. Perform each of the following visual and electrical tests:
 - a. Compare cable data with drawings and specifications to ensure compliance with contract documents.
 - b. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - c. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - d. Inspect compression-applied connectors for correct cable match and indentation.
 - e. Inspect for correct identification.
 - f. Inspect cable jacket and condition.
 - g. Continuity test on each conductor and cable.
 - h. Uniform resistance of parallel conductors.
- C. Insulation resistance test is required for all feeder conductors prior to energizing feeders, sub-feeders, or service entrance conductors.
 - 1. All current carrying feeder 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 insulation resistance tester. In the procedures listed below shall be followed:
 - a. Minimum readings shall be one million (1,000,000) or more ohms for #6 AWG wire and smaller, 250,000 ohms or more for #4 AWG wire or larger, between conductors and between conductor and the grounding conductor.
 - b. 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 insulation resistance reading between the neutral bar and the grounded enclosure. If this reading is less than 250,000 ohms, the Contractor shall disconnect the branch circuit neutral wires from

this neutral bar. He shall then test each one separately to the panel and until the low readings are found. The Contractor shall correct troubles, reconnect and retest until at 250,000 ohms from the neutral bar to the grounded panel can be achieved with only the neutral feeder disconnected.

- c. The Contractor shall send a letter to the Engineer certifying that the above has been done and tabulating the insulation resistance readings for each panel. This shall be done at least four (4) days prior to final inspection.
 - d. At final inspection, The Contractor shall furnish a insulation resistance tester and show the Engineer's representatives that the panels comply with the above requirements. He shall also furnish a hook-on type ammeter and voltmeter to take current and voltage readings as directed by the representatives.
 - e. Results of the test shall be made available to the engineer at the required pre-energization walk through.
2. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.
- D. Correct deficiencies and replace damaged or defective conductors and cables and re-test as indicated above. Contractor shall submit new test results to the Engineer to demonstrate the deficiency has been corrected.

END OF SECTION 26 05 19

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.
- D. Ground bars.
- E. Ground rod electrodes.

1.2 REFERENCE STANDARDS

- A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2012.
- B. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; 2022.
- C. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
- D. NFPA 70 - National Electrical Code; National Fire Protection Association, Including All Applicable Amendments and Supplements; 2020.
- E. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify exact locations of underground metal water service pipe entrances to building.
 - 2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
 - 3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.4 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.
- B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

- C. Field quality control test reports.
- D. Project Record Documents: Record actual locations of grounding electrode system components and connections.

1.5 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Product Listing Organization Qualifications: Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 GROUNDING AND BONDING REQUIREMENTS

- A. Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.
- B. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- C. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
- D. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- E. Grounding System Resistance:
 - 1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect. Precipitation within the previous 48 hours does not constitute normally dry conditions.
 - 2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
 - 3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-to-point" methods.
- F. Grounding Electrode System:
 - 1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
 - a. Provide continuous grounding electrode conductors without splice or joint.

- b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
2. Metal Underground Water Pipe(s):
 - a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.
 - b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
 - c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
3. Metal In-Ground Support Structure:
 - a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
4. Concrete-Encased Electrode:
 - a. Where metallic structural components meet the definition of a concrete encased electrode as defined in NEC 250.52, the concrete encased electrode shall be bonded to the grounding electrode system per NEC 250.50. Coordinate with the structure prior to pouring concrete foundations.
 - b. Provide connection to concrete-encased electrode consisting of not less than 20 feet of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
5. Ground Rod Electrode(s):
 - a. Space electrodes not less than 10 feet from each other and any other ground electrode until maximum allowed resistance to ground is achieved.
 - b. Where location is not indicated, locate electrode(s) at least 5 feet outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.
6. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
7. Ground Bar: Provide ground bar in main electrical room, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.
 - a. Ground Bar Size: 1/4" x 2" x 18" unless otherwise indicated or required.
 - b. Where ground bar location is not indicated, locate in accessible location as near as possible to service disconnect enclosure.
8. unless otherwise noted. Location as identified on plans.

9. Ground Riser: Provide common grounding electrode conductor not less than 3/0 AWG for tap connections to multiple separately derived systems as permitted in NFPA 70.
- G. Service-Supplied System Grounding:
1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
 2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.
- H. Separately Derived System Grounding:
1. Separately derived systems include, but are not limited to:
 - a. Transformers.
 - b. Uninterruptible power supplies (UPS), when configured as separately derived systems.
 - c. Generators, when neutral is switched in the transfer switch.
 2. Provide grounding electrode conductor to connect derived system grounded conductor to nearest effectively grounded metal building frame. Unless otherwise indicated, make connection at neutral (grounded) bus in source enclosure.
 3. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, where not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.
 4. Where common grounding electrode conductor ground riser is used for tap connections to multiple separately derived systems, provide bonding jumper to connect the metal building frame and metal water piping in the area served by the derived system to the common grounding electrode conductor.
 5. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.
- I. Bonding and Equipment Grounding:
1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
 2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
 3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.

4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
 5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
 6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
 7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
 - a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
 - b. Metal gas piping.
 - c. Metal process piping.
- J. Communications Systems Grounding and Bonding:
1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.
 2. Provide bonding jumper in raceway from intersystem bonding termination to each communications room or backboard and provide ground bar for termination.
 - a. Bonding Jumper Size: #3/0 AWG.
 - b. Raceway Size: 1" trade size unless otherwise indicated or required.
 - c. Ground Bar Size: 1/4" x 2" x 18" unless otherwise indicated or required.
 - d. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.

2.2 GROUNDING AND BONDING COMPONENTS

- A. General Requirements:
1. Provide products listed, classified, and labeled as suitable for the purpose intended.
 2. Provide products listed and labeled as complying with UL 467 where applicable.
- B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 05 26:
1. Use insulated copper conductors unless otherwise indicated.
 - a. Exceptions:
 - 1) Use bare copper conductors where installed underground in direct contact with earth.
 - 2) Use bare copper conductors where directly encased in concrete (not in raceway).
 2. Where insulated grounding conductors are used conductors shall be colored solid green.
 3. Grounding electrode conductors #4 AWG and larger shall be installed in raceway.

C. Connectors for Grounding and Bonding:

1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
3. Unless otherwise indicated, use double crimp compression connectors or exothermic welded connections for accessible connections.

D. Ground Bars:

1. Description: Copper rectangular ground bars with mounting brackets and insulators.
2. Size: As indicated elsewhere in this section.
3. Holes for Connections: All mechanical connectors shall be double hole double crimp compression connectors..

E. Ground Rod Electrodes:

1. Comply with NEMA GR 1.
2. Material: Copper-bonded (copper-clad) steel.
3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that work likely to damage grounding and bonding system components has been completed.
- B. Verify that field measurements are as indicated.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install grounding and bonding system components in a neat and workmanlike manner.
- C. Boxes with concentric, eccentric or oversized knockouts shall be provided with bonding bushings and jumpers. The jumper shall be sized per NEC table 250-122 and lugged to the box.
- D. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle.
 1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.
- E. Make grounding and bonding connections using specified connectors.
 1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.

2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
 3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
 4. Compression Connectors: Secure connections using manufacturer's recommended tools and dies. Connectors must be UL listed for use with grounding electrode conductors.
- F. Identify grounding and bonding system components in accordance with Section 26 05 53.

3.3 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS Section 7.13.
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Verify that ground system was installed in accordance with the contract documents and NEC Article 250.
 3. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
 4. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal at ground test wells and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without 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.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
- B. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
- C. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.
- D. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION 26 05 26

**SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 33.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.
- B. Section 26 05 36 - Cable Trays for Electrical Systems: Additional support and attachment requirements for cable tray.
- C. Section 26 05 33.16 - Boxes and Cabinets: Additional support and attachment requirements for boxes.

1.3 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; National Fire Protection Association, Including All Applicable Amendments and Supplements; 2020.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
- B. Sequencing:

1.5 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, non-penetrating rooftop supports, and post-installed concrete and masonry anchors.
- B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.6 QUALITY ASSURANCE

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
 - 1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
 - 2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.

3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of _____. Include consideration for vibration, equipment operation, and shock loads where applicable.
 4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- B. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
 2. Conduit Clamps: Bolted type unless otherwise indicated.
- C. Anchors and Fasteners:
1. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
 2. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
 3. Hollow Masonry: Use toggle bolts.
 4. Hollow Stud Walls: Use toggle bolts.
 5. Steel: Use beam clamps, machine bolts, or welded threaded studs.
 6. Sheet Metal: Use sheet metal screws, bolts, or bolts.
 7. Wood: Use wood screws.
 8. Plastic and lead anchors are not permitted.
 9. Powder-actuated fasteners are not permitted.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- D. Do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

G. Equipment Support and Attachment:

1. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

H. Conduits installed on the interior of exterior building walls shall be spaced off the wall surface a minimum of 1/4 inch using "clamp-backs" or strut.

I. Remove temporary supports.

3.3 FIELD QUALITY CONTROL

A. Inspect support and attachment components for damage and defects.

B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

C. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 26 05 29

**SECTION 26 05 33.13
CONDUIT FOR ELECTRICAL SYSTEMS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).
- B. PVC-coated galvanized steel rigid metal conduit (RMC).
- C. Flexible metal conduit (FMC).
- D. Liquidtight flexible metal conduit (LFMC).
- E. Electrical metallic tubing (EMT).
- F. Rigid polyvinyl chloride (PVC) conduit.
- G. Conduit fittings.
- H. Accessories.

1.2 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2020.
- B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2020.
- C. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit; 2018.
- D. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- E. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- F. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- G. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2020.
- H. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2017.
- I. NFPA 70 - National Electrical Code; National Fire Protection Association, Including All Applicable Amendments and Supplements; 2020.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.

4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.4 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.
- B. Project Record Documents: Record actual routing for conduits installed underground exterior to the building envelope.

1.5 QUALITY ASSURANCE

- A. Conduit shall be delivered to the project site in bundles of full length pipes, each length marked with the trademark of the manufacturer and the Underwriters' Laboratories, Inc. stamp. Each conduit length shall be straight, true and free from scales, blisters, burrs and other imperfections.
 1. Product Listing Organization Qualifications: Third party agencies shall be amongst those accredited by the NCBC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications.
- C. Embedded Within Concrete:
 1. Within Slab on Grade: Not permitted.
 2. Within Slab Above Ground: Not permitted.
 3. Within Poured Concrete Walls Above Ground: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
- D. Outdoors: Apply raceways as indicated below unless otherwise noted
 1. Above ground conduit: Rigid galvanized steel conduit with 90o rigid elbow below grade transition to PVC.

2. Roof: Rigid galvanized steel conduit supported on rubber blocks and unistrut frame. Conduit must be at least 3-1/2" above roof surface.
 3. Feeders: PVC Type DB concrete encased
 4. Branch circuits: Schedule 40 PVC direct buried
 5. Telecommunications: Schedule 40 PVC concrete encased
 6. Connections to vibrating equipment including transformers, generators, and other motor driven equipment: Liquid tight flexible metal conduit.
 7. Boxes and enclosures above ground Nema Type 4
 8. Where rigid polyvinyl (PVC) conduit is used for feeder conductors, transition to galvanized steel rigid metal conduit a minimum of three feet horizontally prior to emerging from underground.
 9. Where rigid polyvinyl (PVC) conduits used for branch circuits, use galvanized steel rigid metal conduit elbows for bends.
- E. Indoors: Finished spaces (not subject to physical damage)
1. Raceway shall be routed concealed in interior portions of furred spaces, ceilings, and cavities, unless other than concrete or solid plaster where possible.
 2. Raceways 2 inch or less shall be allowed to be EMT conduit.
 3. All raceways concealed in exterior walls shall be rigid galvanized steel conduit.
 4. All raceways larger than 2 inch shall be rigid galvanized conduit.
 5. Where surface mounted conduit is required in finished spaces, contractor shall utilize surface metal raceway wire mold.
 6. Where there is a transition between RGS in a wall to EMT above ceiling, it shall be made at a junction box above accessible ceiling.
 7. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit.
- F. Stub Ups
1. All feeder stub ups shall transition below grade from PVC to rigid a minimum of 3 feet horizontally from stub up location.
 2. All branch circuit stub ups, where exposed or in non-CMU walls, shall transition to rigid galvanized steel at 90 degree elbow.
 3. Schedule 40 rigid polyvinyl (PVC) stub ups are only allowed where conduits come up in CMU walls or the bottom of floor mounted equipment.
- G. Unfinished spaces subject to damage (Electrical, Mechanical etc.)
1. All conduit in unfinished spaces shall rigid galvanized steel. Conduit is not considered subject to damage when installed at least 10 feet above finished floor or tight to structure.

2. Conduits are not required to transition to transition to rigid galvanized steel where they are routed down into panelboards or other wall mounted equipment.
- H. Exposed, Interior finished spaces: Use surface metal raceway as identified on the drawings.
1. Surface metal raceway shall be manufactured by Wiremold or approved equal.
 2. A separate equipment ground conductor shall be run in the surface metal raceway.
- I. Connection to vibrating equipment shall be made with flexible metal conduit or liquid tight flexible metal conduit depending on the environment installed.
- J. Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit shall be allowed.
1. Maximum Length: 6 feet.
- K. Connections to Vibrating Equipment:
1. Dry Locations: Use flexible metal conduit.
 2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
 3. Maximum Length: 6 feet unless otherwise indicated.
 4. Vibrating equipment includes, but is not limited to:
 - a. Transformers.
 - b. Motors.
 - c. Generators.

2.2 CONDUIT REQUIREMENTS

- A. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling a mandrel through them.
- B. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Minimum Conduit Size, Unless Otherwise Indicated:
1. Interior: 3/4 inch (21 mm) trade size.
 2. Flexible Connections to Luminaires: 1/2 inch (13 mm) trade size.
 3. Exterior: 1 inch (27 mm) trade size.

2.3 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
1. Allied Tube & Conduit.
 2. Republic Conduit.

3. Wheatland Tube Company.
 4. or approved equal.
- B. Description: NFPA 70, Type RMC standard weight mild steel, hot dipped galvanized, sherardised or zinc-coated rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- C. Fittings:
1. Manufacturers:
 - a. Thomas & Betts Corporation.
 - b. Rayco.
 - c. Appleton.
 - d. or approved equal.
 2. Connectors and Couplings: Use steel compression fittings with insulated throats.

2.4 INTERMEDIATE METAL CONDUIT (IMC)

- A. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.
- B. Fittings:
1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 2. Material: Use steel or malleable iron.
 3. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.5 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
1. Allied Tube & Conduit.
 2. Republic Conduit.
 3. Wheatland Tube Company.
 4. or approved equal.
- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.
- C. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil.
- D. PVC-Coated Fittings:
1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.

2. Non-Hazardous Locations: Use fittings listed and labeled as complying with UL 514B.
3. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil.

2.6 FLEXIBLE METAL CONDUIT AND LIQUIDTIGHT FLEXIBLE METAL CONDUIT (FMC LFMC)

- A. Manufacturers:
 1. Allied Tube & Conduit.
 2. Republic Conduit.
 3. Wheatland Tube Company.
 4. or approved equal.
- B. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.
- C. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- D. Spiral strip construction shall allow the conduit to bend up to four times its internal radius.
- E. Fittings shall be compression type with insulated throats and listed for use with conduit specified.

2.7 ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
 1. Allied Tube & Conduit.
 2. Republic Conduit.
 3. Wheatland Tube Company.
 4. or approved equal.
- B. Description: NFPA 70, Type EMT cold-rolled steel electrical metallic tubing with zinc coating on the inside and protected on the inside by a zinc, enamel or equivalent corrosion-resistant coating complying with ANSI C80.3 and listed and labeled as complying with UL 797.
- C. Fittings:
 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 2. Material: Use steel or malleable iron.
 3. Connectors and Couplings: Use hexagonal compression (gland) type.
 - a. Do not use indenter type connectors and couplings.
 - b. Do not use set-screw type connectors and couplings.

2.8 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

- A. Manufacturers:
-

1. Allied Tube & Conduit.
 2. Republic Conduit.
 3. Wheatland Tube Company.
 4. or approved equal.
- B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 or Schedule 80 as indicated; rated for use with conductors rated 90 degrees C.
- C. Fittings:
1. Manufacturer: Same as manufacturer of conduit to be connected.
 2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.9 ACCESSORIES

- A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil.
- B. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.
- C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
- D. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive conduits.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install conduit in a neat and workmanlike manner tight against walls, columns or ceilings.
- C. The conduit shall bend cold 90 degrees about a radius equal to ten (10) times its own diameter without signs of flaw or fracture in either pipe or protective coverings. All bends and offsets shall be made on a forming tool to prevent the conduit or its coating from being damaged in the bending.
- D. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
- E. Install intermediate metal conduit (IMC) in accordance with NECA 101.
- F. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by the manufacturer.

- G. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.
- H. Conduit Routing:
1. Unless dimensioned, conduit routing indicated is diagrammatic.
 2. Conceal all conduits unless specifically indicated to be exposed.
 3. Conduits in the following areas may be exposed, unless otherwise indicated:
 - a. Electrical rooms.
 - b. Mechanical equipment rooms.
 4. Arrange conduit to maintain maximum headroom, clearances, and access.
 5. Arrange conduit to provide no more than the equivalent of four 90 degree bends between pull points.
 6. Arrange conduit to provide no more than 100 feet between pull points.
 7. In every instance, conduit shall be installed in such a manner that the conductors may readily and easily be drawn or pulled in without strain or damage to the insulation; and, also, so that defective conductors may be readily and easily withdrawn and replaced by new conductors. Long radius bends and a sufficient number of approved pull and junction boxes shall be approved for this purpose, and as may be directed by the Engineer. All conduit shall be securely supported and grounded.
 8. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
 9. Where conduits join any couplings or threaded fittings, the ends shall be made watertight.
 10. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
- I. Conduit Support:
1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
 2. Secure and support conduits in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
 3. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
 4. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
 5. Use conduit strap to support single surface-mounted conduit.
 - a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
 6. Use metal channel (strut) with accessory conduit clamps to support multiple parallel surface-mounted conduits.

7. Use conduit clamp to support single conduit from beam clamp or threaded rod.
 8. Use trapeze hangers assembled from threaded rods and metal channel (strut) with accessory conduit clamps to support multiple parallel suspended conduits.
 9. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
 - a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
 - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
 10. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
 - a. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch.
 - b. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.
- J. Connections and Terminations:
1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
 2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
 3. Use suitable adapters where required to transition from one type of conduit to another.
 4. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
 5. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
 6. Secure joints and connections to provide maximum mechanical strength and electrical continuity.
 7. Condulet fittings shall not be used in lieu of pull boxes.
- K. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams.
 2. Make penetrations perpendicular to surfaces unless otherwise indicated.
 3. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
 - a. All raceway penetrating exterior walls or other water proof membranes shall slope away from the building with a minimum slope of 4" over 100 feet.
 4. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as required

- to preserve integrity of roofing system and maintain roof warranty.
5. Install firestopping to preserve fire resistance rating of partitions and other elements. Refer to penetration details on plans.
 6. Where conduits cross building expansion joints or pass between areas with a temperature difference of 14 degrees C, provide expansion fittings on all raceway.
- L. Underground Installation:
1. Minimum Cover, Unless Otherwise Indicated or Required:
 - a. Underground, Exterior: 24 inches.
 2. Provide underground warning tape six to eight inches below finished grade directly above raceway. Tape shall be six inches wide with a minimum thickness of seven mil, non-distorting, colorfast, no-stretch, 600 pound tensile strength per six inch width, ultraviolet light fast. Message must repeat within a maximum of 40 inches. Painted legend shall be indicative of the type of underground line.
- M. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide concrete in accordance with Section 03 30 00 with minimum concrete cover of 3 inches on all sides unless otherwise indicated.
- N. Ductbanks containing conductors of 600 volts or more shall be concrete encased with red dyed concrete.
- O. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
 2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
 3. Where conduits are subject to earth movement by settlement or frost.
- P. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
1. Where conduits pass from outdoors into conditioned interior spaces.
 2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
 3. Where conduits penetrate coolers or freezers.
- Q. Provide 200 pound tensile strength pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end. All empty conduits shall terminate in a junction box.
- R. All ducts shall be sealed at terminations, using sealing compound and plugs, as required to withstand 15 psi minimum hydrostatic pressure.

3.3 FIELD QUALITY CONTROL

- A. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- B. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.
- C. Correct deficiencies and replace damaged or defective conduits.

3.4 CLEANING

- A. Clean interior of conduits to remove moisture and foreign matter.

3.5 PROTECTION

- A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION 26 05 33.13

**SECTION 26 05 33.16
BOXES AND CABINETS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.
- C. Floor boxes.

1.2 REFERENCE STANDARDS

- A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- B. NFPA 70 - National Electrical Code; National Fire Protection Association, Including All Applicable Amendments and Supplements; 2020.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
 - 4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
 - 5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
 - 6. Coordinate the work with other trades to preserve insulation integrity.
 - 7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
 - 8. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.4 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for outlet and device boxes, junction and pull boxes, cabinets and enclosures, and floor boxes.
- B. Project Record Documents: Record actual locations for outlet and device boxes, cabinets and enclosures, and floor boxes.

1.5 QUALITY ASSURANCE

- A. Product Listing Organization Qualifications: Third party agencies shall be amongst those accredited by the NCBC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 BOXES

- A. General Requirements:

1. The Electrical Contractor shall provide junction boxes, pull boxes, cable, support boxes, and wiring troughs as required by NEC and as otherwise indicated in the Drawings.
2. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
3. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
4. Provide products listed, classified, and labeled as suitable for the purpose intended.
5. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
6. Provide grounding terminals within boxes where equipment grounding conductors terminate.
7. Each outlet designated on the plans shall be provided with an outlet box.
8. In general, outlets shall be installed at the heights indicated. The Contractor shall examine the plans of and coordinate with all other trades to assure mounting heights are correct for the intended purpose. Assure that all mounting heights comply with the latest version of ADA. Outlets installed at incorrect heights shall be relocated to the correct elevation at the Contractor's expense.

- B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:

1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
3. Outlet boxes shall be 4" square, 2 1/8" deep unless otherwise noted.
4. Use suitable concrete type boxes where flush-mounted in concrete.
5. Use suitable masonry type boxes where flush-mounted in masonry walls.
6. Do not use "through-wall" boxes designed for access from both sides of wall.
7. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.

8. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
 9. Junction boxes larger than 4" square shall be galvanized and without pre-formed knockouts.
 10. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
 11. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes.
 12. Manufacturers Recessed:
 - a. Steel City Electric Company
 - b. Metropolitan
 - c. B & C
 - d. or approved equal.
 13. Manufacturers Surface:
 - a. Crouse-Hinds
 - b. Appleton
 - c. Rayco
 - d. or approved equal.
- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
 2. NEMA 250 Environment Type, Unless Otherwise Indicated:
 3. Junction and Pull Boxes Larger Than 100 cubic inches:
 - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
 - b. Boxes 12" square and Larger: Provide hinged-cover enclosures with quick access latches.
 4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
 - a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
 5. Manufacturers Surface:
 - a. Cooper.
 - b. Hoffman.
 - c. Hubbell Incorporated.
 - d. or approved equal..

D. Floor Boxes:

1. Description: Floor boxes compatible with floor box service fittings provided; with partitions to separate multiple services; furnished with all components, adapters, covers, faceplates, and trims required for complete installation. Number of gangs as identified on plans.
2. Cover and finish options shall be selected by architect prior to ordering.
3. Use cast iron floor boxes within slab on grade.
 - a. Protect moisture barrier during floor box installation.
4. Use sheet-steel floor boxes or fire rated poke throughs within slab above grade.
5. Metallic Floor Boxes: Fully adjustable (with integral means for leveling adjustment prior to and after concrete pour).
6. Manufacturer:
 - a. Legrand Wiremold
 - b. Hubbell Incorporated
 - c. Thomas & Betts Corporation
 - d. or approved equal.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive boxes.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in a neat and workmanlike manner.
- C. Arrange equipment to provide maximum clearances.
- D. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
- E. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
- F. Box Locations:
 1. Locate boxes in accessible locations.
 2. Locate boxes so that wall plates do not span different building finishes.
 3. Locate boxes so that wall plates do not cross masonry joints.

4. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
 5. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
 6. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
- G. Box Supports:
1. Secure and support boxes in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
- H. Install boxes plumb and level.
- I. Flush-Mounted Boxes:
1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
 2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
 3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.
- J. Install boxes as required to preserve insulation integrity.
- K. Metallic Floor Boxes: Install box level at the proper elevation to be flush with finished floor.
- L. Boxes in damp or wet locations shall be provided with gaskets and covers.
- M. Install permanent barrier between ganged wiring devices when voltage difference between adjacent devices exceeds 300 V.
- N. Close unused box openings.
- O. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.

3.3 CLEANING

- A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.4 PROTECTION

- A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION 26 05 33.16

**SECTION 26 05 36
CABLE TRAYS FOR ELECTRICAL SYSTEMS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Metal cable tray systems:
 - 1. Metal ladder cable tray.
 - 2. Metal wire mesh/basket cable tray.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the arrangement of cable tray with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others. Coordinate the work with other trades to avoid installation of obstructions within cable tray required clearances.
 - 2. Coordinate arrangement of cable tray with the dimensions and clearance requirements of the actual products to be installed.
 - 3. Coordinate the work with placement of supports, anchors, etc. required for mounting.
 - 4. Notify of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not begin installation of cables until installation of associated cable tray run is complete.

1.3 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for cable tray system components and accessories. Include dimensions, materials, fabrication details, finishes, and span/load ratings.
- B. Project Record Documents: Record actual routing of cable tray and locations of supports.

1.4 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Product Listing Organization Qualifications: Third party agencies shall be amongst those accredited by the NCBC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions and NEMA VE 2do not store cable tray outdoors without cover.

- B. Handle products carefully to avoid damage to finish.

PART 2 PRODUCTS

2.1 CABLE TRAY SYSTEM - GENERAL REQUIREMENTS

- A. Provide new cable tray system consisting of all required components, fittings, supports, accessories, etc. as necessary for a complete system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Do not use cable tray for applications other than as permitted by NFPA 70 and product listing/classification.
- D. Provide cable tray system and associated components suitable for use at indicated span/load ratings under the service conditions at the installed location.

2.2 METAL CABLE TRAY SYSTEMS

- A. Manufacturers:
 - 1. Metal Cable Tray System:
 - a. Cablofil, a brand of Legrand North America, Inc; _____.
 - b. Cope, a brand of Atkore International Inc; _____.
 - c. Thomas & Betts Corporation; _____.
 - d. or approved equal.
- B. Finishes:
 - 1. Zinc Electroplated Steel: Comply with ASTM B633.
- C. Metal Ladder Cable Tray:
 - 1. Material: Aluminum with black powder coat finish.
 - 2. Side Rail Construction: I-beam or C-channel flange in.
 - 3. Load/Fill Depth: As indicated on drawings.
 - 4. Span/Load Rating: As indicated on drawings.
 - 5. Rung Spacing: 9 inches on center for straight lengths.
 - 6. Inside Width: As indicated on drawings.
 - 7. Inside Radius of Fittings: 36 inches.
- D. Metal Wire Mesh/Basket Cable Tray:
 - 1. Material: Zinc electroplated steel or mill-galvanized before fabrication (pre-galvanized) steel.
 - 2. Tray Depth: As indicated on drawings.
 - 3. Span/Load Rating: As indicated on drawings.

4. Mesh Spacing: 2 by 4 inches.
5. Tray Width: As indicated on drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that work likely to damage cable tray system has been completed.
- B. Verify that field measurements are as indicated.
- C. Verify that the dimensions and span/load ratings of cable tray system components are consistent with the indicated requirements.
- D. Verify that mounting surfaces are ready to receive cable tray and associated supports.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
 - B. Unless otherwise indicated, arrange cable tray to be parallel or perpendicular to building lines.
 - C. Arrange cable tray to provide required clearances and maintain cable access.
 1. Minimum Clearance Above and Adjacent to Cable Tray: 12 inches.
 2. Minimum Clearance below tray to accessible ceiling: 6 inches.
 - D. Install cable tray plumb and level, with sections aligned and with horizontal runs at the proper elevation.
 - E. Metal Wire Mesh/Basket Cable Tray: Field fabricate fittings in accordance with manufacturer's instructions, using only manufacturer-approved connectors classified for bonding.
 1. Inside Radius of Fittings: 12 inches.
 - F. Cable Tray Movement Provisions:
 1. Provide suitable expansion fittings where cable tray is subject to movement, including but not limited to:
 - a. Where cable tray crosses structural joints intended for expansion.
 - b. Long straight cable tray runs in accordance with NEMA VE 2.
 2. Use expansion guides in lieu of hold-down clamps where prescribed in NEMA VE 2.
 3. Set gaps for expansion fittings in accordance with NEMA VE 2.
 - G. Provide end closures at unconnected ends of cable tray runs.
 - H. Cable Tray Support:
 1. Use manufacturer's recommended hangers and supports, located in accordance with manufacturer's requirements.
-

2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- I. Grounding and Bonding Requirements, in Addition to Requirements of Section 26 05 26:
 1. Comply with grounding and bonding requirements of NEMA VE 2.
 2. Metal Cable Tray Systems: Use suitable bonding jumpers or classified connectors to provide electrical continuity.
- J. Conduit Termination:
 1. Provide insulating bushing at conduit termination to protect cables.
 2. Provide independent support for conduit.

3.3 FIELD QUALITY CONTROL

- A. Inspect cable tray system for damage and defects.
- B. Correct deficiencies and replace damaged or defective cable tray system components.

3.4 ADJUSTING

- A. Adjust tightness of mechanical connections to manufacturer's recommended torque settings.

3.5 CLEANING

- A. Remove dirt and debris from cable tray.
- B. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.6 PROTECTION

- A. Protect cable tray system from subsequent construction operations.

END OF SECTION 26 05 36

SECTION 26 05 48
VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 2 PRODUCTS

END OF SECTION 26 05 48

**SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Underground warning tape.
- E. Warning signs and labels.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
- B. Sequencing:
 - 1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
 - 2. Do not install identification products until final surface finishes and painting are complete.

1.3 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
- B. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.

1.4 FIELD CONDITIONS

- A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.1 IDENTIFICATION REQUIREMENTS

- A. Identification for Equipment:
 - 1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
 - a. Switchboards:
 - 1) Identify ampere rating.
 - 2) Identify voltage and phase.

- 3) Identify power source and circuit number. Include location.
 - 4) Use identification nameplate to identify main overcurrent protective device.
 - 5) Use identification nameplate to identify load(s) served for each branch device where not identified in a panelboard schedule.
- b. Panelboards:
- 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify power source and circuit number. Include location.
 - 4) Use typewritten circuit directory to identify load(s) served.
- c. Transformers:
- 1) Identify kVA rating.
 - 2) Identify voltage and phase for primary and secondary.
 - 3) Identify power source and circuit number. Include location.
 - 4) Identify load(s) served. Include location.
- d. Enclosed switches, circuit breakers, and motor controllers:
- 1) Identify voltage and phase.
 - 2) Identify power source and circuit number. Include location.
 - 3) Identify load(s) served. Include location.
- e. Enclosed Contactors:
- 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify coil voltage.
 - 4) Identify load(s) and associated circuits controlled. Include location.
- f. Transfer Switches:
- 1) Identify voltage and phase.
 - 2) Identify power source and circuit number for both normal power source and standby power source. Include location.
 - 3) Identify load(s) served. Include location.
 - 4) Identify short circuit current rating based on the specific overcurrent protective device type and settings protecting the transfer switch.

2. Service Equipment:
 - a. For buildings or structures supplied by more than one service, or any combination of branch circuits, feeders, and services, use identification nameplate at each service disconnecting means to identify all other services, feeders, and branch circuits supplying that building or structure. Verify format and descriptions with authority having jurisdiction.
 3. Emergency System Equipment:
 - a. Use identification nameplate or voltage marker to identify emergency system equipment in accordance with NFPA 70.
 4. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
 5. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.
 - a. Service equipment.
 6. Arc Flash Hazard Warning Labels: Comply with Section 26 05 73.
- B. Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 05 19.
 2. Identification for Communications Conductors and Cables: Comply with Section 27 10 00.
 3. Use underground warning tape to identify power and communication feeders and branch circuits exterior to the building.
- C. Identification for Cable Tray: Comply with Section 26 05 36.
- D. Identification for Boxes:
1. Use color coded boxes to identify specified systems.
 - a. Color-Coded Boxes: Field-painted per the same color coding as identified in this section for the system contained within.
 - b. Fire alarm junction boxes shall be painted on all sides including the box cover.
 2. For boxes concealed above accessible ceilings or exposed in mechanical or electrical rooms use neatly handwritten text using indelible marker to identify circuits enclosed.
 3. For exposed boxes in public areas, use only type written labels.
- E. Identification for Devices:
1. Wiring Device and Wallplate Finishes: Comply with Section 26 27 26.
 2. Use identification label to identify fire alarm system devices.
 3. For devices concealed above suspended ceilings, provide additional identification on ceiling tile below device location.

4. Use identification label to identify receptacles protected by upstream GFI protection, where permitted.

F. Color Coding

1. Phenolic Nameplates and associated conduit and boxes shall be identified with the following color scheme. Note: For existing buildings the contractor shall field verify the existing building standard and revise the color scheme to match the existing field conditions. Failure to match existing conditions will result in the contractor correcting the mislabeled equipment at his expense.
 - a. Blue surface white core - 120/208V equipment.
 - b. Black surface white core - 277/480V equipment.
 - c. Bright red surface white core - fire alarm equipment.
 - d. Dark red (burgundy) surface white core - security equipment.
 - e. Green surface white core - emergency systems.
 - f. Orange surface white core - telephone systems.
 - g. Brown surface white core - data systems.
 - h. White surface black core - paging systems.
 - i. Purple surface white core - TV systems.

2.2 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:

1. Materials:
 - a. Indoor Clean, Dry Locations: Use plastic nameplates.
 - b. Outdoor Locations: Use plastic nameplates suitable for exterior use.
2. Plastic Nameplates: Two-layer or three-layer laminated electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
3. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.
4. Nameplates shall be secured with self tapping stainless steel screws; if screws have sharp ends they shall be protected, otherwise rivets shall be used.

B. Identification Labels:

1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
 - a. Use only for indoor locations.
2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text.

C. Format for Equipment Identification:

1. Minimum Size: 1 inch by 2.5 inches.
2. Text: All capitalized unless otherwise indicated.
3. Minimum Text Height:
 - a. Equipment Designation: 1/2 inch.
 - b. Exception: Provide minimum text height of 1 inch for equipment located more than 10 feet above floor or working platform.
- D. Wiring device circuit labels.
 1. All wiring devices (receptacles and switches) shall be labeled with the circuit serving the device. Label shall be a typed adhesive label affixed to the front of the wiring device face plate. Label shall have black text on clear background.

2.3 UNDERGROUND WARNING TAPE

- A. Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 7 mil, unless otherwise required for proper detection.
- B. Legend: Type of service, continuously repeated over full length of tape.
- C. Color:
 1. Tape for Buried Power Lines: Black text on red background.
 2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.4 WARNING SIGNS AND LABELS

- A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- B. Warning Signs:
 1. Materials:
 - a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
 - b. Outdoor Locations: Use factory pre-printed rigid aluminum signs.
 2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
- C. Warning Labels:
 1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
 2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.

PART 3 EXECUTION

3.1 PREPARATION

- A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance.
- C. Install identification products centered, level, and parallel with lines of item being identified.
- D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws.
- E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.
- F. Install underground warning tape above buried lines with one tape per trench at six to eight inches below finished grade.
- G. Secure rigid signs using stainless steel screws.
- H. Mark all handwritten text, where permitted, to be neat and legible.

3.3 FIELD QUALITY CONTROL

- A. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION 26 05 53

**SECTION 26 05 73
POWER SYSTEM STUDIES**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Short-circuit study.
- B. Protective device coordination study.
- C. Arc flash and shock risk assessment.
 - 1. Includes arc flash hazard warning labels.
- D. Criteria for the selection and adjustment of equipment and associated protective devices not specified in this section, as determined by studies to be performed.

1.2 REFERENCE STANDARDS

- A. IEEE 1584 - IEEE Guide for Performing Arc-Flash Hazard Calculations; 2018, with Errata (2019).
- B. NFPA 70 - National Electrical Code; National Fire Protection Association, Including All Applicable Amendments and Supplements; 2020.
- C. NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work to provide equipment and associated protective devices complying with criteria for selection and adjustment, as determined by studies to be performed.
 - 2. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Submit study reports prior to or concurrent with product submittals.
 - 2. Contractor shall be responsible for making any and all changes to the purchased equipment as recommended in the study results. Changes to the electrical distribution equipment, generator, transfer switches, and breakers due to study recommendations and to comply with the requirements of this section shall not incur an additional cost to the project. This includes but is not limited to changes in equipment or breakers to meet required maximum fault current levels, changes in breaker models, types or frame sizes to achieve selective coordination where required, changes in breaker models or types to achieve the required minimum AIC rating for transfer switches.
 - 3. Do not order equipment until matching study reports and product submittals have both been evaluated by Architect.
 - 4. Verify naming convention for equipment identification prior to creation of final drawings, reports, and arc flash hazard warning labels to match equipment name plates.

5. Study shall be updated prior to project completion. All changes throughout construction shall be incorporated in the update.
6. After study has been updated with construction changes, print and apply labels.
7. Final study shall be included in the O&M manuals.

1.4 SUBMITTALS

- A. Study preparer's qualifications.
- B. Study reports, stamped or sealed and signed by study preparer.
- C. Product Data:
 1. Include characteristic time-current trip curves for protective devices.
 2. Clearly indicate short circuit current ratings for all equipment. Series rating is not allowed.
- D. All submittals transmitted to the engineer for approval shall have a digital copy of the report and model files included on a USB drive.
- E. Arc Flash Hazard Warning Label Samples: One of each type required. All labels shall be rated to withstand the environment where installed.
- F. Certification that field adjustable protective devices have been set in accordance with requirements of studies.
- G. Project Record Documents: Revise studies as required to reflect as-built conditions.
 1. Include hard copies with operation and maintenance data submittals.
 2. Include computer software files used to prepare studies with file name(s) cross-referenced to specific pieces of equipment and systems.

1.5 POWER SYSTEM STUDIES

- A. Scope of Studies:
 1. Perform analysis of new electrical distribution system as indicated on drawings.
 2. Except where study descriptions below indicate exclusions, analyze system at each bus from primary protective devices of utility source down to each piece of equipment involved, including parts of system affecting calculations being performed (e.g. fault current contribution from motors).
 3. Include in analysis alternate sources and operating modes (including known future configurations) to determine worst case conditions.
 - a. Known Operating Modes:
 - 1) Utility as source.
 - 2) Generator as source.
- B. General Study Requirements:

-
1. Perform studies utilizing computer software complying with specified requirements; manual calculations are not permitted.
- C. Data Collection:
1. Compile information on project-specific characteristics of actual installed equipment, protective devices, feeders, etc. as necessary to develop single-line diagram of electrical distribution system and associated input data for use in system modeling.
 - a. Utility Source Data: Include primary voltage, maximum and minimum three-phase and line-to-ground fault currents, impedance, X/R ratio, and primary protective device information.
 - 1) Obtain up-to-date information from Utility Company.
 - 2) Include in the report documentation the following information
 - (a) Utility Company: Contractor to Determine.
 - (1) Point of Contact: Contractor to Determine.
 - (2) Address: Contractor to Determine.
 - (3) Phone: Contractor to Determine.
 - (4) Email: Contractor to Determine.
 - (5) Utility Company Project Reference Number: Contractor to Determine.
 - (6) Date Fault Current was obtained from power company.
 - b. Generators: Include manufacturer/model, kW and voltage ratings, and impedance.
 - c. Motors 25HP and greater: Include manufacturer/model, type (e.g. induction, synchronous), horsepower rating, voltage rating, and full load amps.
 - d. Branch circuit and overcurrent protective device information associated with all industrial control panels, including HVAC control panels.
 - e. Transformers: Include primary and secondary voltage ratings, kVA rating, winding configuration, percent impedance, and X/R ratio.
 - f. Protective Devices:
 - 1) Circuit Breakers: Include manufacturer/model, type (e.g. thermal magnetic, electronic trip), frame size, trip rating, voltage rating, interrupting rating, available field-adjustable trip response settings, and features (e.g. zone selective interlocking).
 - 2) Fuses: Include manufacturer/model, type/class (e.g. Class J), size/rating, and speed (e.g. time delay, fast acting).
 - g. Conductors: Include feeder size, material (e.g. copper, aluminum), insulation type, voltage rating, number per phase, raceway type, and actual length.
 - h. Contractor shall maintain a log of all conductor sizes and lengths to be used in the power systems study.
-

D. Short-Circuit Study:

1. For purposes of determining equipment short circuit current ratings, consider conditions that may result in maximum available fault current, including but not limited to:
 - a. Maximum utility fault currents.
 - b. Maximum motor contribution.
2. For each bus location, calculate the maximum available three-phase bolted symmetrical and asymmetrical fault currents. For grounded systems, also calculate the maximum available line-to-ground bolted fault currents.
3. Calculate the short circuit current at the following additional locations:
 - a. Elevator Controllers.
 - b. Industrial Control Panels, including HVAC control panels.
 - c. Motor Control Centers.

E. Protective Device Coordination Study:

1. Analyze alternate scenarios considering known operating modes (e.g. utility as source, generator as source).
2. Analyze protective devices on the normal power system and associated settings for suitable margins between time-current curves to achieve best possible coordination while providing adequate protection for equipment and conductors.
3. For emergency systems analyze protective devices and associated settings so that full selective coordination is achieved per NEC 700.27

F. Arc Flash and Shock Risk Assessment:

1. Comply with NFPA 70E.
2. Perform incident energy and arc flash boundary calculations in accordance with IEEE 1584 (as referenced in NFPA 70E Annex D), where applicable.
3. Analyze alternate scenarios considering conditions that may result in maximum incident energy, including but not limited to:
 - a. Maximum and minimum utility fault currents.
 - b. Maximum and minimum motor contribution.
 - c. Known operating modes (e.g. utility as source, generator as source).

G. Study Reports:

1. General Requirements:
 - a. Identify date of study and study preparer.
 - b. Identify study methodology and software product(s) used.

- c. Identify scope of studies, assumptions made, implications of possible alternate scenarios, and any exclusions from studies.
 - d. Include single-line diagram and associated input data used for studies; identify buses on single-line diagram as referenced in reports, and indicate bus voltage.
 - e. Include conclusions and recommendations.
2. Short-Circuit Study:
- a. For each scenario, identify at each bus location:
 - 1) Calculated maximum available symmetrical and asymmetrical fault currents (both three-phase and line-to-ground where applicable).
 - 2) Fault point X/R ratio.
 - 3) Associated equipment short circuit current ratings.
 - b. Identify locations where the available fault current exceeds the equipment short circuit current rating, along with recommendations.
3. Protective Device Coordination Study:
- a. For each scenario, include time-current coordination curves plotted on log-log scale graphs.
 - b. For each graph include (where applicable):
 - 1) Partial single-line diagram identifying the portion of the system illustrated.
 - 2) Protective Devices: Time-current curves with applicable tolerance bands for each protective device in series back to the source, plotted up to the maximum available fault current at the associated bus.
 - 3) Transformers: Inrush points and damage curves.
 - 4) Generators: Full load current, overload curves, decrement curves, and short circuit withstand points.
 - 5) Motors: Full load current, starting curves, and damage curves.
 - c. For each protective device, identify fixed and adjustable characteristics with available ranges and recommended settings.
 - 1) Circuit Breakers: Include long time pickup and delay, short time pickup and delay, and instantaneous pickup.
 - 2) Include ground fault pickup and delay.
 - 3) Include fuse ratings.
 - d. Identify cases where either full selective coordination or adequate protection is not achieved, along with recommendations.
4. Arc Flash and Shock Risk Assessment:

- a. For the worst case for each scenario, identify at each bus location:
 - 1) Calculated incident energy and associated working distance.
 - 2) Calculated arc flash boundary.
 - 3) Bolted fault current.
 - 4) Arcing fault current.
 - 5) Clearing time.
 - 6) Arc gap distance.
 - b. For purposes of producing arc flash hazard warning labels, summarize the maximum incident energy and associated data reflecting the worst case condition of all scenarios at each bus location.
 - c. Include recommendations for reducing the incident energy at locations where the calculated maximum incident energy exceeds 8 calories per sq cm.
5. For Oneline diagram indicate the following:
- a. At each Bus:
 - 1) Equipment ID.
 - 2) Voltage.
 - 3) 3 Phase Fault Current.
 - 4) 1 Phase Fault Current.
 - 5) X/R ratio.
 - b. At each breaker:
 - 1) Equipment ID.
 - 2) Device Amperage.
 - 3) Voltage Rating.
 - 4) Interrupting Rating.
 - 5) Breaker Settings (If applicable).
 - c. At each source:
 - 1) Device ID.
 - 2) Voltage.
 - 3) 3 Phase Fault Current.
 - 4) 1 Phase Fault Current.
-

- 5) X/R Rating.
- d. At each Generator:
 - 1) Equipment ID.
 - 2) Rated kW.
 - 3) Rated kVA.
 - 4) Voltage.
- e. At each Transformer:
 - 1) Equipment ID.
 - 2) Rated kVA.
 - 3) Primary Voltage.
 - 4) Secondary Voltage.
 - 5) Percent Impedance.
- f. At each Motor:
 - 1) Equipment ID.
 - 2) Rated Horse Power.

1.6 QUALITY ASSURANCE

- A. Study Preparer Qualifications: Professional electrical engineer licensed in the State in which the Project is located and with minimum three years experience in the preparation of studies of similar type and complexity using specified computer software.
 - 1. Study preparer may be employed by the manufacturer of the electrical distribution equipment.
- B. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.
 - 1. Acceptable Software Products:
 - a. EasyPower LLC: www.easypower.com/#sle.
 - b. ETAP/Operation Technology, Inc: www.etap.com/#sle.
 - c. SKM Systems Analysis, Inc: www.skm.com/#sle.

PART 2 PRODUCTS

2.1 ARC FLASH HAZARD WARNING LABELS

- A. Provide warning labels complying with ANSI Z535.4 to identify arc flash hazards for each work location analyzed by the arc flash and shock risk assessment.

1. Materials: Label shall be vinyl adhesive with moisture and UV resistance. Paper adhesive labels will not be accepted.
2. Label Information shall comply with 2015 NFPA 70E.
3. Legend: Provide custom legend in accordance with NFPA 70E based on equipment-specific data as determined by arc flash and shock risk assessment.
 - a. Include at least the following information:
 - 1) Arc flash boundary.
 - 2) Available incident energy and corresponding working distance.
 - 3) Site-specific PPE (personnel protective equipment) requirements.
 - 4) Nominal system voltage.
 - 5) Limited approach boundary.
 - 6) Restricted approach boundary.
 - 7) Equipment identification.
 - 8) Date calculations were performed.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Labels shall be cut with straight and perpendicular lines.
- B. Labels shall be installed neatly and consistently from one piece of equipment to another.
- C. Clean surface of equipment so that it is free of dirt, dust, or other foreign substance prior to applying labels.

3.2 FIELD QUALITY CONTROL

- A. Adjust equipment and protective devices for compliance with studies and recommended settings.

END OF SECTION 26 05 73

SECTION 26 08 00
COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Commissioning is the process for ensuring that the Electrical System is installed and performs interactively according to the design intent and meets the building operational performance expectations as defined in the sequences of operations. The process also provides adequate documentation of installation, start-up and functional testing and ensures that the Owner's maintenance personnel are adequately trained. It provides for discovery of system operational performance deficiencies prior to substantial completion while the responsible contractors can provide a timely response. It establishes testing and communication protocols in an effort to advance the Electrical System from installation to complete dynamic operation and optimization.
- B. The commissioning process involves all the parties involved in the design and construction process as well as the Owner and the Commissioning Agent (CxA). Primary elements of Commissioning during the construction, acceptance and warranty phases of the project include:
1. Verify applicable equipment and systems are installed in accordance with manufacturers' instructions and contract documents and receive adequate operational start-up checkout by installing contractors.
 2. Demonstrate functional operational performance of equipment and systems in the commissioning program.
 3. Verify O&M documentation submitted is complete. Provide required documentation and information to allow compilation of Building Systems Manuals in accordance with Section 01 7823.
 4. Verify Owner's maintenance personnel are adequately trained in accordance with specified training plan requirements.
 5. Verify systems are interacting and performing optimally in accordance with the system sequence of operations.
 6. The commissioning process requires Division 26 participation, as necessary, in support of the mechanical system commissioning for the Division 23 systems. This may include participation in system installation and start-up activities (e.g. full load amp readings on motors) and monitoring electrical systems during function performance testing. Section 01 9113 specifies the systems included in the commissioning program.
 7. Furnish labor and material to accomplish electrical system commissioning and systems' testing as specified herein and other related sections.
8. RELATED SECTIONS
- a. Section 01 7823 – Operation and Maintenance Data
 - b. Section 01 9113 - General Commissioning Requirements
 - c. Section 01 7513 – Pre-Functional Checklists
 - d. Section 01 9114 – Functional Testing Requirements
 - e. Section 01 7900 – Demonstration and Training
 - f. Section 23 0800 – Commissioning of HVAC Systems.

- g. Section 23 0801 – Commissioning of Building Controls System
 - h. Division 26 Sections pertaining to the electrical systems included in the commissioning program.
9. SUBMITTALS
- a. Refer to Section 01 9113 for commissioning submittal requirements. Provide copies of commissioning submittal requirements to the Commissioning Agent, in addition to the copies required by the Owner and Design Professional.
10. COORDINATION
- a. The installation schedule for the electrical systems included in the commissioning program shall be such that the commissioning requirements can be met without impacting the construction schedule. Commissioning Functional Performance Testing is a requirement for Substantial Completion. The functional performance testing is scheduled to occur the two months prior to substantial completion.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. Provide industry standard test equipment to verify readings and test system and equipment performance. This test equipment will also be made available to the CxA. Generally, no equipment will be required beyond that required to perform Contractors work under these Contract Documents. The standards and accuracy requirements for test equipment are defined in Section 01 9113.

PART 3 - EXECUTION

3.1 COMMISSIONING

- A. General Requirements. For additional information regarding general commissioning requirements refer to Section 01 9113.
- B. Installation sub-contractors shall be responsible for executing and documenting equipment installation, start-up and check out for systems and equipment prior to the Commissioning Agent scheduling the functional performance test. Contractor shall also be responsible for providing training for the Owner's maintenance personnel in accordance with project requirements.
- C. Installation verification and start-up checklists for each type of equipment and system shall be provided to the installation contractors by the Commissioning Agent for use by the contractor in documenting the installation and start-up of equipment in the commissioning program. Refer to Section 01 7513 – Pre-Functional Checklists.
- D. For equipment and system components requiring a manufacturer's representative for installation verification and start-up, manufacturer documentation of these activities shall be attached to the checklists provided by the Commissioning Agent.
- E. Completed Start-up checklists for all pieces of equipment shall be submitted by Contractor to the Commissioning Agent prior to verification and performance testing.

1. TRAINING

- a. Refer to Section 01 7900 - Demonstration and Training for training requirements.

SECTION 26 08 00 - COMMISSIONING OF ELECTRICAL SYSTEMS

- b. Contractor responsible for the installation of the system shall coordinate the participation of other sub-contractors and manufacturer's representatives in the training program.
2. GENERAL SYSTEM TESTING CRITERIA
- a. Functional Performance Testing
 - 1) Refer to Sections 01 9113 - General Commissioning Requirements and 01 9114 - Functional Testing Requirements. Installation contractor shall be responsible for providing qualified manufacturer's representatives to demonstrate the operational capabilities of the electrical systems.

END OF SECTION 260800 26 08 00

**SECTION 26 09 23
LIGHTING CONTROL DEVICES**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Occupancy sensors.

1.2 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; National Fire Protection Association, Including All Applicable Amendments and Supplements; 2020.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of wall switch occupancy sensors with actual installed door swings.
 - 2. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.
 - 3. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.
- B. Sequencing:
 - 1. Do not install lighting control devices until final surface finishes and painting are complete.

1.4 SUBMITTALS

- A. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
 - 1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.
- B. Shop Drawings:
 - 1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.
- C. Field Quality Control Reports.
- D. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Operation and Maintenance Data: Include detailed information on device programming and setup.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
- G. Project Record Documents: Record actual installed locations and settings for lighting control devices.

1.5 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Product Listing Organization Qualifications: Third party agencies shall be amongst those accredited by the NCBC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.

1.6 DELIVERY, STORAGE, AND PROTECTION

- A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.7 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.8 WARRANTY

- A. Provide five year manufacturer warranty for all occupancy sensors.

PART 2 PRODUCTS

2.1 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.

2.2 OCCUPANCY SENSORS

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell.com/#sle.
 - 2. Sensor Switch Inc.
 - 3. WattStopper.
 - 4. Approved Equal.
 - 5. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.
- B. All Occupancy Sensors:
 - 1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
 - 2. Sensor Technology:
 - a. Passive Infrared (PIR) Occupancy Sensors: Designed to detect occupancy by sensing movement of thermal energy between zones.

- b. Ultrasonic Occupancy Sensors: Designed to detect occupancy by sensing frequency shifts in emitted and reflected inaudible sound waves.
 - c. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and ultrasonic technologies.
 3. Provide LED to visually indicate motion detection.
 4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.
 5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
 6. Passive Infrared Lens Field of View: Field customizable by addition of factory masking material, adjustment of integral blinders, or similar means to block motion detection in selected areas.
 7. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
 8. Sensitivity: Field adjustable.
 9. Adaptive Technology: Field selectable; capable of self-adjusting sensitivity and time delay according to conditions.
 10. Isolated Relay for Low Voltage Occupancy Sensors: SPDT dry contacts, for interface with HVAC systems.
- C. Wall Switch Occupancy Sensors:
 1. All Wall Switch Occupancy Sensors:
 - a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
 - b. Unless otherwise indicated or required to control the load indicated on drawings, provide line voltage units with self-contained relay.
 - c. Where indicated, provide two-circuit units for control of two separate lighting loads, with separate manual controls and separately programmable operation for each load.
 - d. Finish: Match finishes specified for wiring devices in Section 26 27 26, unless otherwise indicated.
 2. Dual Technology wall switch occupancy sensors: Capable of detecting motion within an area of 35 x 30 foot area for major motion and a 20 x 15 foot area for minor motion.
 - a. Products:
 - 1) Single Button: Wattstopper DW-100.
 - 2) Two Button: Wattstopper DW-200.
 - 3) or approved equal.
- D. Ceiling Mounted Occupancy Sensors:

1. All Ceiling Mounted Occupancy Sensors:
 - a. Description: Low profile occupancy sensors designed for ceiling installation.
 - b. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
 - c. Provide field selectable setting for disabling LED motion detector visual indicator.
 - d. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.
 - e. Finish: White unless otherwise indicated.
2. Passive Infrared (PIR) Ceiling Mounted Occupancy Sensors:
 - a. Standard Range Sensors: Capable of detecting motion within an area of 500 square feet coverage at a mounting height of 8 feet, with a field of view of 360 degrees.
 - 1) Products:
 - (a) Wattstopper CI-200-1.
 - (b) Approved Equal.
 - b. Extended Range Sensors: Capable of detecting motion within an area of 2,000 square feet coverage at a mounting height of 15 feet, with a field of view of 360 degrees.
 - 1) Products:
 - (a) Wattstopper CX-100.
 - (b) or approved equal.
3. Ultrasonic Ceiling Mounted Occupancy Sensors:
 - a. Extended Range Sensors: Capable of detecting motion within an area of 1,100 square feet coverage at a mounting height of 12 feet, with a field of view of 360 degrees.
 - 1) Products:
 - (a) Room Sensors: Wattstopper WT1100.
 - (b) Corridor Sensor with 90 linear feet of coverage Wattstopper WT 2250.
 - (c) or approved equal.
4. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
 - a. Extended Range Sensors: Capable of detecting motion within an area of 1,000 square feet coverage 9 feet, with a field of view of 360 degrees.
 - 1) Products:
 - (a) Wattstopper DT-300.

E. Directional Occupancy Sensors:

1. All Directional Occupancy Sensors: Designed for wall or ceiling mounting, with integral swivel for field adjustment of motion detection coverage.
 - a. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
 - b. Provide field selectable setting for disabling LED motion detector visual indicator.
 - c. Finish: White unless otherwise indicated.
 2. Passive Infrared (PIR) Directional Occupancy Sensors:
 3. Passive Infrared/Ultrasonic Dual Technology Directional Occupancy Sensors: Capable of detecting motion within a distance of 40 feet at a mounting height of 10 feet.
 - a. Products:
 - 1) Wattstopper CX-100.
 - 2) Wattstopper DT-200.
 - 3) or approved equal.
- F. Power Packs for Low Voltage Occupancy Sensors:
1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.
 2. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
 3. Input Supply Voltage: Dual rated for 120/277 V ac.
 4. Power packs shall be capable of fitting in a standard 4" square junction box.
 5. Load Rating: As required to control the load indicated on drawings.
 6. Provide isolated relay for interface with HVAC units.

2.3 LIGHTING OVERRIDE SWITCHES AND BAS PROGRAMMING

- A. Coordinate all override lighting controls, contactors, and programming with the BAS controls contractor.
- B. BAS controls contractor shall provide single button override switches with all associated wiring back to BAS panel. Electrical contractor shall provide device box, and 3/4" conduit, with pull string, to above nearest accessible ceiling.
- C. BAS system will have all required outputs to control the lighting contactors identified on the drawings.
- D. Override switches shall be programmed by BAS controls contractor as follows:
 1. Time of day schedule shall be coordinated with owner.
 2. During scheduled on period: button press has no effect.

3. Impending off event: Fifteen minutes prior to a scheduled off event BAS shall blink the lights on and off three times in three second intervals to warn occupants.
 4. If button is pressed during an impending off event the normal schedule shall be overridden to be on for two hours from the time the button is pressed.
 5. 15 minutes prior to the 2 hour override is expired if the normal schedule is still off another impending off blink warning will be initiated.
 6. Pressing the button at any time during a normally scheduled off period will initiate a 2 hour on override.
- E. Exterior Lighting Controls Programming.
1. Exterior lighting schedule shall be confirmed with owner prior to programming.
 2. On/Off schedule shall be adjustable based on daylight sensor input to turn exterior lighting on/off based on exterior lighting levels.
 3. In general exterior lighting shall turn on 15 minutes prior to sunset, off at 12:00am, and on again at 5:00 am until sunrise. Coordinate final sequence with owner.
- F. Upon activation of fire alarm system the BAS shall automatically override any schedule off period or event. Normal programmed schedule to resume once fire alarm system is no longer in alarm.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.
- F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.
- G. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. Perform work in a neat and workmanlike manner in accordance.

- B. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of lighting control devices provided under this section.
 - 1. Mounting Heights: Unless otherwise indicated, as follows:
 - a. Wall Switch Occupancy Sensors: 48 inches above finished floor.
 - 2. Orient outlet boxes for vertical installation of lighting control devices unless otherwise indicated.
- C. Install lighting control devices in accordance with manufacturer's instructions.
- D. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- E. Install lighting control devices plumb and level, and held securely in place.
- F. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 26 27 26.
- G. Provide required supports in accordance with Section 26 05 29.
- H. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings.
- I. Occupancy Sensor Locations:
 - 1. Location Adjustments: Locations indicated are diagrammatic and only intended to indicate which rooms or areas require devices. Provide quantity and locations as required for complete coverage of respective room or area based on manufacturer's recommendations for installed devices.
 - 2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors a minimum of 6 feet from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.
- J. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling near the sensor location.
- K. Unless otherwise indicated, install switches on load side of power packs so that switch does not turn off power pack.

3.4 FIELD QUALITY CONTROL

- A. Provide System Commissioning in accordance with 2018 NCECC Section C408.
- B. Inspect each lighting control device for damage and defects.
- C. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area.
- D. Correct wiring deficiencies and replace damaged or defective lighting control devices.

3.5 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

- B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect.
- C. Adjust position of directional occupancy sensors and outdoor motion sensors to achieve optimal coverage as required.
- D. Where indicated or as directed by Architect or owner, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.
- E. Adjust time switch settings to achieve desired operation schedule as indicated or as directed by Architect.

3.6 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.7 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate proper operation of lighting control devices to Architect, and correct deficiencies or make adjustments as directed.
- B. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of two hours of training.
 - 3. Instructor: Qualified contractor familiar with the project and with sufficient knowledge of the installed lighting control devices.
 - 4. Location: At project site.

END OF SECTION 26 09 23

**SECTION 26 22 00
DRY TYPE TRANSFORMERS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General purpose transformers.

1.2 REFERENCE STANDARDS

- A. UL 1561 - Standard for Dry-Type General Purpose and Power Transformers; Current Edition, Including All Revisions.
- B. NFPA 70 - National Electrical Code; National Fire Protection Association, Including All Applicable Amendments and Supplements; 2020.

1.3 SUBMITTALS

- A. Product Data: Include voltage, kVA, impedance, tap configurations, insulation system class and rated temperature rise, efficiency, sound level, enclosure ratings, outline and support point dimensions, weight, required clearances, service condition requirements, and installed features.
 - 1. Vibration Isolators: Include attachment method and rated load and deflection.
- B. Shop Drawings: Provide dimensioned plan and elevation views of transformers and adjacent equipment with all required clearances indicated.
- C. Field Quality Control Test Reports.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Maintenance Data: Include recommended maintenance procedures and intervals.
- F. Project Record Documents: Record actual locations of transformers.

1.4 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Product Listing Organization Qualifications: Third party agencies shall be amongst those accredited by the NCBC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

1.6 FIELD CONDITIONS

- A. Ambient Temperature: Do not exceed the following maximum temperatures during and after installation of transformers.
 - 1. 104 degrees F maximum.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. ABB/GE: www.geindustrial.com/#sle.
- B. Eaton Corporation.
- C. Schneider Electric; Square D Products.
- D. Approved Equal.
- E. Source Limitations: Furnish transformers produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.2 TRANSFORMERS - GENERAL REQUIREMENTS

- A. Description: Factory-assembled, dry type transformers for 60 Hz operation designed and manufactured in accordance with NEMA ST 20 and listed, classified, and labeled as suitable for the purpose intended.
- B. Unless noted otherwise, transformer ratings indicated are for continuous loading according to IEEE C57.96 under the following service conditions:
 - 1. Altitude: Less than 3,300 feet.
 - 2. Ambient Temperature:
 - a. Not exceeding 104 degrees F.
- C. Core: High grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Keep magnetic flux densities substantially below saturation point, even at 10 percent primary overvoltage. Tightly clamp core laminations to prevent plate movement and maintain consistent pressure throughout core length.
- D. Impregnate core and coil assembly with non-hydroscopic thermo-setting varnish to effectively seal out moisture and other contaminants.
- E. Basic Impulse Level: 10 kV.
- F. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.
- G. Isolate core and coil from enclosure using vibration-absorbing mounts.
- H. Nameplate: Include transformer connection data, ratings, wiring diagrams, and overload capacity based on rated winding temperature rise.

2.3 GENERAL PURPOSE TRANSFORMERS

- A. Description: Self-cooled, two winding transformers listed and labeled as complying with UL 506 or UL 1561; ratings as indicated on the drawings.

- B. Insulation System and Allowable Average Winding Temperature Rise:
 - 1. 15 kVA and Larger: Class 220 degrees C insulation system with 115 degrees C average winding temperature rise.
- C. Coil Conductors: Continuous copper windings with terminations brazed or welded.
- D. Winding Taps:
 - 1. 15 kVA through 300 kVA: Two 2.5 percent full capacity primary taps above and four 2.5 percent full capacity primary taps below rated voltage.
 - 2. 500 kVA and Larger: Two 2.5 percent full capacity primary taps above and two 2.5 percent full capacity primary taps below rated voltage.
- E. Energy Efficiency: Comply with DOE 2016.
- F. Sound Levels: Standard sound levels complying with NEMA ST 20
- G. Mounting Provisions:
 - 1. 15 kVA through 75 kVA: Suitable for wall, floor, or trapeze mounting.
 - 2. Larger than 75 kVA: Suitable for floor mounting.
- H. Transformer Enclosure: Comply with NEMA ST 20.
 - 1. Environment Type per NEMA 250: As indicated on the drawings.
 - 2. Construction: Steel.
 - a. 15 kVA and Larger: Ventilated.
 - 3. Finish: Manufacturer's standard grey, suitable for outdoor installations.
 - 4. Provide lifting eyes or brackets.
- I. Accessories:
 - 1. Lug Kits: Sized as required for termination of conductors as indicated on the drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that suitable support frames and anchors are installed where required and that mounting surfaces are ready to receive transformers.
- C. Perform pre-installation tests and inspections on transformers per manufacturer's instructions and as specified in NECA 409. Correct deficiencies prior to installation.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Perform work in a neat and workmanlike manner.
- B. Install products in accordance with manufacturer's instructions.
- C. Use flexible conduit, under the provisions of Section 26 05 33.13, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- D. Arrange equipment to provide minimum clearances as specified on transformer nameplate and in accordance with manufacturer's instructions and NFPA 70.
- E. Install transformers plumb and level.
- F. Transformer Support:
 - 1. Provide required support and attachment in accordance with Section 26 05 29, where not furnished by transformer manufacturer.
 - 2. Use integral transformer flanges, accessory brackets furnished by manufacturer, or field-fabricated supports to support wall-mounted transformers.
 - 3. Unless otherwise indicated, mount floor-mounted transformers on properly sized 4 inch high concrete pad constructed in accordance with Section 03 30 00.
 - 4. Use trapeze hangers assembled from threaded rods and metal channel (strut) to support suspended transformers. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- G. Provide grounding and bonding in accordance with Section 26 05 26.
- H. Remove shipping braces and adjust bolts that attach the core and coil mounting bracket to the enclosure according to manufacturer's recommendations in order to reduce audible noise transmission.
- I. Where not factory-installed, install lugs sized as required for termination of conductors as indicated.

3.3 FIELD QUALITY CONTROL

- A. Perform inspections and tests listed in NETA ATS Sections 7.2.1.1 and 7.2.1.2. Tests and inspections listed as optional are not required.
 - 1. Visual and Mechanical Inspection.
 - a. Verify equipment name plate is in accordance with contract documents.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, and grounding.
 - d. Verify that resilient mounts are free and that any shipping brackets have been removed.
 - e. Verify the unit is clean.
 - f. Verify that as-left tap connections are as specified.
 - 2. 167 kVA single phase, 500 kVA three phase and smaller:
 - a. Electrical Tests:

- 1) Measure resistance at each winding, tap, and bolted connection.
 - 2) Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index: the value of the index shall not be less than 1.0.
 - 3) Perform turns-ratio tests at all tap positions. Test results shall not deviate by more than one-half percent from either the adjacent coils or the calculated ratio. If test fails, replace the transformer.
 - 4) Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.
3. Larger than 167 kVA single phase and 500 kVA three phase:
- a. Electrical Tests
 - 1) Measure resistance at each winding, tap, and bolted connection.
 - 2) Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index: the value of the index shall not be less than 1.0.
 - 3) Perform power-factor or dissipation-factor tests on all windings.
 - 4) Perform turns-ratio tests at all tap positions. Test results shall not deviate by more than one-half percent from either the adjacent coils or the calculated ratio. If test fails, replace the transformer.
 - 5) Perform an excitation-current test on each phase.
 - 6) Perform an applied voltage test on all high- and low-voltage windings to ground. See IEEE C57.12.91, Sections 10.2 and 10.9.
 - 7) Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.

3.4 ADJUSTING

- A. Measure primary and secondary voltages and make appropriate tap adjustments.
- B. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.5 CLEANING

- A. Clean dirt and debris from transformer components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 22 00

**SECTION 26 24 16
PANELBOARDS****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Power distribution panelboards.
- B. Lighting and appliance panelboards.
- C. Overcurrent protective devices for panelboards.

1.2 REFERENCE STANDARDS

- A. UL 67 - Panelboards; Current Edition, Including All Revisions.
- B. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- C. NFPA 70 - National Electrical Code; National Fire Protection Association, Including All Applicable Amendments and Supplements; 2020.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
 - 4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.4 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
 - 1. Contractor shall confirm that all lug sizes and quantities submitted are compatible with the conductors specified on the contract documents. Changes required to lug sizes and quantities due to lack of coordination between the contractor and the supplier are to be made at the contractor's expense.
- B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

1. It is the contractor's responsibility to ensure that the equipment submitted to comply with the requirements of this section are in compliance with the requirements and recommendations of the power system studies. Any changes recommended by the power system study shall be incorporated at no expense to the project.
- C. Field Quality Control Test Reports.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.
- F. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

1.5 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Product Listing Organization Qualifications: Third party agencies shall be amongst those accredited by the NCBC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.
- D. Contractor shall schedule a pre-energization site visit with the Engineer. Meeting shall be scheduled at least 7 days in advance. The results of the megger test and service ground resistance test shall be made available to the Engineer prior to scheduling the pre-energization site visit.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.7 FIELD CONDITIONS

- A. Maintain ambient temperature within the following limits during and after installation of panelboards:
 1. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. ABB/GE: www.geindustrial.com/#sle.
- B. Eaton Corporation.
- C. Schneider Electric; Square D Products.

-
- D. Source Limitations: Furnish panelboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.2 PANELBOARDS - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
1. Altitude: Less than 6,600 feet.
 2. Ambient Temperature:
 - a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.
- C. Short Circuit Current Rating:
1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
 2. When a power system study is included in the contract short circuit current ratings shall be verified with the study prior to submitting equipment for approval. Any changes required to meet the maximum available fault current shall be made in the submittal.
 3. Series rating is not allowed.
- D. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- E. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- F. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
- G. Bussing: Sized in accordance with UL 67 temperature rise requirements.
1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
 2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
- H. Conductor Terminations: Suitable for use with the conductors to be installed.
- I. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
1. Environment Type per NEMA 250: As indicated on the drawings.
 2. Boxes: Galvanized steel unless otherwise indicated.
 3. Fronts:
 - a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
 - b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.

- c. All covers shall be door in door type where one door can be opened to access the breakers and and dead front and the second door opens to the wire bending space adjacent to the dead front.
- d. Door in door covers shall feature a full length piano hinge.
- 4. Lockable Doors: All locks keyed alike unless otherwise indicated.
- J. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
- K. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.
- L. Load centers are not acceptable.

2.3 POWER DISTRIBUTION PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:
 - 1. Main and Neutral Lug Material: Copper, suitable for terminating copper conductors only.
 - 2. Main and Neutral Lug Type: Compression.
- C. Bussing:
 - 1. Phase and Neutral Bus Material: Copper.
 - 2. Ground Bus Material: Copper.
- D. Circuit Breakers:
 - 1. Provide bolt-on type.
 - 2. Provide thermal magnetic circuit breakers for circuit breaker frame sizes less than 250 amperes.
 - 3. Provide electronic trip circuit breakers for circuit breaker frame sizes 250 amperes and above.
- E. Enclosures:
 - 1. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
 - 2. Provide clear plastic circuit directory holder mounted on inside of door.

2.4 LIGHTING AND APPLIANCE PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:

1. Main and Neutral Lug Material: Copper, suitable for terminating copper conductors only.
 2. Main and Neutral Lug Type: Compression.
- C. Bussing:
1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
 2. Phase and Neutral Bus Material: Copper.
 3. Ground Bus Material: Copper.
- D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.
- E. Provide electronic trip circuit breakers for circuit breaker frame sizes [250] amperes and above.
- F. Enclosures:
1. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
 2. Provide clear plastic circuit directory holder mounted on inside of door.

2.5 OVERCURRENT PROTECTIVE DEVICES

- A. Molded Case Circuit Breakers:
1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
 2. **Service Entrance Equipment Main Breakers shall be 100% Full Rated.**
 3. Interrupting Capacity:
 - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated.
 - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
 4. Conductor Terminations:
 - a. Provide compression lugs.
 - b. Lug Material: Copper, suitable for terminating copper conductors only.
 5. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
 - a. Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 100 amperes and larger.
 6. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.

7. Provide electronic trip circuit breakers for circuit breaker frame sizes larger than 250 amperes.
 - a. Provide the following individually field-adjustable trip response settings:
 - 1) Long time pickup, adjustable by setting dial.
 - 2) Long time delay.
 - 3) Short time pickup and delay.
 - 4) Instantaneous pickup.
 - 5) Ground fault pickup and delay where ground fault protection is indicated.
8. Do not use handle ties in lieu of multi-pole circuit breakers.
9. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.
10. Provide the following features and accessories where indicated or where required to complete installation:
 - a. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
 - b. Handle Pad-Lock Provision: For locking circuit breaker handle in OFF position.
 - 1) Provide handle locks for all breakers serving fire alarm equipment or elevator emergency communication systems. Handle locks shall be Space Age Electronics ELOCK series or approved equal.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive panelboards.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install panelboards securely, in a neat and workmanlike manner.
- D. Arrange equipment to provide at least clearances in accordance with manufacturer's instructions and NFPA 70.
- E. Provide required support and attachment in accordance with Section 26 05 29.
- F. Install panelboards plumb.

- G. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.
- H. Provide grounding and bonding in accordance with Section 26 05 26.
- I. Install all field-installed branch devices, components, and accessories.
- J. Set field-adjustable circuit breaker tripping function settings as directed. If a power system study is included in the contract, set breakers according to the recommendations made in the study.
- K. Provide filler plates to cover unused spaces in panelboards.
- L. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated. Also provide for the following:
 - 1. Emergency and night lighting circuits.
 - 2. Fire detection and alarm circuits.
 - 3. Intrusion detection and access control system circuits.
 - 4. Video surveillance system circuits.
- M. Identify panelboards in accordance with Section 26 05 53.

3.3 FIELD QUALITY CONTROL

- A. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than 600 amperes. Tests listed as optional are not required.
 - 1. Verify equipment nameplate is in accordance with contract documents.
 - 2. Inspect physical and mechanical condition.
 - 3. Inspect anchorage and alignment.
 - 4. Verify unit is clean.
 - 5. Operate breaker to ensure smooth operation.
 - 6. Perform breaker adjustments in accordance with the power system study.
 - 7. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
 - 8. Perform insulation-resistance test for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed.
 - 9. Perform contact/pole resistance test.
 - 10. Determine long-time and short time pickup and delay settings by primary current injection.
 - 11. Determine ground fault pickup and time delay by primary current injection.
 - B. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
 - C. Test GFCI circuit breakers to verify proper operation.
-

- D. Test AFCI circuit breakers to verify proper operation.
- E. Test shunt trips to verify proper operation.
- F. Correct deficiencies and replace damaged or defective panelboards or associated components.
- G. For Services and feeders 1000 amperes and larger, and any installation utilizing selective coordination, the following test should be performed on the circuit breakers. Testing shall be performed by a qualified manufacturer's factory technician at the job site. All readings shall be tabulated.
 - 1. Phase Tripping tolerance (within 20% of UL requirements).
 - 2. Trip time (per phase) in seconds.
 - 3. Instantaneous trip (amps) per phase.
 - 4. Insulation resistance (in megohms) at 1000-volts DC (phase to phase, and line to load).

3.4 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of panelboard fronts.
- C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.5 CLEANING

- A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 24 16

**SECTION 26 27 26
WIRING DEVICES**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wall switches.
- B. Wall dimmers.
- C. Receptacles.
- D. Wall plates.
- E. Floor box service fittings.
- F. Poke-through assemblies.

1.2 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
- C. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
- D. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.
- E. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.
- F. NFPA 70 - National Electrical Code; National Fire Protection Association, Including All Applicable Amendments and Supplements; 2020.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
 - 3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
 - 4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
 - 5. Coordinate the core drilling of holes for poke-through assemblies with the work covered under other sections.
 - 6. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

- B. Sequencing:
 - 1. Do not install wiring devices until final surface finishes and painting are complete.

1.4 SUBMITTALS

- A. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
 - 1. Wall Dimmers: Include derating information for ganged multiple devices.
- B. Certificates for Surge Protection Receptacles: Manufacturer's documentation of listing for compliance with UL 1449.
- C. Field Quality Control Test Reports.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Operation and Maintenance Data:
 - 1. Wall Dimmers: Include information on operation and setting of presets.
 - 2. GFCI Receptacles: Include information on status indicators.
- F. Project Record Documents: Record actual installed locations of wiring devices.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Screwdrivers for Tamper-Resistant Screws: Two for each type of screw.
 - 2. Extra Keys for Locking Switches: Two of each type.
 - 3. Extra Wall Plates: Two of each style, size, and finish.

1.5 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Products: Listed, classified, and labeled as suitable for the purpose intended.
- D. Product Listing Organization Qualifications: Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.

1.6 DELIVERY, STORAGE, AND PROTECTION

- A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.1 WIRING DEVICE APPLICATIONS

- A. Provide wiring devices suitable for intended use and with ratings adequate for load served.

- B. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.
- C. Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.
- D. Provide GFCI protection for receptacles installed within 6 feet of sinks.
- E. Provide GFCI protection for receptacles installed in kitchens.
- F. Provide GFCI protection for receptacles serving electric drinking fountains.
- G. Unless noted otherwise, do not use combination switch/receptacle devices.
- H. For flush floor service fittings, use carpet flanges for installations in carpeted floors.

2.2 WIRING DEVICE FINISHES

- A. Provide wiring device finishes as described below unless otherwise indicated.
- B. Wiring Devices, Unless Otherwise Indicated: White with stainless steel wall plate.
- C. Wiring Devices Installed in Finished Spaces: White with stainless steel wall plate.
- D. Wiring Devices Installed in Unfinished Spaces: White with galvanized steel wall plate.
- E. Wiring Devices Connected to Emergency Power: Red with stainless steel wall plate.

2.3 WALL SWITCHES

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell.com/#sle.
 - 2. Leviton Manufacturing Company, Inc.
 - 3. Pass & Seymour, a brand of Legrand North America, Inc
 - 4. Approved Equal.
- B. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20; types as indicated on the drawings.
 - 1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.
- C. Standard Wall Switches: Industrial heavy duty grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, three way, or four way as indicated on the drawings.

2.4 WALL DIMMERS

- A. Manufacturers:
 - 1. Leviton Manufacturing Company, Inc.

2. Lutron Electronics Company, Inc.
 3. Pass & Seymour, a brand of Legrand North America, Inc
 4. Or approved equal.
- B. Wall Dimmers - General Requirements: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1472; types and ratings suitable for load controlled as indicated on the drawings.
- C. Provide accessory wall switches to match dimmer appearance when installed adjacent to each other.
- D. Contractor shall ensure dimmer switch compatibility with luminaire controlled prior to ordering.

2.5 RECEPTACLES

- A. Manufacturers:
1. Hubbell Incorporated: www.hubbell.com/#sle.
 2. Leviton Manufacturing Company, Inc.
 3. Pass & Seymour, a brand of Legrand North America, Inc.
 4. Approved equal.
 5. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.
- B. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498 and where applicable FS W-C-596; types as indicated on the drawings.
1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
 2. NEMA configurations specified are according to NEMA WD 6.
- C. Convenience Receptacles:
1. Standard Convenience Receptacles: Industrial Heavy Duty Grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
- D. GFCI Receptacles:
1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
 - a. Provide test and reset buttons of same color as device.
 2. Standard GFCI Receptacles: Extra Heavy Duty Grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
 3. Weather Resistant GFCI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.

2.6 WALL PLATES

- A. Manufacturers:
 - 1. Hubbell Incorporated.
 - 2. Leviton Manufacturing Company, Inc.
 - 3. Pass & Seymour, a brand of Legrand North America, Inc.
 - 4. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.
- B. Wall Plates: Comply with UL 514D.
 - 1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
 - 2. Size: Semi-Jumbo; Midi Size.
 - 3. Screws: Metal with slotted heads finished to match wall plate finish.
- C. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.
- D. Galvanized Steel Wall Plates: Rounded corners and edges, with corrosion resistant screws.
- E. Weatherproof Covers for Wet and Damp Locations: Gasketed, thermoplastic, with self-closing hinged cover and corrosion-resistant screws; listed as suitable for use in wet locations with cover closed. Covers must be weatherproof while in use.

2.7 FLOOR BOX SERVICE FITTINGS

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell.com/#sle.
 - 2. Thomas & Betts Corporation.
 - 3. Wiremold, a brand of Legrand North America, Inc.
 - 4. Or approved equal.
- B. Description: Service fittings compatible with floor boxes provided under Section 26 05 33.16 with components, adapters, and trims required for complete installation.
- C. Flush Floor Service Fittings:
 - 1. Dual Service Flush Combination Outlets:
 - a. Cover: Round - Finish to be selected by Architect.
 - b. Configuration:
 - 1) Power: Two standard convenience duplex receptacles.
 - 2) Communications: As indicated on drawings.
 - 3) Voice and Data Jacks: As indicated on the drawings.

2. Accessories:
 - a. Tile Rings: Finish to match covers; configuration as required to accommodate specified covers.
 - b. Carpet Flanges: Finish to match covers; configuration as required to accommodate specified covers.

2.8 POKE-THROUGH ASSEMBLIES

- A. Manufacturers:
 1. Hubbell Incorporated: www.hubbell.com/#sle.
 2. Thomas & Betts Corporation.
 3. Wiremold, a brand of Legrand North America, Inc.
 4. Or approved equal.
- B. Description: Assembly comprising floor service fitting, poke-through component, fire stops and smoke barriers, and junction box for conduit termination; fire rating listed to match fire rating of floor and suitable for floor thickness where installed.
- C. Flush Floor Service Fittings:
 1. Dual Service Flush Combination Outlets:
 - a. Cover: Round - Finish to be selected by Architect.
 - b. Configuration:
 - 1) Power: Two standard convenience duplex receptacles.
 - 2) Communications: As indicated on drawings.
 - 3) Voice and Data Jacks: As indicated on the drawings.
 2. Accessories:
 - a. Closure Plugs: Size and fire rating as required to seal unused core hole and maintain fire rating of floor.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that floor boxes are adjusted properly.

- F. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- G. Verify that core drilled holes for poke-through assemblies are in proper locations.
- H. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. Perform work in a neat and workmanlike manner.
 - B. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of wiring devices provided under this section.
 - 1. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
 - 2. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
 - 3. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.
 - C. Install wiring devices in accordance with manufacturer's instructions.
 - D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
 - E. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.
 - F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.
 - G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
 - H. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.
 - I. Install wiring devices plumb and level with mounting yoke held rigidly in place.
 - J. Install wall switches with OFF position down.
 - K. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
 - L. Do not share neutral conductor on branch circuits utilizing wall dimmers.
 - M. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.
-

- N. Where receptacles are indicated to be mounted above counters they shall be mounted horizontally.
- O. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings.
- P. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.
- Q. Install poke-through closure plugs in each unused core holes to maintain fire rating of floor.

3.4 FIELD QUALITY CONTROL

- A. Inspect each wiring device for damage and defects.
- B. Operate each wall switch and wall dimmer with circuit energized to verify proper operation.
- C. Test each receptacle to verify operation and proper polarity.
- D. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.
- E. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.5 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust presets for wall dimmers according to manufacturer's instructions as directed by Architect.

3.6 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION 26 27 26

**SECTION 26 28 13
FUSES****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Fuses.
- B. Spare fuse cabinet.

1.2 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. NFPA 70 - National Electrical Code; National Fire Protection Association, Including All Applicable Amendments and Supplements; 2020.
- C. UL 248-4 - Low-Voltage Fuses - Part 4: Class CC Fuses; Current Edition, Including All Revisions.
- D. UL 248-8 - Low-Voltage Fuses - Part 8: Class J Fuses; Current Edition, Including All Revisions.
- E. UL 248-10 - Low-Voltage Fuses - Part 10: Class L Fuses; Current Edition, Including All Revisions.
- F. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses; Current Edition, Including All Revisions.
- G. UL 248-15 - Low-Voltage Fuses - Part 15: Class T Fuses; Current Edition, Including All Revisions.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
 - 2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
 - 3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.4 SUBMITTALS

- A. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.
 - 1. Spare Fuse Cabinet: Include dimensions.
- B. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Fuses: One set(s) of three for each type and size installed.
 - 3. Fuse Pullers: One set(s) compatible with each type and size installed.

- 4. Spare Fuse Cabinet Keys: Two.

1.5 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Product Listing Organization Qualifications: Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Bussmann, a division of Eaton Corporation.
- B. Littelfuse, Inc.
- C. Mersen.
- D. Approved equal.

2.2 FUSES

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.
- C. Provide fuses of the same type, rating, and manufacturer within the same switch.
- D. Comply with UL 248-1.
- E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.
- F. Voltage Rating: Suitable for circuit voltage.
- G. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.
- H. Provide the following accessories where indicated or where required to complete installation:
 - 1. Fuseholders: Compatible with indicated fuses.

2.3 SPARE FUSE CABINET

- A. Description: Wall-mounted sheet metal cabinet with shelves and hinged door with cylinder lock, suitably sized to store spare fuses and fuse pullers specified.
- B. Cabinet shall be located in the main electrical room unless otherwise indicated by owner.
- C. Finish: Manufacturer's standard, factory applied grey finish unless otherwise indicated.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.
- B. Verify that mounting surfaces are ready to receive spare fuse cabinet.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Do not install fuses until circuits are ready to be energized.
- B. Install fuses with label oriented such that manufacturer, type, and size are easily read.
- C. Install spare fuse cabinet where indicated.
- D. Identify spare fuse cabinet in accordance with Section 26 05 53.

END OF SECTION 26 28 13

**SECTION 26 28 16.16
ENCLOSED SWITCHES AND CIRCUIT BREAKERS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Enclosed safety switches.
- B. Enclosed circuit breakers.

1.2 REFERENCE STANDARDS

- A. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- B. NFPA 70 - National Electrical Code; National Fire Protection Association, Including All Applicable Amendments and Supplements; 2020.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.4 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.
- B. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 - 1. Include wiring diagrams showing all factory and field connections.
 - 2. Contractor shall confirm that all lug sizes and quantities submitted are compatible with the conductors specified on the contract documents. Changes required to lug sizes and quantities due to lack of coordination between the contractor and the supplier are to be made at the contractor's expense.
 - 3. It is the contractor's responsibility to ensure that the equipment submitted to comply with the requirements of this section are in compliance with the requirements and recommendations of the power system studies. Any changes recommended by the power system study shall be incorporated at no expense to the project.

- C. Field Quality Control Test Reports.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- E. Project Record Documents: Record actual locations of enclosed switches or circuit breakers.
- F. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

1.5 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Product Listing Organization Qualifications: Third party agencies shall be amongst those accredited by the NCBC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

1.7 FIELD CONDITIONS

- A. Maintain ambient temperature between 23 degrees F and 104 degrees F during and after installation of enclosed circuit breakers.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. ABB/GE; _____: www.geindustrial.com/#sle.
- B. Eaton Corporation.
- C. Schneider Electric; Square D Products.
- D. Source Limitations: Furnish enclosed switches and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.2 ENCLOSED SAFETY SWITCHES

- A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. All switches shall be heavy duty type.

- D. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet.
 - 2. Ambient Temperature: Between -22 degrees F and 104 degrees F.
- E. Horsepower Rating: Suitable for connected load.
- F. Voltage Rating: Suitable for circuit voltage.
- G. Auxilary Contacts: Suitable for 120v rated control circuit. Contractor is to provide auxilary contacts in any disconnecting means that is downstream from a frequency drive. aux contacts shall be mechanically tied to switching mechanisms and shall provide both a N.O. and N.C. contacts. verify with DIV 23 prior to ordering equipment.
- H. Short Circuit Current Rating:
 - 1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
 - 2. When a power system study is included in the contract, confirm the short circuit current rating of all devices with the results of the study prior to submitting for approval.
- I. Enclosed Safety Switches Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- J. Provide with switch blade contact position that is visible when the cover is open.
- K. Fuse Clips for Fusible Switches: As required to accept fuses indicated.
 - 1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.
- L. Conductor Terminations: Suitable for use with the conductors to be installed.
- M. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.
- N. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.
- O. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA 250: As indicated on the drawings.
 - 2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.
- P. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
- Q. Heavy Duty Switches:
 - 1. Comply with NEMA KS 1.

2. Conductor Terminations:
 - a. Provide mechanical lugs for switch ratings less than 400 amperes.
 - b. Provide compression lugs for switch ratings 400 amperes and above.
 - c. Lug Material: Copper, suitable for terminating copper conductors only.
3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.

2.3 ENCLOSED CIRCUIT BREAKERS

- A. Description: Units consisting of molded case circuit breakers individually mounted in enclosures.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 1. Altitude: Less than 6,600 feet.
 2. Ambient Temperature: Between 23 degrees F and 104 degrees F.
- D. Short Circuit Current Rating:
 1. Provide enclosed circuit breakers with listed short circuit current rating not less than the available fault current at the installed location indicated on the drawings.
- E. Enclosed Circuit Breakers Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- F. Auxiliary Contacts: Suitable for 120v rated control circuit. Contractor is to provide auxiliary contacts in any disconnecting means that is downstream from a frequency drive. aux contacts shall be mechanically tied to switching mechanisms and shall provide both a N.O. and N.C. contacts. verify with DIV 23 prior to ordering equipment.
- G. Conductor Terminations: Suitable for use with the conductors to be installed.
- H. Provide thermal magnetic circuit breakers for circuit breaker frame sizes less than 250 amperes.
- I. Provide electronic trip circuit breakers for circuit breaker frame sizes 250 amperes and above.
- J. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.
- K. Provide solidly bonded equipment ground bus in each enclosed circuit breaker, with a suitable lug for terminating each equipment grounding conductor.
- L. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 1. Environment Type per NEMA 250: As indicated on the drawings.
 2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.

3. Provide surface-mounted enclosures unless otherwise indicated.
- M. Provide externally operable handle with means for locking in the OFF position.
- N. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
 1. Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.
- O. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.
- P. MOLDED CASE CIRCUIT BREAKERS
 1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
 2. Interrupting Capacity:
 - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated.
 - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated. Series rating is not allowed.
 3. Conductor Terminations:
 - a. Provide mechanical lugs for circuit breaker frame sizes less than 400 amperes.
 - b. Provide compression lugs for circuit breaker frame sizes 400 amperes and above.
 - c. Lug Material: Copper, suitable for terminating copper conductors only.
 4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
 - a. Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 100 amperes and larger.
 5. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
 - a. Provide the following individually field-adjustable trip response settings:
 - 1) Long time pickup, adjustable by setting dial.
 - 2) Long time delay.
 - 3) Short time pickup and delay.
 - 4) Instantaneous pickup.
 - 5) Ground fault pickup and delay where ground fault protection is indicated.
 6. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive enclosed safety switches.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install enclosed switches securely, in a neat and workmanlike manner.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required support and attachment in accordance with Section 26 05 29.
- E. Install enclosed switches and breakers plumb.
- F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
- G. Provide grounding and bonding in accordance with Section 26 05 26.
- H. Provide fuses complying with Section 26 28 13 for fusible switches as indicated or as required by equipment manufacturer's recommendations.
- I. Set field-adjustable circuit breaker tripping function settings as directed.
- J. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- K. Identify enclosed switches and breakers in accordance with Section 26 05 53.

3.3 FIELD QUALITY CONTROL

- A. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1 for breakers larger than 600A.
 - 1. Verify equipment nameplate is in accordance with contract documents.
 - 2. Inspect physical and mechanical condition.
 - 3. Inspect anchorage and alignment.
 - 4. Verify unit is clean.
 - 5. Operate breaker to ensure smooth operation.
 - 6. Perform breaker adjustments in accordance with the power system study.

7. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
 8. Perform insulation-resistance test for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed.
 9. Perform contact/pole resistance test.
 10. Determine long-time and short time pickup and delay settings by primary current injection.
 11. Determine ground fault pickup and time delay by primary current injection.
- B. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.4 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.5 CLEANING

- A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 28 16.16

SECTION 26 43 00
SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Surge protective devices for service entrance locations.
- B. Surge protective devices for distribution locations.

1.2 REFERENCE STANDARDS

- A. UL 1283 - Standard for Electromagnetic Interference Filters; Current Edition, Including All Revisions.
- B. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.
- C. NFPA 70 - National Electrical Code; National Fire Protection Association, Including All Applicable Amendments and Supplements; 2020.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate size and location of overcurrent device compatible with the actual surge protective device and location to be installed. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to ordering equipment.

1.4 SUBMITTALS

- A. Product Data: Include detailed component information, voltage, surge current ratings, repetitive surge current capacity, voltage protection rating (VPR) for all protection modes, maximum continuous operating voltage (MCOV), nominal discharge current (I-n), short circuit current rating (SCCR), connection means including any required external overcurrent protection, enclosure ratings, outline and support point dimensions, weight, service condition requirements, and installed features.
 - 1. SPDs with EMI/RFI filter: Include noise attenuation performance.
- B. Shop Drawings: Include wiring diagrams showing all factory and field connections with wire and circuit breaker/fuse sizes.
- C. Certificates: Manufacturer's documentation of listing for compliance with the following standards:
 - 1. UL 1449.
 - 2. UL 1283 (for Type 2 SPDs).
- D. Field Quality Control Test Reports.
- E. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- F. Operation and Maintenance Data: Include information on status indicators and recommended maintenance procedures and intervals.
- G. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

H. Project Record Documents: Record actual connections and locations of surge protective devices.

1.5 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Product Listing Organization Qualifications: Third party agencies shall be amongst those accredited by the NCBC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.

1.6 DELIVERY, STORAGE, AND PROTECTION

- A. Store in a clean, dry space in accordance with manufacturer's written instructions.

1.7 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.8 WARRANTY

- A. Manufacturer's Warranty: Provide minimum five year warranty covering repair or replacement of surge protective devices showing evidence of failure due to defective materials or workmanship.
- B. Exclude surge protective devices from any clause limiting warranty responsibility for acts of nature, including lightning, stated elsewhere.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Field-installed, Externally Mounted Surge Protective Devices:
 - 1. ABB/GE: www.geindustrial.com/#sle.
 - 2. Advanced Protection Technologies, Inc (APT).
 - 3. Current Technology; a brand of Thomas & Betts Power Solutions.
 - 4. Schneider Electric; Square D Brand SurgeLogic Products.
 - 5. Liebert.
 - 6. Approved equal.
- B. Source Limitations: Furnish surge protective devices produced by a single manufacturer and obtained from a single supplier.

2.2 SURGE PROTECTIVE DEVICES - GENERAL REQUIREMENTS

- A. Description: Factory-assembled surge protective devices (SPDs) for 60 Hz service; listed, classified, and labeled as suitable for the purpose intended; system voltage as indicated on the drawings.
- B. Unless otherwise indicated, provide field-installed, externally-mounted or factory-installed, internally-mounted SPDs.

- C. List and label as complying with UL 1449, Type 1 when connected on line side of service disconnect overcurrent device and Type 1 or 2 when connected on load side of service disconnect overcurrent device.
- D. Protected Modes:
 - 1. Wye Systems: L-N, L-G, N-G, L-L.
- E. UL 1449 Voltage Protection Ratings (VPRs):
 - 1. 208Y/120V System Voltage: Not more than 700 V for L-N, L-G, and N-G modes and 1,000 V for L-L mode.
 - 2. 480Y/277V System Voltage: Not more than 1,200 V for L-N, L-G, and N-G modes and 2,000 V for L-L mode.
- F. UL 1449 Maximum Continuous Operating Voltage (MCOV): Not less than 115% of nominal system voltage.
- G. Enclosure Environment Type per NEMA 250: As indicated on the drawings.
- H. Mounting for Field-installed, Externally Mounted SPDs: Unless otherwise indicated, as specified for the following locations:
 - 1. Provide surface-mounted SPD where mounted in non-public areas or adjacent to surface-mounted equipment.

2.3 SURGE PROTECTIVE DEVICES FOR SERVICE ENTRANCE LOCATIONS

- A. Unless otherwise indicated, provide field-installed, externally mounted SPDs.
- B. Surge Current Rating:
 - 1. Ampacity: 2500 - 6000A 300 kA per mode 600 kA per phase.
 - 2. Ampacity: 1200 - 2000A 250 kA per mode 500 kA per phase.
 - 3. Ampacity: 600 - 1000A 200 kA per mode 400 kA per phase.
 - 4. Ampacity: 225 - 400A 150 kA per mode 300 kA per phase.
 - 5. Ampacity: 125 - 225A 100 kA per mode 200 kA per phase.
- C. Opening of supplementary protective devices, internal or external, shall not be permissible during UL 1449 3rd Edition Nominal Discharge testing.

2.4 SURGE PROTECTIVE DEVICES FOR DISTRIBUTION LOCATIONS

- A. Unless otherwise indicated, provide field-installed, externally mounted SPDs.
- B. Surge Current Rating:
 - 1. Ampacity: 400 - 800A 150 kA per mode 300 kA per phase.
 - 2. Ampacity: 125 - 225A 100 kA per mode 200 kA per phase.
 - 3. Ampacity: 15 - 100A 50 kA per mode 100 kA per phase.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the service voltage and configuration marked on the SPD are consistent with the service voltage and configuration at the location to be installed.
- C. Verify that electrical equipment is ready to accept connection of the SPD and that installed overcurrent device is consistent with requirements of drawings and manufacturer's instructions.
- D. Verify system grounding and bonding is in accordance with Section 26 05 26, including bonding of neutral and ground for service entrance and separately derived systems where applicable. Do not energize SPD until deficiencies have been corrected.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Perform work in a neat and workmanlike manner.
- B. Install products in accordance with manufacturer's instructions.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Unless indicated otherwise, connect service entrance surge protective device on load side of service disconnect main overcurrent device.
- E. Provide conductors with minimum ampacity not less than manufacturer's recommended minimum conductor size.
- F. Install conductors between SPD and equipment terminations as short and straight as possible, not exceeding manufacturer's recommended maximum conductor length. Breaker locations may be reasonably rearranged in order to provide leads as short and straight as possible. Twist conductors together to reduce inductance.
- G. Do not energize SPD until bonding of neutral and ground for service entrance and separately derived systems is complete in accordance with Section 26 05 26 where applicable. Replace SPDs damaged by improper or missing neutral-ground bond.
- H. Disconnect SPD prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPD connected.

3.3 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS Section 7.19.1.
- C. Procure services of a qualified manufacturer's representative to observe installation and assist in inspection, testing, and adjusting. Include manufacturer's reports with field quality control submittals.

3.4 CLEANING

- A. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 43 00

**SECTION 26 51 00
INTERIOR AND EXTERIOR LIGHTING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Interior luminaires.
- B. Emergency lighting units.
- C. Exit signs.
- D. LED Drivers.
- E. Emergency power supply units.
- F. Lamps.
- G. Accessories.

1.2 REFERENCE STANDARDS

- A. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products; 2019.
- B. NFPA 70 - National Electrical Code; National Fire Protection Association, Including All Applicable Amendments and Supplements; 2020.
- C. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
- E. UL 935 - Fluorescent-Lamp Ballasts; Current Edition, Including All Revisions.
- F. UL 1598 - Luminaires; Current Edition, Including All Revisions.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
 - 2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
 - 3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
 - 4. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
 - 1. Ballasts: Include wiring diagrams and list of compatible lamp configurations.
 - 2. Lamps: Include rated life, color temperature, color rendering index (CRI), and initial and mean lumen output.
- C. Certificates for Dimming Drivers: Manufacturer's documentation of compatibility with dimming controls to be installed.
- D. Field quality control reports.
- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- F. Warranties.
- G. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

1.5 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Product Listing Organization Qualifications: Third party agencies shall be amongst those accredited by the NCBC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.

1.6 DELIVERY, STORAGE, AND PROTECTION

- A. Receive, handle, and store products according to manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.7 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

PART 2 PRODUCTS

2.1 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.

2.2 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.

- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. Recessed Luminaires:
 - 1. Ceiling Compatibility: Comply with NEMA LE 4.
 - 2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
 - 3. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.
 - 4. Luminaires Recessed in Fire Rated Ceiling: Provide fire rated tenting to match the fire resistant rating of the surrounding ceiling.
- H. LED Luminaires:
 - 1. Components: UL 8750 recognized or listed as applicable.
 - 2. Tested in accordance with IES LM-79 and IES LM-80.
 - 3. Outdoor: Provide a minimum of 10 kV integral surge suppression.
 - 4. Indoor: Provide a minimum of 2.5 kV integral surge suppression.
- I. Luminaires Mounted in Continuous Rows: Provide quantity of units required for length indicated, with all accessories required for joining and aligning.

2.3 EMERGENCY LIGHTING UNITS

- A. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
- B. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
- C. Battery:
 - 1. Sealed maintenance-free nickel cadmium unless otherwise indicated on the lighting fixture schedule.
 - 2. Size battery to supply all connected lamps, including emergency remote heads where indicated.

- D. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation. All fixtures shall be equipped with self diagnostics in addition to the manual operation.
- E. Provide low-voltage disconnect to prevent battery damage from deep discharge.
- F. Accessories:
 - 1. Provide compatible accessory mounting brackets where indicated or required to complete installation.
 - 2. Provide compatible accessory wire guards where indicated.

2.4 EXIT SIGNS

- A. Description: Exit signs complying with NFPA 101 and applicable state and local codes, and listed and labeled as complying with UL 924.
 - 1. Number of Faces: Single- or double-face as indicated or as required for installed location.
 - 2. Directional Arrows: As indicated or as required for installed location.
- B. Self-Powered Exit Signs:
 - 1. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation. All fixtures shall be equipped with self diagnostics in addition to the manual operation.
- C. Accessories:
 - 1. Provide compatible accessory wire guards where indicated.

2.5 DRIVERS

- A. Drivers - General Requirements:
 - 1. Provide Drivers containing no polychlorinated biphenyls (PCBs).
 - 2. Minimum Efficiency/Efficacy: Provide drivers complying with all current applicable federal and state ballast efficiency/efficacy standards.
- B. Dimmable LED Drivers:
 - 1. Dimming Range: Continuous dimming from 100 percent to ten percent relative light output unless dimming capability to lower level is indicated in the fixture schedule, without flicker.
 - 2. Control Compatibility: Fully compatible with the dimming controls to be installed. Refer to drawings.
 - 3. Square wave inverters shall not be used with LED emergency lighting. Sinusoidal wave inverters must be used.

2.6 EMERGENCY POWER SUPPLY UNITS

- A. Description: Self-contained emergency power supply units suitable for use with indicated luminaires, complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
- B. Compatibility:

1. Drivers: Compatible with electronic, standard magnetic, energy saving, and dimming AC ballasts, including those with end of lamp life shutdown circuits.
- C. Operation: Upon interruption of normal power source, solid-state control automatically switches connected lamp(s) to the emergency power supply for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
- D. Unit shall have a maximum of 5% total harmonic distortion with sine wave output. Square wave output is not acceptable.
- E. Battery: Sealed maintenance-free high-temperature nickel cadmium unless otherwise indicated. Normal expected life of 10 years.
- F. Diagnostics: Provide accessible and visible multi-chromatic combination test switch/indicator light to display charge, test, and diagnostic status and to manually activate emergency operation.
- G. Operating Temperature: From 32 degrees F to 122 degrees F unless otherwise indicated or required for the installed location.

2.7 LAMPS

- A. Lamps - General Requirements:
 1. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.
 2. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.
 3. Minimum Efficiency: Provide lamps complying with all current applicable federal and state lamp efficiency standards.
 4. Color Temperature Consistency: Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature. Replace lamps that are determined by the Architect to be inconsistent in perceived color temperature.
 - a. Unless otherwise noted on the drawings color temperatures shall be as listed below. Notify engineer if there is an inconsistency in color temperatures listed in the fixture schedule prior to ordering.
 - 1) Interior Lighting: 4000 K
 - 2) Exterior Lighting: 4000 K

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.

- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of luminaires provided under this section.
 - B. All luminaire surge suppression shall be evaluated and tested in accordance with ANSI C62.41.2 standard.
 - C. Install products in accordance with manufacturer's instructions.
 - D. Provide required support and attachment in accordance with Section 26 05 29.
 - E. Install luminaires securely, in a neat and workmanlike manner.
 - F. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
 - G. Suspended Ceiling Mounted Luminaires:
 - 1. Do not use ceiling tiles to bear weight of luminaires.
 - 2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
 - 3. Secure surface-mounted and recessed luminaires to ceiling support channels or framing members or to building structure.
 - 4. Secure pendant-mounted luminaires to building structure.
 - 5. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
 - 6. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gauge, connected from opposing corners of each recessed luminaire to building structure.
 - H. Recessed Luminaires:
 - 1. Install trims tight to mounting surface with no visible light leakage.
 - 2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
 - 3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.
 - I. Suspended Luminaires:
 - 1. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
 - 2. Provide minimum of two supports for each luminaire, with no more than 4 feet between supports.
-

- 3. Install canopies tight to mounting surface.
- J. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.
- K. Install accessories furnished with each luminaire.
- L. Bond products and metal accessories to branch circuit equipment grounding conductor.
- M. Fluorescent Luminaires Controlled by Dual-Level Switching: Connect such that each switch controls the same corresponding lamps in each luminaire.
- N. Emergency Lighting Units:
 - 1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
 - 2. Install lock-on device on branch circuit breaker serving units, where served by a dedicated circuit.
- O. Exit Signs:
 - 1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
 - 2. Install lock-on device on branch circuit breaker serving units, where served by a dedicated circuit.
- P. Emergency Power Supply Units:
 - 1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal ballast(s) in luminaire. Bypass local switches, contactors, or other lighting controls.
 - 2. Install lock-on device on branch circuit breaker serving units.
- Q. Identify luminaires connected to emergency power system in accordance with Section 26 05 53.
- R. Install lamps in each luminaire.
- S. Lamp Burn-In: Operate lamps at full output for prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

3.4 WARRANTY

- A. Exit signs: Provide a minimum five year warranty. The battery shall have an additional 2 year pro rated warranty. Warranty period begins from the date of project acceptance.
- B. Emergency Luminaires: Provide a minimum of 5 year warranty for emergency luminaires. Batteries shall be warranted for 3 years with an additional 3 year pro-rated warranty. Warranty period begins from the date of project acceptance.
- C. Emergency Power supplies and inverters shall have a minimum of 10 year prorated warranty.

3.5 FIELD QUALITY CONTROL

- A. Inspect each product for damage and defects.
- B. Operate each luminaire after installation and connection to verify proper operation.

- C. Test self-powered exit signs, emergency lighting units, and fluorescent emergency power supply units to verify proper operation upon loss of normal power supply. Test shall be conducted for 90 minutes in accordance with NEC 700. Test shall be conducted a maximum of 10 days prior to final inspection and light level readings recorded at the beginning and end of the test shall be submitted to the engineer for review.
- D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

3.6 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.
- B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Architect or authority having jurisdiction.
- C. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect or authority having jurisdiction.

3.7 CLEANING

- A. Clean surfaces according to manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.8 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate proper operation of luminaires to Architect, and correct deficiencies or make adjustments as directed.
- B. After the designer final inspection and final acceptance replace all lamps that have failed and clean all lenses.

3.9 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION 26 51 00

**DIVISION 27
COMMUNICATIONS**

**SECTION 27 10 00
STRUCTURED CABLING FOR VOICE AND DATA**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Communications system design requirements.
- B. Communications pathways.
- C. Copper cable and terminations.
- D. Fiber optic cable and interconnecting devices.
- E. Communications equipment room fittings.
- F. Communications outlets.
- G. Communications grounding and bonding.
- H. Communications identification.

1.2 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- C. Section 26 05 33.13 - Conduit for Electrical Systems.
- D. Section 26 05 36 - Cable Trays for Electrical Systems.
- E. Section 26 05 33.16 - Boxes and Cabinets.
- F. Section 26 05 53 - Identification for Electrical Systems: Identification products.
- G. Section 26 27 26 - Wiring Devices.

1.3 REFERENCE STANDARDS

- A. TIA-455-21 - FOTP-21 - Mating Durability of Fiber Optic Interconnecting Devices; 1988a (Reaffirmed 2012).
- B. TIA-568 (SET) - Commercial Building Telecommunications Cabling Standard Set; 2020.
- C. TIA-568.2 - Balanced Twisted-Pair Telecommunications Cabling and Components Standards; 2018d, with Addenda (2020).
- D. TIA-568.3 - Optical Fiber Cabling and Components Standard; 2022e.
- E. TIA-569 - Telecommunications Pathways and Spaces; 2019e, with Addendum (2022).
- F. TIA-598 - Optical Fiber Cable Color Coding; 2014d, with Addendum (2018).
- G. TIA-606 - Administration Standard for Telecommunications Infrastructure; 2021d.

- H. TIA-607 - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises; 2019d, with Addendum (2021).
- I. UL 444 - Communications Cables; Current Edition, Including All Revisions.
- J. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.
- K. UL 1651 - Fiber Optic Cable; Current Edition, Including All Revisions.
- L. UL 1863 - Communications-Circuit Accessories; Current Edition, Including All Revisions.
- M. NFPA 70 - National Electrical Code; National Fire Protection Association, Including All Applicable Amendments and Supplements; 2020.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week prior to commencing work of this section to review service requirements and details with Communications Service Provider representative.
- B. Provide all labor, equipment, supplies, materials, and incidentals and all operations necessary for the "TURNKEY," fully operational, tested, and completed installation of a Complete Wiring Infrastructure to support owner supplied equipment for voice and data systems, in complete accordance with the Contract Documents.
- C. Coordination:
 - 1. Coordinate requirements for service entrance and entrance facilities with Communications Service Provider.
 - 2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for communications equipment.
 - 3. Coordinate arrangement of communications equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 4. Coordinate with the Electrical Contractor for the Grounding of all cable trays and relay racks / cabinets. Provide telecommunications ground bars at each network closet as identified on plans.
 - 5. The Structured Wiring Contractor shall coordinate with the electrical contractor such that if additional conduit sleeves are required for installation of the cabling infrastructure then the electrical contractor shall provide, install and seal as required.
 - 6. Coordination of the Raceway installation and racks & equipment placement with the Owners IT Department and Electrical Contractor.
 - 7. The Structured Wiring Contractor shall coordinate required wiring for Phone lines Circuits for the Fire Alarm System, Security Intrusion System, Building Automation System and Elevators. He shall provide and install the voice lines from that vendor's outlet / panel to the Owners phone equipment in the MDF identified on the plans. Terminate in MDF on Biscuit jacks. The owners IT staff shall coordinate the phone extensions needed for each system. Corrdinate with owners IT Department.
 - 8. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

9. Contractor shall provide all cabling infrastructure which include: Racks, wire managers, fiber/copper patch panels, patch cables, 120V AC surge strips, ladder cable way (IDF Room), SC fiber connectors, RJ45 Copper connectors, Cat 6 plenum rated cabling, Cat 6A plenum rated cabling (WAP drops), 50 micron plenum rated fiber cabling, plenum inner duct, SMB boxes for Waps and Cameras, and 3 ft patch cords for cameras. All network electronics (switches, WAPS, etc.) shall be by JCSS. Cameras and associated mounts, programming and aiming shall be by JCSS. Note all cabling shall be tested and verified/approved by engineer and owner. Note: Provide fiber enclosures as needed in the existing MDF room to accommodate the new fiber backbone cabling. Coordinate location and placement with Owner's IT Department.

- D. Arrange for Communications Service Provider to provide service.

1.5 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
- B. Shop Drawings: Show compliance with requirements on isometric schematic diagram of network layout, showing cable routings, telecommunication closets, rack and enclosure layouts and locations, service entrance, and grounding, prepared and approved by BICSI Registered Communications Distribution Designer (RCDD).
- C. Evidence of qualifications for installer.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.
- E. Test Plan: Complete and detailed plan, with list of test equipment, procedures for inspection and testing, and intended test date; submit at least 60 days prior to intended test date.
- F. Field Test Reports.
- G. Project Record Documents: Prepared and approved by BICSI Registered Communications Distribution Designer (RCDD).
 1. Record actual locations of outlet boxes and distribution frames.
 2. Show as-installed color coding, pair assignment, polarization, and cross-connect layout.
 3. Identify distribution frames and equipment rooms by room number on drawings.
- H. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of project record documents.

1.6 QUALITY ASSURANCE

- A. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- B. Manufacturer Qualifications: At least 3 years experience manufacturing products of the type specified.
- C. Installer Qualifications: A company having at least 7 years experience in the installation and testing of the type of system specified, and:
 1. Employing a BICSI Registered Communications Distribution Designer (RCDD).
 2. Supervisors and installers factory certified by manufacturers of products to be installed.

- 3. Employing BICSI Registered Cabling Installation Technicians (RCIT) for supervision of all work.
- D. Products: Listed, classified, and labeled as suitable for the purpose intended.
- E. FCC Approval - The system shall be approved for direct interconnection to the telephone utility under Part 68 of FCC rules and regulations. Systems which are not FCC approved or utilized an intermediary device for connection, shall not be considered. Provide the FCC registration number of the system being proposed as a part of the submittal process.
- F. Product Listing Organization Qualifications: Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Keep stored products clean and dry.

1.8 WARRANTY

- A. Correct defective Work within a 1 year period after Date of Project Acceptance.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Copper Cabling:
 - 1. General Cable.
 - 2. Panduit.
 - 3. Commscope.
 - 4. Superior Essex
 - 5. Or approved Equal
- B. Fiber Cabling
 - 1. General Cable.
 - 2. Commscope.
 - 3. Corning.
 - 4. Or approved equal.
- C. Connectivity:
 - 1. Panduit.
 - 2. Commscope.
 - 3. Leviton.
 - 4. Hubbell.

5. Or approved equal.
- D. Relay Racks:
1. Middle Atlantic.
 2. Hoffman.
 3. Chatsworth.
 4. Hubbell.
 5. Or approved equal.

2.2 SYSTEM DESIGN

- A. As part of this Project the Structured Wiring Contractor shall provide and install ALL relay racks /surge suppressor strips, horizontal /vertical wire management, Patch panels (Fiber / Copper) and Patch cords (Fiber / Copper). Coordinate closely with the owners IT staff for placement of equipment in racks to accommodate owner provided network switches.
- B. Permits and Inspections: Obtain and pay for all permits and inspections required by all legal authorities and agencies having jurisdiction for the work. These permits or inspections shall be a part of the work of the Contractor performing the work.
- C. Provide a complete permanent system of cabling and pathways for voice and data communications, including cables, conduits and wireways, pull wires, support structures, enclosures and cabinets, and outlets.
1. Comply with TIA-568 (SET) (cabling) and TIA-569 (pathways) (commercial standards).
 2. Comply with Communications Service Provider requirements.
 3. Provide fixed cables and pathways that comply with NFPA 70 and TIA-607 and are UL listed or third party independent testing laboratory certified.
 4. Provide connection devices that are rated for operation under conditions of 32 to 140 degrees F at relative humidity of 0 to 95 percent, noncondensing.
 5. In this project, the term plenum is defined as return air spaces above ceilings, inside ducts, under raised floors, and other air-handling spaces.
- D. Existing Main Distribution Frame (MDF): Centrally located support structure for terminating horizontal cables that extend to telecommunications outlets, functioning as point of presence to external service provider.
1. Main distribution frame as indicated on the drawings.
 2. Capacity: As required to terminate all cables required by design criteria plus minimum 25 percent spare space.
- E. Intermediate Distribution Frames (IDF): Support structures for terminating horizontal cables that extend to telecommunications outlets.
1. Locate intermediate distribution frames as indicated on the drawings.
- F. Backbone Cabling: Cabling, pathways, and terminal hardware connecting intermediate distribution frames (IDF's) with main distribution frame (MDF), wired in star topology with main distribution frame at center hub of

star.

- G. Cabling to Outlets: Specified horizontal cabling, wired in star topology to distribution frame located at center hub of star; also referred to as "links".

2.3 PATHWAYS

- A. Conduit: As specified in Section 26 05 33.13; provide pull cords in all conduit.
- B. Cable Trays: As specified in Section 26 05 36.
- C. All telecommunications stub-ups and sleeves shall have insulated bushings to protect cabling. Bushings must be plenum rated.

2.4 COPPER CABLE AND TERMINATIONS

- A. Provide cables with lead content less than 300 parts per million.
- B. Copper Horizontal Cable:
 - 1. Description: 100 ohm, balanced twisted pair cable complying with TIA-568.2 and listed and labeled as complying with UL 444.
 - 2. Cable Type - Voice and Data: TIA-568.2 Category 6 UTP (unshielded twisted pair); 23 AWG.
 - 3. Cable Type - Data (WAPS): TIA-569.2 Category 6A UTP : 23AWG
 - 4. Cable Capacity: 4-pair.
 - 5. Cable Applications:
 - a. Plenum Applications: Use listed NFPA 70 Type CMP plenum cable.
 - 6. Cable Jacket Color -Data Cable: Blue.
 - 7. Cable Jacket Color - Security Cameras: Green.
 - 8. Cable Jacket Color - Wireless Access Points: Blue
- C. Copper Cable Terminations: Insulation displacement connection (IDC) type using appropriate tool; use screw connections only where specifically indicated.
- D. Jacks and Connectors: Modular RJ-45, non-keyed, terminated with 110-style insulation displacement connectors (IDC); high impact thermoplastic housing; suitable for and complying with same standard as specified horizontal cable; UL 1863 listed.
 - 1. Performance: 500 mating cycles.
 - 2. Voice and Data Jacks: 8-position modular jack, color-coded for both T568A and T568B wiring configurations.
- E. Copper Patch Cords:
 - 1. Description: Factory-fabricated 4-pair cable assemblies with 8-position modular connectors terminated at each end.

2. Patch Cords for Patch Panels:
 - a. Quantity: 250, Length 3ft.
 - b. Quantity: 50, Length 10ft.

2.5 FIBER OPTIC CABLE AND INTERCONNECTING DEVICES

- A. Provide cables with lead content less than 300 parts per million.
- B. Fiber Optic Backbone Cable:
 1. Description: Tight buffered, non-conductive fiber optic cable complying with TIA-568.3, TIA-598, ICEA S-83-596 and listed as complying with UL 444 and UL 1651.
 2. Cable Type: Multimode, 50/125 um (OM2) complying with TIA-492AAAB.
 3. Cable Capacity: 24-fiber.
 4. Cable Applications:
 - a. Provide Fiber backbone cabling between the MDF and each IDF closet in a star topology.
 - b. Plenum Applications: Use listed NFPA 70 Type OFNP plenum cable.
- C. In field splicing of fiber optic cables shall not be permitted.
- D. Fiber Optic Interconnecting Devices:
 1. Connector Type: Type SC.
 2. Connector Performance: 500 mating cycles, when tested in accordance with TIA-455-21.
 3. Connector tip material shall be ceramic;
 4. Connectors shall accept a maximum fiber jacket diameter of 3.0 mm;
 5. Connectors shall be spring loaded, bayonet style for a positive contact;
 6. Connectors shall be keyed to prevent rotation after insertion;
 7. Connectors shall utilize cured adhesive methods for assembly;
 8. Maximum Attenuation/Insertion Loss: 0.3 dB.
 9. All fibers shall be terminated.

2.6 COMMUNICATIONS EQUIPMENT ROOM FITTINGS

- A. Copper Cross-Connection Equipment:
 1. Cat-6 and Cat-6A Patch Panels for Copper Cabling / WAPS: Sized to fit EIA/ECA-310 standard 19 inch wide equipment racks; 0.09 inch thick aluminum; cabling terminated on Type 110 insulation displacement connectors; printed circuit board interface.
 - a. Jacks: Non-keyed RJ-45, suitable for and complying with same standard as cable to be terminated; maximum 48 ports per standard width panel.

- b. Capacity: Provide ports sufficient for cables to be terminated plus 25 percent spare.
 - c. Labels: Factory installed laminated plastic nameplates above each port, numbered consecutively; comply with TIA-606.
 - d. Provide incoming cable strain relief and routing guides on back of panel.
 - e. Provide cable management panels between each patch panel for twisted pair cable. Cable management panels shall be Panduit "WMP" series, or equal.
- B. Fiber Optic Cross-Connection Equipment:
- 1. Patch Panels for Fiber Optic Cabling: Sized to fit EIA/ECA-310 standard 19 inch wide equipment racks; 0.09 inch thick aluminum.
 - a. Adapters: As specified above under FIBER OPTIC CABLE AND INTERCONNECTING DEVICES; maximum of 24 duplex adaptors per standard panel width.
 - b. Labels: Factory installed laminated plastic nameplates above each port, numbered consecutively; comply with TIA-606.
 - c. Provide incoming cable strain relief and routing guides on back of panel.
 - d. Provide rear cable management tray at least 8 inches deep with removable cover.
 - e. Provide dust covers for unused adapters.
- C. Equipment Frames, Racks and Cabinets:
- 1. Component Racks: EIA/ECA-310 standard 19 inch wide.
 - 2. Floor Mounted Two Post Open Racks: Aluminum or steel construction with corrosion resistant finish; vertical and horizontal cable management channels, top and bottom cable troughs, and grounding lug.
 - a. Provide 1 rack in each IDF Room.

2.7 COMMUNICATIONS OUTLETS

- A. Outlet Boxes: Comply with Section 26 05 33.16.
- 1. Provide depth as required to accommodate cable manufacturer's recommended minimum conductor bend radius.
- B. Wall Plates:
- 1. Comply with system design standards and UL 514C.
 - 2. Accepts modular jacks/inserts.
 - 3. Capacity:
 - a. Data or Combination Voice/Data Outlets: 6 individual ports.
 - 4. Wall Plate Material/Finish - Flush-Mounted Outlets: Match wiring device and wall plate finishes specified in Section 26 27 26.

- a. Single gang, flush mountable.
 - b. Shall accept data, telephone, fiber optic, MATV, video, audio and blank insert modules;
 - c. Inserts shall snap in and out from the front of the Data Station Outlet;
 - d. Face plates shall be supplied with pressure-sensitive icon labels;
 - e. At locations where Owner provided and installed VOIP wall phones are located the Structured Wiring Contractor shall coordinate with the owner for the compatible wall plate to support the owner provided VOIP phone.
5. Inserts (Insert colors shall match colors listed for cable type above. Coordinate final colors with owner)
- a. Provide Data Port inserts with the following features: RJ-45 type rated for Category 6;
 - 1) RJ-45 insert shall be configured to EIA-568 wiring standards;
 - 2) Attenuation through the RJ-45 port at 10/16 MHz shall be less than .015/.025 dB;
 - 3) Provide 110 style IDC terminations for all eight conductors of a UTP cable;
 - 4) Data port inserts shall be by Panduit, Commscope, Hubbell, or Leviton.
 - b. Provide Telephone Inserts with the following features RJ-45 type rated for Category 6;
 - 1) RJ-45 insert shall be configured to USOC wiring standards;
 - 2) Provide 110 style IDC terminations for all six conductors of a UTP phone cable.
 - 3) Telephone inserts shall be by Panduit, Commscope, Hubbell, or Leviton
 - c. Provide Fiber Optic Inserts with the following features:
 - 1) SC-SC type, feed-through connector;
 - 2) Connector type shall be multi-mode;
 - 3) Insert shall provide two SC connectors;
 - 4) Fiber Optic Inserts shall be by
 - d. Provide MATV inserts with the following features:
 - 1) "F" - "F" type, feed-through connector;
 - 2) MATV inserts shall be by Panduit, Commscope, Hubbell, Leviton.

2.8 GROUNDING AND BONDING COMPONENTS

- A. Comply with TIA-607.

2.9 IDENTIFICATION PRODUCTS

- A. Comply with TIA-606.

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

- A. Comply with latest editions and addenda of TIA-568 (SET) (cabling), TIA-569 (pathways), TIA-607 (grounding and bonding), NECA/BICSI 568, NFPA 70, and SYSTEM DESIGN as specified in PART 2.
- B. Comply with Communication Service Provider requirements.
- C. Grounding and Bonding: Perform in accordance with TIA-607 and NFPA 70.
- D. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

3.2 PATHWAYS

- A. The Wiring Contractor shall be responsible for reviewing and coordinating conduit installation for the Voice Data systems with the Division 26 Prime Contractor.

3.3 INSTALLATION OF EQUIPMENT AND CABLING

- A. Cabling:
 - 1. Do not bend cable at radius less than manufacturer's recommended bend radius; for unshielded twisted pair use bend radius of not less than 4 times cable diameter.
 - 2. Do not over-cinch or crush cables.
 - 3. Do not exceed manufacturer's recommended cable pull tension.
 - 4. When installing in conduit, use only lubricants approved by cable manufacturer and do not chafe or damage outer jacket.
 - B. Service Loops (Slack or Excess Length): Provide the following minimum extra length of cable, looped neatly:
 - 1. At Distribution Frames: 36 inches.
 - 2. At Outlets - Copper: 24 inches.
 - 3. At Outlets - Optical Fiber: 24 inches.
 - C. Copper Cabling:
 - 1. Category 6: Maintain cable geometry; do not untwist more than 1/2 inch from point of termination.
 - 2. For 4-pair cables in conduit, do not exceed 25 pounds pull tension.
 - 3. Use T568B wiring configuration.
 - D. Fiber Optic Cabling:
 - 1. Prepare for pulling by cutting outer jacket for 10 inches from end, leaving strength members exposed. Twist strength members together and attach to pulling eye.
 - 2. Support vertical cable at intervals as recommended by manufacturer.
 - E. Wall-Mounted Racks and Enclosures:
 - 1. Install to plywood backboards only, unless otherwise indicated.
-

2. Mount so height of topmost panel does not exceed 78 inches above floor.
- F. Floor-Mounted Racks and Enclosures: Permanently anchor to floor in accordance with manufacturer's recommendations.
- G. Identification:
1. Use wire and cable markers to identify cables at each end.
 2. Use manufacturer-furnished label inserts, identification labels, or engraved wallplate to identify each jack at communications outlets with unique identifier.
 3. Use identification nameplate to identify cross-connection equipment, equipment racks, and cabinets.

3.4 FIELD QUALITY CONTROL

- A. Comply with inspection and testing requirements of specified installation standards.
- B. Visual Inspection:
1. Inspect cable jackets for certification markings.
 2. Inspect cable terminations for color coded labels of proper type.
 3. Inspect outlet plates and patch panels for complete labels.
 4. Inspect patch cords for complete labels.
- C. Testing - Copper Cabling and Associated Equipment:
1. Test backbone cables for DC loop resistance, shorts, opens, intermittent faults, and polarity between connectors and between conductors and shield, if cable has overall shield.
 2. Test operation of shorting bars in connection blocks.
 3. Test each twisted pair cable segment (example: from the data station port through the patch bay and patch cable to the hub port connector). Publish a log of each test to verify that the cable segment passes the EIA/TIA-568 TEB-36 requirements for Category 6 compliance. Bind the test log in a booklet and turn the booklet over to the Owner. The test shall include:
 - a. Connector/cable continuity - line mapping;
 - b. Cable segment length;
 - c. Dual near end cross talk (NEXT);
 - d. Attenuation at 100 MHz;
 - e. Attenuation per foot;
 - f. Pass/fail results of each portion of the test above.
- D. Testing - Fiber Optic Cabling:
1. Backbone: Perform optical fiber end-to-end attenuation test using an optical time domain reflectometer (OTDR) and manufacturer's recommended test procedures; perform verification acceptance tests and

factory reel tests.

2. Multimode Backbone: Perform tests in accordance with TIA-526-14.

E. Final Testing: After all work is complete, including installation of telecommunications outlets, and telephone dial tone service is active, test each voice jack for dial tone.

END OF SECTION 27 10 00

**SECTION 27 51 13
INTERCOM SYS**

PART 1 - GENERAL

1.1 INTERCOM EQUIPMENT.

1.2 INTERCOM CABLE.

1.3 ACCESSORIES.

A. RELATED SECTIONS

1. Section 26 05 33 - Raceway and Boxes for Electrical Systems
2. Section 26 05 26 - Grounding and Bonding for Electrical Systems

B. SUBMITTALS

1. Submit under provisions of Division 1.
2. Shop Drawings: Indicate cable routing and connections; equipment rack configuration; wiring diagrams.
3. Submit product data for each item of equipment and each cable type.
4. Submit manufacturer's installation instructions.

C. PROJECT RECORD DOCUMENTS

1. Submit record documents under provisions of Division 1.
2. Accurately record actual locations of devices and wiring.

D. OPERATION AND MAINTENANCE DATA

1. Submit under provisions of Division 1.
2. Operation Data: Include instructions for routine operation of master and remote stations.
3. Maintenance Data: Include instructions for minor troubleshooting, preventive maintenance, and cleaning.

E. QUALITY ASSURANCE

1. Supplier: Company by manufacturer and specializing in supplying products specified in this Section with minimum five years' experience.
2. Installer: Company specializing in installing the products specified in this Section with minimum five years' experience and must have office facility within 50 mile radius to project.
3. All items of equipment shall be designed by the manufacturer to function as a complete system and shall be accomplished by the manufacturer's complete service notes and drawings detailing all interconnections.
4. The communication system supplied shall be listed by Underwriter's Laboratories under UL Standard 1459. A copy of the UL listing card for the proposed system shall be included with the Contractor's

submittal.

F. MAINTENANCE SERVICE

1. Furnish service and maintenance of intercom system for one year from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. INTERCOM SYSTEM

B. Scope:

1. Expand the existing Bogen Multicom 2000 to incorporate the new Classroom Addition, Connector and Renovated Areas. Provide any network cards as needed. Coordinate with Owner to maintain the existing facility functionality. Verify prior to bid.

C. MANUFACTURERS

1. Existing Bogen Multi-com 2000

D. SPEAKER/BAFFLE/BACK BOX ASSEMBLY- Lowell P875X or equal

1. Classroom/hallway 1' X 2' loudspeaker unit Bogen CDS1x2U or equal.
2. Provide Bogen AT10A or equal at locations where volume control is indicated on plans.

E. SPEAKER/HORN

1. 15 watt paging talk back speaker-horn (weatherproof) with adjustable tap transformer (25 volt). Bogen FMH-15T or equal

F. WEATHERPROOF & VANDALPROOF BAFFEL

1. Square Lowell SQLK-6 baffle or equal for mounting speaker unit, LUH-15T or equal, baffle shall have concealed speaker mounting studs. Utilize in all.
2. Square recessed enclosure (Flush MTD.) - Lowell P875x-6.
3. Surface mounted enclosure - Lowell CB86-6 or equal.

G. INTERCOM CABLING

1. Cable shielding and size shall be fully compatible with intercom system manufacturer's recommendations. Classrooms West Penn fl 357 (plenum rated). Speaker only circuits West Penn #292 (plenum rated).

H. PUNCH-DOWN BLOCKS

1. Provide 66-block and stand-off wall brackets mounted on 4' x 4' x 3/4" fire retardant plywood board, for all intercom terminations at head-end equipment.
2. Provide protectors on all intercom cabling. ITW LINX (ULTRALINX UP3P-39) or equal.
 - a. Clamping Level 39 VDC solid state

- b. Reaction time of 1-5 nanoseconds
- c. 66-block mounting
- d. Warranty lifetime

I. PROVIDE LIGHTNING/SURGE SUPPRESSION FOR INTERCOM SYSTEM.

PART 3 - EXECUTION

3.1 EXECUTION

A. EXAMINATION

- 1. Verify that surfaces are ready to receive work.
- 2. Verify field measurements are as instructed by manufacturer.
- 3. Verify that required utilities are available, in proper location, and ready for use.
- 4. Beginning of installation means installer accepts conditions.

B. INSTALLATION

- 1. Install in accordance with manufacturer's instructions.
- 2. Intercom cabling shall be installed in conduit with bushings at both ends, from outlet box to above accessible ceiling. Cable above ceiling shall be neatly routed and properly supported.
- 3. Support all intercom cabling above ceiling with bridle rings spaced not more than 6 feet on centers.
- 4. Intercom cabling shield shall not be used as a conductor. Bond shield only at intercom cabinet.
- 5. Terminate cables on 66 blocks with surge protectors.
- 6. Provide additional expansion capacity and all components necessary, except handsets, for 10 additional stations.

C. FIELD QUALITY CONTROL

- 1. Field testing will be performed under provisions of Division 1.
- 2. Perform operational test on completed installation to verify proper operation.
- 3. Replace equipment, components, and wiring to eliminate audible noise, clicks, pops, or hum when system is in standby or operation.
- 4. The Contractor shall provide all necessary transient protection on the AC power feed and on all station lines leaving or entering the building.
- 5. The Contractor shall note in his system drawings, the type and location of these protection devices as well as all wiring information.

D. MANUFACTURER'S FIELD SERVICES

- 1. Prepare and start systems under provisions of Division 1.

2. Make final connections to units.
3. Perform field inspection and testing.
4. Demonstrate system operation.

E. ADJUSTING

1. Adjust work under provisions of Division 1.
2. Adjust controls and configuration switches for operation as indicated.
3. Adjust wireless clock system, adding repeaters as needed for a fully operational system.

F. DEMONSTRATION

1. Provide on-site systems demonstration and instructions under provisions of Division 1. Allow minimum of 16 hours.
2. Conduct walking tour of Project and briefly describe function, operation, and maintenance of each component.
3. Use submitted operation and maintenance manual as reference during demonstration and training.

END OF SECTION 275113 27 51 13

DIVISION 28
ELECTRONIC SAFETY AND SECURITY

**SECTION 28 10 01
ACCESS CONTROL**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Access control panel.
- B. Access control devices.
- C. Accessory devices.

1.2 RELATED SECTIONS

- A. Section 26 05 19 - Wires and Cables

1.3 REFERENCES

- A. NFPA 70 - National Electrical Code 2020.
- B. NFPA 72H - Guide for Test Procedures for Protective Signaling Systems.
- C. NFPA 730 - Guide for Premises Security

1.4 SYSTEM DESCRIPTION

- A. Access Control System: Complete system that controls quantity of doors as shown on plans. System includes control panels, power supplies, card readers, and all accessories required for a complete system. All access control components and door hardware for access control shall be furnished and installed by the Contractor.

1.5 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Shop Drawings: Indicate system wiring diagram showing each device and wiring connection required.
- C. Product Data: Provide electrical characteristics and connection requirements.
- D. Test Reports: Indicate satisfactory completion of required tests and inspections.
- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.
- F. Protection Plan: Indicate doors with readers and device locations on floor plan for approval by Owner.

1.6 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 1.
- B. Record actual locations of all devices and path of wiring.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Division 1.

- B. Operation Data: Operating instructions.
- C. Maintenance Data: Maintenance and repair procedures.

1.8 QUALIFICATIONS

- A. Electrical Contractor shall employ an alarm system subcontractor that is licensed in the State of North Carolina and who specializes in installation of Products specified in this section with minimum five years' experience, and with service facilities within one hour of Project so as to provide prompt service.

1.9 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish Products listed and classified by UL or other third party testing agency recognized by The State of North Carolina as suitable for purpose specified and indicated.
- C. Architects Section 01 23 00, The preferred JCSS Access Control System is manufactured by S2 Security Netbox.

PART 2 PRODUCTS

2.1 ACCESS CONTROL HARDWARE

- A. Provide S2 Security Netbox Access Control Solution with up to 32 doors of access control. Provide additional S2 Network Nodes where needed to accommodate additional access controlled doors.
- B. The S2 system shall be fully integrated and connected to the JCSS S2 Global ACS for centralized administration of card holder records.
- C. Provide power supplies to match all electric door hardware. See door hardware specifications.
- D. Provide HID Multiclass Mini-Mullion contactless card readers P/N #S2900PTNNEK0060-S2SEC or approved equal.
- E. All doors shall have:
 - 1. REX Motion (Request to Exit Motion Sensor) Takex PU-PS520W or Honeywell CK-I5310WH.
 - 2. Door Position Switch (internal mount) GE Magnetics Series 1078, 1" diameter or equal.
- F. Cards provided by JCSS.
- G. Wiring as required by manufacturer, shielded stranded, (plenum type).

PART 3 EXECUTION

3.1 INSTALLATION

- A. A pre-installation meeting with Owner, Engineer and Contractors is required prior to installation of system.
- B. Install in accordance with manufacturer's instructions.
- C. Contractor to coordinate with JCSS and the JCSS S2 Global Contractor for proper programming of the S2 system and connection to the JCSS S2 Global system.

- D. Obtain account code and card start number from JCSS security shop prior to programming.
- E. Use plenum 4c#22-4 minimum size for data and signaling circuits.
- F. Use plenum 2c#18-2E to power motion detectors from power supplies.
- G. Access control panel shall be surface mounted 5' above finished floor.
- H. Door Intercom/Video station shall be mounted at 4' above finished floor to top of outlet box.
- I. All conductors entering into control panel or component boxes shall be concealed in $\frac{3}{4}$ " or 1" conduits. Conduits will be accessible to ceiling voids. All control panels shall have a minimum of two (2) conduits for cabling entering panel. No exposed conductors will be permitted at the panel or at any instrument box where field wiring, i.e. power supplies, transformers and other devices, terminate into an instrument box.
- J. Install all cables in permanent raceways within walls and inaccessible spaces. Support low voltage cables in accessible ceilings with J-Hooks. Cables shall be supported directly by the building structure. Bridle rings with saddles are also acceptable for cable supports attached to down rods or the ceiling cross beams. Do not use wire to support the J-Hooks or bridle rings. Route all low voltage cable in accordance with NEC. Use nylon bushings at ends of conduits.
- K. All 120V power supply wiring shall be in conduit.
- L. JCSS does not want door supplies above door locations. Therefore, locate at nearest Telco closet. Coordinate locations with electrical contractor for 120V AC to power supply.
- M. No splices shall be permitted at any point in the system.

3.2 SYSTEM TESTING AND CERTIFICATION

- A. Upon completion of the Access Control and Video Intercom systems, JCSS Security and Contractors shall together test each and every initiating device for proper response and annunciation.
- B. After successful completion of inspections and tests, the warranty begins. In the event of malfunctions or excessive false alarms, the Contractor must take prompt corrective actions. The Owner may require a repeat of the Contractor's 100% system test or other inspections. Continued improper performance during the warranty period shall be cause to require the Contractor to remove the system.

END OF SECTION 281001 28 10 01

SECTION 28 16 00
SECURITY INTRUSION DETECTION SYS

PART 1 - GENERAL

1.1 SUMMARY

- A. The Replacement Intrusion Detection system specified herein shall be provided and installed by the contractor as part of the base. Bid. JCSS will not provide any equipment for this system.
- B. The electrical contractor shall provide all conduit, boxes and 120V AC wiring.
- C. The licensed low-voltage security contractor shall provide and install panel, key-pads, zone modules, low voltage wiring, devices and any accessory items including making final connections and testing for a complete system.

1.2 RELATED SECTIONS

- A. Section 23 09 00 - Building Automation System
- B. Section 26 05 19 - Wires and Cables

1.3 REFERENCES

- A. NFPA 70 - National Electrical Code 2020.
- B. NFPA 72H - Guide for Test Procedures for Protective Signaling Systems.
- C. NFPA 730 -Guide for Premises Security.
- D. Architects Alternate Section 01 23 00.The JCSS preferred system is a GEMINI / NAPCO Integrated Control Communicator. Refer to Architects section for Preferred Brand Alternates.

1.4 SYSTEM DESCRIPTION

- A. Intrusion Detection System: Protect building and selected areas from intrusion during secure hours.
- B. System shall be an integrated control/communicator for monitoring status of detection devices and communicating via dedicated telephone lines to multiple telephone numbers using two programmable reporting formats.
- C. The School shall be partitioned into separate protected areas as directed by WCPSS Security.
- D. System capacity shall be such that every motion sensor is individually zoned and signal from fire alarm panel separately zoned.
- E. All equipment shall be provided by the Electrical and Security Contractors. No equipment will be provided by JCSS.

1.5 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Shop Drawings: Indicate system wiring diagram showing each device and wiring connection required.
- C. Product Data: Provide electrical characteristics and connection requirements.

- D. Test Reports: Indicate satisfactory completion of required tests and inspections.
- E. Manufacturers Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.
- F. Protection Plan: Indicate building protection areas and device locations on floor plan for approval by Owner.

1.6 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 1.
- B. Record actual locations of initiating devices, signaling appliances, and end-of-line devices.
- C. The program and all zone information will be turned over to JCSS security shop.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Division 1.
- B. Operation Data: Operating instructions.
- C. Maintenance Data: Maintenance and repair procedures.

1.8 QUALIFICATIONS

- A. Electrical Contractor shall employ an alarm system subcontractor that is licensed in the State of North Carolina and who specializes in installation of Products specified in this section with minimum five years experience, and with service facilities within 60 miles of Project site.

1.9 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish Products listed and classified by UL or other third party testing agency recognized by The State of North Carolina as suitable for purpose specified and indicated.

PART 2 - PRODUCTS

2.1 PRODUCTS

- A. INTRUSION DETECTION CONTROL PANEL
 - 1. Control Panel: Napco X 255
 - 2. Keypads: maximum number of keypads to a system is 8. Keypad# Napco RP1CAez. **(Provide (3) keypads to replace the existing keypads to be compatible with new replacement system)**
 - 3. Power Supply: NS-P5ASUP, 5 Amp supervised power supply/charger.
 - 4. Communicator: GEMC-NL-MOD Network communication module
 - 5. Motion Detectors: Bosch DC778, DS936, DS939 or equivalent
 - 6. Hold-up Button: USP HUB Hold-up button or functionally equivalent.
 - B. CONDUCTORS
-

1. Plenum rated 22-4 minimum size for data and signaling circuits.
2. Plenum rated 18-2 to power portion detectors from power supplies.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install and program in accordance with manufacturer's instructions.
- B. Contractor shall coordinate with JCSS Security Shop to obtain account codes, phone numbers and zone instructions.
- C. Use cabling as identified in B.2.
- D. Control panels and keypads shall be surfaced mounted 60" above finished floor. Outlet box shall be recessed mounted.
- E. All conductors that enter a control panel or instrument boxes will be concealed in $\frac{3}{4}$ " or 1" conduits. Conduits will be accessible to ceiling voids. Routed from control panel and or instrument boxes shall be concealed in $\frac{3}{4}$ "C or 1"C conduit. Conduit(s) shall be accessible to ceiling voids. Provide two (2) $\frac{3}{4}$ " or two (2) 1" conduits at panel for all conductors entering the panel. No exposed conductors will be permitted at the panel or instrument boxes where field wiring" (i.e. power supplies, transformer, EZM's or any other devices terminate into an instrument box).
- F. All keypads and EZM modules shall be homeruns to main panel. No splices in data loops will be accepted. Acceptable practice to loop from KP to KP or from EZM to EZM; IE daisy chain loop is an acceptable practice, but no splice in the daisy chain loops.
- G. EZM modules will be mounted in Mier Instrument boxes 11"x14"x4" with louvers or functionally equivalent. Provide a minimum of (1 or 2) $\frac{3}{4}$ " or 1" conduits for conductors entering instrument boxes. Conduits are to be stubbed to accessible ceiling spaces, with nylon bushings. Mount instrument boxes 60" above finished floor. Locations of EZM's and power supplies will be shown on shop drawings. Where permitted, provide at least one 110V quad receptacle for power supplies below splice can. Security contractor shall coordinate with the electrical contractor for outlet placement.
- H. Each motion sensor shall be individually zoned. No splices on conductors shall be permitted at any point in this system. Each detector requires a 2.2K ohm resistor at the EOL.
- I. Where required, the electrical contractor shall provide gang boxes for motion detectors and keypads. The Wide-angle detectors and Long-range detectors shall have a single gang box. Keypads shall have a double gang box, mounted at 60" above finished floor. Motion detector in classrooms and offices shall be mounted 1" to 2" below lay-in ceilings so as no conductors will be exposed. Long-range detectors in hallway will also have a single gang box and 1" to 2" below lay-in ceiling grid. Conduit mounts shall be used. Applications where motion detectors do not require gang boxes, each motion detector should be surface mounted on sheet rock or masonry walls, mount 1" to 2" below ceiling grid in classroom, offices and corridors. Remote transmission: Each Alarm Panel requires a dedicated phone line for transmitting all information to Central Station. Contractors are to provide CAT-6 4 pair telephone line and a RJ31X phone block from the Panel to the Main Demark where Telecommunications provides all Life Safety and Dedicated phone lines. The lines shall be homerun to the main panel with no splices permitted.
- J. Install a hold-up button under the reception desk in the main office and wire as a dedicated zone to the main panel or nearest EZM.

- K. Install all cables in permitted raceways within walls and in accessible spaces. Support cables in accessible ceilings with "J" type hooks. Cables shall be supported directly by the building structure. Bridle rings with saddles are also acceptable for cable supports attached to down rods or the ceiling cross beams. Do not use wire to support the "J" hooks or the bridled ring. Route all low voltage cable in accordance with the NEC. Use nylon bushings at the top of conduits where stubbed into accessible ceiling spaces.

3.2 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Division 1.
- B. Test in accordance with NFPA 72H.

3.3 MANUFACTURERS FIELD SERVICES

- A. Prepare and start systems under provisions of Division 1.
- B. Include services of technician to supervise installation, adjustments, final connections, system testing, and Owner training.

3.4 SYSTEM TESTING AND CERTIFICATION

- A. Upon completion of the installation of the intrusion detection system, authorized representatives shall together test each initiating device for proper response and annunciation. Each area shall be verified for proper office, classrooms, corridors, numbers/names and locations.
- B. After successful completion of inspections and test, the warranty period begins. In the event of malfunctions or excessive false alarms, the Contractor must take prompt corrective actions. The Owner may require a repeat of the Contractor's 100% system test or other inspections. Continued improper performance during the warranty period shall be cause to require the Contractor to remove the system.

END OF SECTION 281600 28 16 00

**SECTION 28 31 12
INTRUSION DETECTION SYSTEM**

PART 1 GENERAL

1.1 SUMMARY

- A. The Intrusion Detection system specified herein shall be provided and installed by the contractor as part of the base. This new system shall replace the existing Napco MA3000 system. JCSS will not provide any equipment for this replacement system.
- B. The electrical contractor shall provide all conduit, boxes and 120V AC wiring.
- C. The licensed low-voltage security contractor shall provide and install panel, key-pads, zone modules, low voltage wiring, devices and any accessory items including making final connections and testing for a complete system.

1.2 RELATED SECTIONS

- A. Section 26 05 19 - Wires and Cables

1.3 REFERENCES

- A. NFPA 70 - National Electrical Code 2020.
- B. NFPA 72H - Guide for Test Procedures for Protective Signaling Systems.
- C. NFPA 730 -Guide for Premises Security.
- D. See Architects Alternate Section for the JCSS preferred system is a GEMINI / NAPCO Integrated Control Communicator.

1.4 SYSTEM DESCRIPTION

- A. Intrusion Detection System: Protect building and selected areas from intrusion during secure hours.
- B. System shall be an integrated control/communicator for monitoring status of detection devices and communicating via dedicated telephone lines to multiple telephone numbers using two programmable reporting formats.
- C. The School shall be partitioned into separate protected areas as directed by JCSS Security.
- D. System capacity shall be such that every motion sensor is individually zoned and signal from fire alarm panel separately zoned.
- E. All equipment shall be provided by the Electrical and Security Contractors. No equipment will be provided by WCPSS.

1.5 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Shop Drawings: Indicate system wiring diagram showing each device and wiring connection required.
- C. Product Data: Provide electrical characteristics and connection requirements.

- D. Test Reports: Indicate satisfactory completion of required tests and inspections.
- E. Manufacturers Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.
- F. Protection Plan: Indicate building protection areas and device locations on floor plan for approval by Owner.

1.6 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 1.
- B. Record actual locations of initiating devices, signaling appliances, and end-of-line devices.
- C. The program and all zone information will be turned over to JCSS security shop.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Division 1.
- B. Operation Data: Operating instructions.
- C. Maintenance Data: Maintenance and repair procedures.

1.8 QUALIFICATIONS

- A. Electrical Contractor shall employ an alarm system subcontractor that is licensed in the State of North Carolina and who specializes in installation of Products specified in this section with minimum five years experience, and with service facilities within 60 miles of Project site.

1.9 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish Products listed and classified by UL or other third party testing agency recognized by The State of North Carolina as suitable for purpose specified and indicated.

PART 2 PRODUCTS

2.1 INTRUSION DETECTION CONTROL PANEL

- A. Eight EOL supervised, programmable zones, expandable to 255 zones with use of EZM multiplex modules of command center zones, for burglary, 2 or 4-wire fire, commercial fire or panic. NAPCO X255.
- B. Communicator: Netlink intranet/internet alarm reporting NAPCO #NL_MOD
- C. Scheduling: 255 event schedule, programmable for 296 types of events.
- D. Logs: 800 Event history log with real time clock, programmable log download, keypad recall of historic log, log sorting by O/C, system trouble, alarm or fire.
- E. Codes: 195 individually reporting user codes with four programmable security levels each. Separate dealer, user program and download codes.
- F. Modes: Diagnostics, flexible watch modes and 11 programmable areas/partitions with keypad management mode.

- G. Secured bypass, two separate interior bypass and auto bypass options.
- H. Auto arm, auto disarm and manual auto arm, with 2 separately programmable entry and exit delay times.
- I. Outputs: 4 programmable relay outputs (one for pulse), armed output, low battery output, onboard supervised printer output.
- J. Eight stages of lightening protection. Dual line telco cut detection. 24-hour protection programmable for all zones. Sensor watch, continuously monitors motion detectors for proper operation.
- K. Communicator: Transmits in all major formats, including high speed modem formats, pager beeper compatibility, DPDT line seizure. Four telephone numbers with subscriber ID numbers assignable by area.
- L. Maximum number of keypads to a system is eight (8).

2.2 EXPANSION MODULE

- A. 8 zone expander module with supervised zones and audible locator. NAPCO GEM-EZM8 or equal. Expansion module shall be by same manufacturer as control panel.

2.3 KEYPAD

- A. Backlit 16 character LCD alphanumeric display keypad, with full sized touchtone keys that brighten when touched and built in four zone expansion module. NAPCO GEM-RPC Ae2 or equal. Keypad shall be by same manufacturer as control panel. Replace the existing (2) keypads with new keypads compatible with the new replacement system.

2.4 POWER SUPPLY

- A. Power supply: Adequate to serve control panel modules and remote detectors, minimum 5 amp-hour supervised power supply/charger. Include battery-operated emergency power supply with capacity for operating system in standby mode for 24 hours.

2.5 INITIATING DEVICES

- A. Passive Infrared Motion Detector:
 - 1. Wide Angle - DSC-BRAVO 600 dual PIR
 - 2. Long Range - Aritech AP-633/AP643 Passive Infrared Detector
 - 3. Ceiling Mounted 360 degree detector

2.6 ACCESSORIES

- A. Handheld Programmer: The JCSS possesses a NAPCO system programmer. If a system by other manufacturer is provided, a handheld programmer shall be turned over to the JCSS with other O&M material and software for remote programming and monitoring.

2.7 CONDUCTORS

- A. Data / Signaling cable - 22 awg., 2 pair UTP, West Penn #25242 (plenum rated).
- B. Power cable -18 AWG 2 PR., stranded, West Penn #25225 (plenum rated).
- C. Network cable: Cat-6 (plenum rated).

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install and program in accordance with manufacturer's instructions.
- B. Use cables as described in B, 7 above, with bridle rings every 10" to properly cabling.
- C. Provide and install Cat-6 plenum cabling connection to owner's network. Coordinate closely with owner's Security and IT Departments.
- D. Prior to installation, final device locations and zoning shall be submitted and approved by Owner.
- E. All conductors shall be concealed in ¾" C to accessible ceiling void.
- F. Control panel and keypads shall be wall mounted 5' above finished floor. All circuiting routed from control panel and or instrument boxes shall be concealed in ¾"C or 1"C conduit. Conduit(s) shall be accessible to ceiling voids. No exposed conductors will be permitted at the panel or instrument boxes where field wiring" (i.e. power supplies, transformer, ezm's or any other devices terminate into an instrument box).
- G. Each device shall be individually zoned.
- H. No splices in conductors shall be permitted at any point in system.
- I. EZM modules shall not be mounted above ceiling. Mount EZM modules 5-0" off in a surface wall box (Mier Instruments or equal, 11" x 14" x 4") in mechanical/electrical rooms or Telco closets. Locate all EZM modules and power supplies on shop drawings for approval prior to installation.
- J. Support all cables above accessible ceilings with "J" hooks or saddled bridle rings fastened to structure. Cables shall not share J-hooks with other system cables.
- K. No exposed conductors permitted. Install nylon bushings in all conduits extended to ceiling void.
- L. Contractor is responsible for programming the system and testing functionality. (Contractor
- M. Provide lightning/surge suppressors for intrusion detection system.
- N. Install a hold-up button under the receptions desk in the main office and wire as a dedicated zone to the main panel or nearest EZM.

3.2 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Division 1.
- B. Test in accordance with NFPA 72H.

3.3 MANUFACTURERS FIELD SERVICES

- A. Prepare and start systems under provisions of Division 1.
- B. Include services of technician to supervise installation, adjustments, final connections, system testing, and Owner training.

3.4 SYSTEM TESTING AND CERTIFICATION

SECTION 28 31 12 - INTRUSION DETECTION SYSTEM

- A. Upon completion of the installation of the intrusion detection system, authorized representatives shall together test each and every initiating device for proper response and annunciation. Each area shall be verified for proper office, classrooms, corridors, numbers/names and locations.
- B. After successful completion of inspections and test, the warranty period begins. In the event of malfunctions or excessive false alarms, the Contractor must take prompt corrective actions. The Owner may require a repeat of the Contractor's 100% system test or other inspections. Continued improper performance during the warranty period shall be cause to require the Contractor to remove the system.

END OF SECTION 281601 28 31 12

**SECTION 28 46 00
FIRE DETECTION AND ALARM**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fire alarm system design and installation, including all components, wiring, and conduit.
- B. Transmitters for communication with supervising station.

1.2 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. NFPA 72 - National Fire Alarm and Signaling Code; 2013
- C. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.3 SCOPE

- A. A expanded Notifier NFS-640 Syetem to incorporate the renovated areas. Note this system shall be interconnected to a new Voice Evacuالتin FACP in the new building expansions. Provide all necessary components, network cards as needed for a fully integrated system.

1.4 SUBMITTALS

- A. Proposal Documents: Submit the following with cost/time proposal:
 - 1. NFPA 72 "Record of Completion", filled out to the extent known at the time.
 - 2. Manufacturer's detailed data sheet for each control unit, initiating device, and notification appliance.
 - 3. Certification by Contractor that the system design will comply with Contract Documents.
- B. Drawings must be prepared using the latest release of ACAD.
- C. Evidence of designer qualifications.
- D. Design Documents: Submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, riser diagrams, and description of operation:
 - 1. NFPA 72 "Record of Completion", filled out to the extent known at the time.
 - 2. Clear and concise description of operation, with input/output matrix similar to that shown in NFPA 72 Appendix A-7-5-2.2(9), and complete listing of software required.
 - 3. System zone boundaries and interfaces to fire safety systems.
 - 4. Location of all components, circuits, and raceways; mark components with identifiers used in control unit programming.
 - 5. Circuit layouts; number, size, and type of raceways and conductors; conduit fill calculations; spare capacity calculations; notification appliance circuit voltage drop calculations.

6. System response matrix.
 7. System riser diagram
 8. Battery calculations showing voltage drop after required standby time.
 9. List of all devices on each signaling line circuit, with spare capacity indicated.
 10. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.
 11. Description of power supplies; if secondary power is by battery include calculations demonstrating adequate battery power.
 12. Certification by either the manufacturer of the control unit or by the manufacturer of each other component that the components are compatible with the control unit.
 13. Certification by the manufacturer of the control unit that the system design complies with Contract Documents.
 14. Certification by Contractor that the system design complies with Contract Documents.
- E. Evidence of installer qualifications.
- F. Evidence of instructor qualifications; training lesson plan outline.
- G. Evidence of maintenance contractor qualifications, if different from installer.
- H. Inspection and Test Reports:
1. Submit inspection and test plan prior to closeout demonstration.
 2. Submit documentation of satisfactory inspections and tests.
 3. Submit NFPA 72 "Inspection and Test Form," filled out.
- I. Operating and Maintenance Data: have one set available during closeout demonstration:
1. Original copy of NFPA 72 with portions that are not relevant to this project neatly crossed out by hand; label with project name and date.
 2. Complete set of specified design documents, as approved by authority having jurisdiction.
 3. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
 4. List of recommended spare parts, tools, and instruments for testing.
 5. Replacement parts list with current prices, and source of supply.
 6. Detailed troubleshooting guide and large scale input/output matrix.
 7. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to Owner.

8. Detailed but easy to read explanation of procedures to be taken by non-technical administrative personnel in the event of system trouble, when routine testing is being conducted, for fire drills, and when entering into contracts for remodeling.
- J. Project Record Documents: Have one set available during closeout demonstration:
1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.
 2. "As installed" wiring and schematic diagrams, with final terminal identifications.
 3. "As programmed" operating sequences, including control events by device, updated input/output chart, and voice messages by event.
 4. Graphic Chart mounted behind plexiglass and secured to wall at FACP and remote annunciator(s). Graphic chart shall indicate all fire alarm devices including the programmed addresses for each device. Frame shall not be removable with standard philips or flat head screw drivers.
 5. A copy of the floor plans with device numbers shall be provided in the control panel. Provide a separate sheet for each floor scaled to be on 11 x17 sheets. All devices shall be clearly labeled and a legend provided on the drawings. Indicate locations of cabinets, modules, and end of line devices. Plans shall be bound and sheets laminated. Provide plan holder in panel or in locked box adjacent to panel keyed to match panel.
 6. Provide CD copy of complete configuration data (site specific programming) for the system submitted to the engineer for distribution to the owner.
 7. Contractor shall provide the following to the owner
 - a. All software required, both for the installed fire alarm system and personal computer necessary to access the fire alarm system for trouble shooting, programming, modifications, monitoring, debugging, or similar functions.
 - b. Complete documentation for all software for both the installed fire alarm system and for any interface PC software necessary for the functions described above.
 - c. Interconnection cable where such is required to connect the fire alarm system to a PC.
- K. Closeout Documents:
1. Certification by manufacturer that the system has been installed in compliance with manufacturer's installation requirements, is complete, and is in satisfactory operating condition.
 2. NFPA 72 "Record of Completion", filled out completely and signed by installer and authorized representative of authority having jurisdiction.
 3. Certificate of Occupancy.
 4. System Report: Provide Engineer two bound copies of the following for transfer to the owner.
 - a. As-built wiring diagram showing all loop numbers and device addresses, plus terminal numbers and where they connect to control equipment.
 - b. As-built wiring and conduit layout diagrams, including wire color code and/or label numbers, and showing interconnections in the system.

- c. Electronic circuit diagrams of all control panels, modules, annunciators, communications panels, etc.
 - d. Manufacturer's detailed maintenance requirements.
 - e. Product data on all devices.
 - f. As-built calculation sheets showing system capacity and voltage drops.
- L. Maintenance Contract: The contractor shall submit a quote for a maintenance contract to provide all maintenance, test, and repair described in this specification and/or in accordance with NFPA 72. Include also a quote for unscheduled maintenance/repair, including hourly rates for technicians trained on this equipment, and response travel costs. Submittals that do not identify all post contract maintenance costs will not be accepted. Rates and costs shall be valid for a period of (5) years after expiration of the guaranty. Maintenance and testing shall be on a semiannual basis or as required whichever is most restrictive. A preventative maintenance schedule shall be provided by the Contractor that shall describe the protocol for preventative maintenance. The schedule shall include:
- 1. Semiannual systematic examination, adjustment and cleaning of all detectors, manual fire alarm stations, control panels, power supplies, relays, water flow switches and all accessories of the fire alarm system.
 - 2. Semiannual testing of each circuit in the fire alarm system.
 - 3. Semi annual testing of each smoke detector in accordance with the requirements of NFPA 72.
- M. Maintenance Materials, Tools, and Software: Furnish the following for Owner's use in maintenance of project.
- 1. Furnish spare parts of same manufacturer and model as those installed; deliver in original packaging, labeled in same manner as in operating and maintenance data.
 - 2. In addition to the items in quantities indicated in PART 2, furnish the following:
 - a. All tools, software, and documentation necessary to modify the fire alarm system using Owner's personnel; minimum modification capability to include addition and deletion of devices, circuits, and zones, and changes to system description, operation, and evacuation and instructional messages.
 - b. One copy, on CD-ROM, of all software not resident in read-only-memory.
 - c. Extra Fuses: Two for each installed fuse; store inside applicable control cabinet.

1.5 QUALITY ASSURANCE

- A. Designer Qualifications: NICET Level III or IV (3 or 4) certified fire alarm technician or registered fire protection engineer, employed by fire alarm control panel manufacturer, Contractor, or installer, with experience designing fire alarm systems in the jurisdictional area of the authorities having jurisdiction.
- B. Installer Qualifications: Firm with minimum 5 years documented experience installing fire alarm systems of the specified type and providing contract maintenance service as a regular part of their business.
 - 1. Authorized representative of control unit manufacturer; submit manufacturer's certification that installer is authorized; include name and title of manufacturer's representative making certification.
 - 2. Installer Personnel: At least 2 years of experience installing fire alarm systems.

3. Supervisor: NICET level III or IV (3 or 4) certified fire alarm technician; furnish name and address.
 4. Technician must be trained and individually certified by the manufacturer, for the Master Control Unit installed. Training must have occurred within the most recent 24 month. If NICET level III certification shall extend to 36 months.
 5. Contract maintenance office located within 50 miles of project site.
 6. Certified in the State in which the Project is located as fire alarm installer.
 7. Only the installer may make programming changes and must be present at the 100% test, Designer's pre-final review and Owner's final inspection.
- C. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.
- D. Instructor Qualifications: Experienced in technical instruction, understanding fire alarm theory, and able to provide the required training; trained by fire alarm control unit manufacturer.
- E. Product Listing Organization Qualifications: Third party agencies shall be amongst those accredited by the NCBC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.

1.6 WARRANTY

- A. Provide control panel manufacturer's warranty that system components other than wire and conduit are free from defects and will remain so for 1 year after Owner's acceptance.
- B. Provide installer's warranty that the installation is free from defects and will remain so for 1 year after date of Owner's acceptance.
- C. Warranty shall cover all parts and labor required to correct any deficient parts.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Addressable analog fire alarm system:
 1. Notifier (Johnston County Preferred System Manufacturer)
 2. EST.
 3. Simplex.
 4. Or approved equal.

2.2 FIRE ALARM SYSTEM

- A. Fire Alarm System: Provide a new automatic fire detection and alarm system:
 1. Provide all components necessary, regardless of whether shown in Contract Documents or not.
 2. Protected Premises: Entire building shown on drawings.
 3. Comply with the following; where requirements conflict, order of precedence of requirements is as listed:

- a. ADA Standards.
 - b. The requirements of the State Fire Marshal.
 - c. The requirements of the local authority having jurisdiction.
 - d. Applicable local codes.
 - e. Contract Documents (drawings and specifications).
 - f. NFPA 72; where the word "should" is used consider that provision mandatory; where conflicts between requirements require deviation from NFPA 72, identify deviations clearly on design documents.
4. Evacuation Alarm: Multiple smoke zones; allow for evacuation notification of any individual zone or combination of zones, in addition to general evacuation of entire premises.
 5. General Evacuation Zones: Each smoke zone is considered a general evacuation zone unless otherwise indicated, with alarm notification in all zones on the same floor, on the floor above, and the floor below.
 6. Hearing Impaired Occupants: Provide visible notification devices in all public areas.
- B. Supervising Stations and Fire Department Connections:
1. Public Fire Department Notification: By on-premises supervising station.
 2. On-Premises Supervising Station: Existing proprietary station operated by Owner, located at _____.
 3. Remote Supervising Station: UL-listed central station under contract to facility.
 4. Means of Transmission to On-Premises Supervising Station: Directly connected noncoded system.
 5. Means of Transmission to Remote Supervising Station: Multi-technology digital alarm communicator transmitter (DACT). DACT shall utilize one traditional phone line and be capable of IP phone and cellular communications to comply with the 2013 NFPA 72 requirements for multiple communication methods.
 - a. When IP communication method is selected as the alternative communication method contractor shall provide a rack mounted UPS at the location of the main IP phone system capable of supporting the IP phone system for a period of at least 24 hours. Coordinate with Owner/Fire marshal/and Supervising Station prior to selecting alternative communication method.
 - b. The following signals shall be reported as applicable
 - 1) Fire Alarm
 - 2) Sprinkler Waterflow Alarm
 - 3) Carbon Monoxide Alarm
 - 4) Fire Pump Running Alarm
 - 5) Fire Pump Abnormal Status Supervisory Signal
 - 6) Sprinkler Valve Tamper Supervisory Signal

- 7) Sprinkler Low Temperature / Air pressure supervisory signal
 - 8) Burglary/Intrusion/Duress/Other Security or Emergency Alarm
 - 9) Fire Alarm System AC Power Trouble (loss of power for 1 hour or more).
- c. Sprinkler and fire pump supervisory signals are permitted to be combined by the DACT for transmission. Coordinate with the fire marshal and the supervising station.
 - d. Signal precedence to the supervising station shall be per NFPA 72 and as defined below.
 - 1) Fire Alarm
 - 2) Carbon Monoxide Alarm
 - 3) Supervisory Signal
 - 4) Trouble Signal
 - 5) Security Alarm
 - e. The contractor must provide a DACT that is compatible with the supervising station. Coordinate with the supervising station prior to ordering and installing DACT. Contractor shall verify proper signal receipt with supervising station and ensure compliance with NFPA 72.
- C. Circuits:
1. Initiating Device Circuits (IDC): Class A.
 2. Signaling Line Circuits (SLC): Class A with no T taps.
 3. Notification Appliance Circuits (NAC): Class B.
- D. Spare Capacity:
1. Initiating Device Circuits: Minimum 25 percent spare capacity.
 2. Notification Appliance Circuits: Minimum 25 percent spare capacity.
 3. Fire Alarm Control Units: Capable of handling all circuits utilized to capacity without requiring additional components other than plug-in control modules.
- E. Power Sources:
1. Primary: Dedicated branch circuits of the facility power distribution system.
 2. Secondary: Storage batteries.
 3. Capacity: Sufficient to operate entire system for period 60 hours in standby with 15 minutes of full alarm at the end of the 60 hours..

2.3 FIRE SAFETY SYSTEMS INTERFACES

- A. Supervision: Provide supervisory signals in accordance with NFPA 72 for the following:
 1. Sprinkler water control valves.

2. Fire pump(s).
 3. Elevator shut-down control circuits.
- B. Alarm: Provide alarm initiation in accordance with NFPA 72 for the following:
1. Sprinkler water flow.
 2. Kitchen hood suppression activation; also disconnect fuel source from cooking equipment.
 3. Elevator lobby, elevator hoistway, and elevator machine room smoke detectors.
 4. Duct smoke detectors.
- C. Elevators:
1. Elevator lobby, hoistway, and machine room smoke detectors: Elevator recall for fire fighters' service.
 2. Elevator Machine Room Heat Detector: Shut down elevator power prior to hoistway sprinkler activation.
 3. Sprinkler pressure or waterflow: Shut down elevator power prior to hoistway sprinkler activation.
- D. HVAC:
1. Duct Smoke Detectors: Close dampers indicated; shut down air handlers indicated.
- E. Doors:
1. Smoke Barrier Door Magnetic Holders: Release upon activation of smoke detectors in smoke zone on either side of door, upon alarm from manual pull station on same floor, and upon sprinkler activation on same floor. Refer to Section 08 71 00. Door hold open magnets may release 60 seconds after loss of 120V power.
- F. Sprinkler System Monitoring
1. The following sprinkler system alarm and supervisory functions shall be provided as part of the fire alarm system:
 - a. Waterflow alarm, by sprinkler zone (not to exceed one floor).
 - b. Supervision of each control valve.
 - c. Supervision of air pressure, if used.
 - d. Supervision of fire pump.
 2. Sprinkler supervisory monitoring of flow switches, tamper switches, and similar functions shall be accomplished with a separate system address for each activity monitored.
 3. Contractor shall be responsible for reviewing the fire protection drawings and providing the quantity of tamper switches, flow switches, air pressure sensors, monitor and relay modules as required by the fire protection system design.
- G. Kitchen exhaust hood extinguishing systems
1. Installation shall comply with the current accepted edition of NFPA 72 for the type of system installed.

2. System shall be interconnected with fire alarm system as a separate system address.

2.4 COMPONENTS

A. General:

1. Provide flush mounted units where installed in finish areas; in unfinished areas, surface mounted unit are acceptable.
2. Provide legible, permanent labels for each control device, using identification used in operation and maintenance data.
3. Consult with facility manager and local fire official prior to locating Master Control Unit, remote annunciator, or system printer.
4. System Capacity and General Operation: The system shall have the following capacities and general operation modes:
 - a. The FACP shall provide, or be capable of expansion to 198 intelligent/addressable devices per Signaling Line Circuits (SLC) and 2000 annunciation points, minimum, per system. The number of SLCs provided shall be as indicated on the Drawings. Total points shall be as indicated on the drawings or otherwise specified.
 - b. The FACP shall include a full featured operator interface control and annunciation panel that shall include a backlit, 80 minimum character liquid crystal display, individual, color coded system status LEDs, and an alphanumeric keypad for the field programming and control of the fire alarm system.
 - c. All programming or editing of the existing program in the system shall be achieved without special equipment and without interrupting the alarm monitoring functions of the fire alarm control panel.

- ### B. Fire Alarm Control Units: Analog, addressable type; listed, classified, and labeled as suitable for the purpose intended.

C. Master Control Unit shall have the following features:

1. The system shall be addressable type, with 24vdc nominal operating voltage.
2. Upload/Download to PC Computer
3. Charger Rate Control
4. Drift Compensation
5. Automatic Day/Night Sensitivity Adjust
6. Device Blink Control
7. Pre-alarm Control Panel Indication
8. Trouble Reminder
9. NFPA 72 Smoke Detector Sensitivity Test
10. System Status Reports
11. Periodic Detector Test

12. Alarm Verification, by device, with tally
 13. Non-Alarm Module Reporting
 14. Block Acknowledge
 15. Smoke Detector Maintenance Alert
 16. Control-By-Time
 17. The control panel shall be capable of printing historical data and device parameters and shall include all equipment necessary to produce printouts, including an external printer and shall be U.L. listed as meeting the NFPA 72 sensitivity testing and maintenance requirements without the need for manually removing and testing each smoke detector. The control panel shall provide a display and a printed list of these sensitivity measurements as a permanent record of the required sensitivity testing. The system shall also annunciate a trouble condition when any smoke detector approaches 80% of its alarm threshold due to gradual contamination, with an annunciation of the location of the smoke detector requiring service. If any specialized equipment must be used to program any function of the smoke detector devices, then one must be furnished as part of the system.
 18. The system shall perform time based control functions including automatic changes of specified smoke detector sensitivity settings.
 19. System shall provide as a feature an alternate signal processing algorithm to verify the presence of smoke. The algorithm shall be selectable during system programming. The total effective delay created by the verification algorithm shall not exceed 60 second.
- D. Central Processing Unit: The Central Processing Unit (CPU) shall communicate with, monitor, and control all other modules within the control panel. Removal, disconnection or failure of any control panel module shall be detected and reported to the system display by the CPU.
1. The CPU shall contain and execute all control-by-event (including ANDing, ORing, NOTing, CROSSZONEing) programs for specific action to be taken if an alarm condition is detected by the system. Such control-by-event programs shall be held in non-volatile programmable memory, and shall not be lost with system primary and secondary power failure. The CPU shall also provide a real-time clock for time annotation of all system displays. The Time-of-Day and date shall not be lost if system primary and secondary power supplies fail.
 2. Digitized electronic signals shall employ check digits or multiple polling. In general a single ground or open on any system signaling line circuit or initiating device circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
 3. The CPU shall be capable of being programmed on site without requiring the use of any external programming equipment. Systems that require the use of external programmers or change of EPROMs are not acceptable.
 4. Loss of power: Alarm signals arriving at the main FACP shall not be lost following a power failure (or outage) until the alarm signal is processed and recorded.
 5. The system shall have multiple access levels so owner's authorized personnel can disable individual alarm inputs or normal system responses (outputs) for alarms, without changing the system's executive programming or affecting operation of the rest of the system. The process on how to do this must be included in the training required to be given to the owner's designated personnel, and must also be part of the written documentation provided by the fire alarm equipment supplier.

E. System Response Conditions.

1. Alarm Condition - When a fire alarm condition is detected and reported by one of the system initiating devices, the following functions shall immediately occur:
 - a. The system alarm LED shall flash.
 - b. A local piezo-electric signal in the control panel shall sound.
 - c. LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location.
 - d. On systems equipped with a printer, printing and history storage shall log the information associated with each new fire alarm signal, along with the time and date of occurrence.
 - e. All system outputs assigned via control-by-event equations to be activated by a particular point shall be executed.
 - f. Activate all fire alarm Notification Appliances.
 - g. Activate IP digital alarm communicator.
 - h. Deactivate all door hold control relays.
 - i. Activate control relays to initiate AHU shutdown.
 - j. In buildings with elevators, activate elevator recall sequence when elevator initiating device is activated.
2. Trouble or Supervisory Condition - When a trouble condition is detected the following stipulations apply:
 - a. System AC power trouble shall not be sent unless maintained for 3 hours or more. Provide additional relays as required for this purpose.
 - b. Provide adjustable time delay for all other trouble signals prior to transmission.
 - c. Supervise all initiating, signaling, and notification circuits throughout the facility by way of monitor and control modules.
 - d. Visually and audibly annunciate any trouble, supervisory condition on operator's terminals, panel display, and annunciators.

F. Operators Control: Provide an operators interface which allows the following minimum functions. In addition, the operators interface shall support any other functions required for system control and/or operation:

1. Acknowledge (ACK/STEP) Switch
2. Signal Silence Switch
3. Alarm Silence Switch
4. System Reset Switch
5. System Test Switch
6. Lamp Test Switch

-
7. Elevator Recall Override Switch.
 8. AHU Shutdown Override Switch.
- G. Display: The system display shall provide all the controls and indicators used by the system operator and may also be used to program all system operational parameters. The display assembly shall contain, and display as required, custom alphanumeric labels for all intelligent detectors, addressable modules, and software zones.
1. The system display shall provide an 80 minimum-character back-lit alphanumeric Liquid Crystal Display (LCD).
 2. The Display shall also provide four Light-Emitting-Diodes (LEDS), that will indicate the status of the following system parameters: AC POWER, SYSTEM ALARM, SYSTEM TROUBLE, and SIGNAL SILENCE.
 3. The system display shall provide a touch key-pad with control capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels shall be accessible through the display interface assembly to prevent unauthorized system control or programming.
- H. Printer: For systems exceeding 100 addressable points, 3 occupied floors in height, or 60,000 square feet, Provide a printer to provide hard-copy printout of all changes in status of the system. The printers shall time stamp such printouts with the current time-of-day and date. The printer shall be standard carriage with 80 characters per line and shall use standard pin-feed paper. Thermal printers are not acceptable. The printer shall operate from a 120V, 60 Hz power source. Provide a table and stand for printer in main data room.
- I. Remote Annunciators: Annunciator shall communicate with the fire alarm control panel via an EIA-485 communications loop (four-wire) and shall individually annunciate all zones in the system. System zones shall be as indicated on the Drawings. Up to 10 annunciators may be co.
1. Annunciator Indicators: The annunciator shall provide a red Alarm LED per zone, and a yellow Trouble LED per zone. The annunciator shall also have an "ON-LINE" LED, local piezo sounder, local acknowledge/lamp test switch, and custom zone/function identification labels. Annunciator switches may be used for System control such as, Global Acknowledge, Global Signal Silence, Alarm Resound, and Global System Reset. All annunciator switches and indicators shall be software programmable.
 2. LCD Alphanumeric Display Annunciator: The Alphanumeric Display Annunciator shall be a supervised, remotely located back-lit LCD display containing a minimum of eighty (80) characters for alarm annunciation in clear English text. The LCD Annunciator shall display all alarms and trouble conditions in the system.
 3. System Capacity: The system shall allow a minimum of four LCD annunciators. In addition to annunciation functions, each LCD annunciator shall be capable of the following software programmed system functions: Acknowledge, Signal Silence, Alarm Resound, and Reset.
 4. Connections: The annunciator shall connect to a two-wire EIA-485 interface. The two-wire connection shall be capable operation at distances of 6,000 feet. Provide interface to fiber optic cable systems and/or repeater units where such are indicated on the Drawings.
- J. Initiating Devices:
1. Addressable Systems:
 - a. Addressable Devices: Individually identifiable by addressable fire alarm control unit.
-

-
- b. Provide suitable addressable interface modules as indicated or as required for connection to conventional (non-addressable) devices and other components that provide a dry closure output.
2. Addressable Devices - General: All initiating devices shall be individually addressable. Addressable devices shall comply with the following requirements:
 - a. All addressable spot type and duct smoke detectors shall be the analog type and the alarm system shall automatically compensate for detector sensitivity changes due to ambient conditions and dust build-up within detectors. This feature must be armed and sensitivities set prior to acceptance of the system.
 - b. Address Setting: Addressable devices shall provide an address-setting means.
 - c. Connections: Addressable devices shall be connected to a Signaling Line Circuit (SLC) with two (2) wires.
 - d. Operational Indications: Addressable initiation devices shall provide dual alarm and power LEDs. Both LEDs shall flash under normal conditions, indicating that the device is operational and in regular communication with the control panel. Both LEDs shall be placed into steady illumination by the FACP to indicate that an alarm condition has been detected. The flashing mode operation of the detector LEDs shall be optional through the system field program. An output connection shall also be provided in the device base to connect an external remote alarm LED.
 - e. Intelligent Initiation Devices: All smoke detectors shall be the "intelligent" in that smoke detector sensitivity shall be set through the FACP and shall be adjustable in the field through the field programming of the system. Sensitivity shall be capable of being automatically adjusted by the FACP on a time-of-day basis. Using software in the FACP, detectors shall be capable of automatically compensating for dust accumulation and other slow environmental changes that may affect performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72.
 - f. Spot-type detectors must be the plug-in type, with a separate base (not a mounting ring), to facilitate their replacement and maintenance. The base shall have integral terminal strips for circuit connections, rather than wire pigtails. Each detector or detector base shall incorporate an LED to indicate alarm.
 3. Smoke Detectors General Requirements:
 - a. Spot-type detectors must be the plug-in type, with a separate base (not a mounting ring), to facilitate their replacement and maintenance. The base shall have integral terminal strips for circuit connections, rather than wire pigtails. Each detector or detector base shall incorporate an LED to indicate alarm.
 - b. Device mounting Base: Unless otherwise specified all detectors shall be ceiling-mount and shall include a separate twist-lock base with locking tamper proof feature.
 - c. Sounder Base: Where indicated on plans provide bases with a built-in (local) sounder rated at 85 dBA minimum, measured at 10 ft. Configure sounder bases such that sounders are activated under conditions as described in the Matrix.
 - d. Test Means: The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel when in the "test" condition.
-

-
- e. Device Identification: Detectors shall store an internal identifying type code that the control panel shall use to identify the type of device. Device identifications shall be either ION, PHOTO, or THERMAL.
 - f. Photoelectric Smoke Detectors: Photoelectric smoke detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.
 - g. Ionization Smoke Detector: Ionization smoke detectors shall use the dual-chamber ionization principal to measure products of combustion and shall, on command from the control panel, send data to the panel representing the analog level of products of combustion.
4. Thermal Detectors: Thermal Detectors shall be intelligent addressable devices rated at 135°F (58°C) and shall have a rate-of-rise element rated at 15° F. (9.4°C) per minute. It shall connect via two wires to the Fire Alarm Control Panel Signaling Line Circuit. Up to 99 intelligent heat detectors may connect to one SLC loop. Thermal detectors shall use an electronic sensor to measure thermal conditions caused by a fire and shall, on command from the control panel, send data to the panel representing the analog level of such thermal measurements.
 5. Duct Smoke Detector: In-Duct Smoke Detector Housings shall accommodate a velocity rated photoelectric detector. The device, independent of the type used, shall provide continuous analog monitoring and alarm verification from the panel. When sufficient smoke is sensed, an alarm signal shall be initiated at the FACP. Proper installation and physical location of each duct detector and access door shall be coordinated between the electrical, the mechanical and the fire alarm sub-contractors and approved by the electrical and mechanical engineers prior to equipment installation.
 - a. Each Duct detector shall have a hinged duct access panel, 12 x 12 inches minimum for sampling tube inspection and cleaning. Indicate airflow direction on the duct adjacent to detector using permanent decal.
 - b. Duct detector sampling tubes shall extend the full width of the duct. Sampling tubes over 36 inches long must be provided with far end support for stability. Install sampling tube per manufacturer's instructions.
 - c. All duct detectors shall be programmed for alarm.
 6. Remote annunciator Indicator Lights (RAIL): RAILs shall be provided for initiating devices where indicated on the plans. RAILs shall be provided with a key type switch for testing of the annunciated device. All RAILs shall be 24 VDC.
 7. Addressable Pull Stations - General: Addressable pull stations shall, on command from the Control Panel, send data to the panel representing the state of the manual switch. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key. All pull stations shall be dual-action, have a positive, visual indication of operation and utilize a key type reset. The Glass-break rods are not allowed.
- K. Notification Appliances:
1. Programmable Electronic Sounders (Horns): Sounders located outdoors or in damp or wet locations shall be listed for use in wet locations. Electric sounders shall operate with synchronized audible output and have the following specifications: .
 - a. Voltage: Programmable electronic sounders shall operate on 24 VDC nominal.
-

- b. Programming: Electronic Sounders shall provide the ANSI 53.41 three-pulse temporal pattern audible evacuation signal, described in NFPA 72, with an output sound level of at least 90 dBA measured at 10 feet from the device. Output sound level shall be 120 dB maximum. Electronic Sounders shall be field programmable without the use of special tools.
2. Strobes: shall be located as shown on the Drawings and provided per the requirements of the NCSBC chapter #11 and ICC A117.1-2009. Strobe lights indicated for use exterior to the building shall be mounted at the indicated elevation and listed for use in wet locations. Strobe lights shall operate with synchronized flash output and have the following specifications:
 - a. Voltage: Strobe lights shall operate on 24 VDC nominal.
 - b. Maximum pulse duration: 2/10ths of one second.
 - c. Strobe intensity and flash rate: Must meet minimum requirements of UL 1971. Provide strobe lights with minimum intensity Candela (Cd) rating of 15/75 Cd, or greater if shown otherwise on drawings.
3. Audible/Visual Combination Devices shall comply with all applicable requirements for both Programmable Electronic Sounders and Strobe Lights.

L. Miscellaneous System Items

1. Addressable Dry Contact Monitor Module: Addressable Monitor Modules shall be provided to connect one supervised zone of non-addressable Alarm Initiating Devices (any Normally Open [N.O.] dry contact device) to one of the Fire Alarm Control Panel Signaling Line Circuit Loops. Monitor modules shall be installed as required by the system configuration. All required monitor modules may not be shown on the Drawings.
 - a. Indication of Operation: An LED shall be provided that shall flash under normal conditions, indicating that the Monitor Module is operational and in regular communication with the control panel.
 - b. Supervision: Unless specifically noted otherwise on the drawings provide one monitor module for each sprinkler switch.
2. Two Wire Detector Monitor Module: Addressable Monitor Modules shall be provided to connect one supervised IDC zone, Class A or alarm initiating devices (any N.O. dry contact device) to one of the Fire Alarm Control Panel Signaling Line Circuit Loops. Monitor modules shall be installed as required by the system configuration. All required monitor modules may not be shown on the Drawings. Indication of Operation: Unless otherwise indicated on the Drawings an LED shall be provided that shall flash under normal conditions, indicating that the Monitor Module is operational and in regular communication with the control panel.
3. Addressable Control Module: Addressable Control Modules shall be provided to supervise and control the operation of one conventional Notification Appliance Circuit (NAC) of compatible, 24 VDC powered, polarized Audio/Visual (A/V) Notification Appliances. For fan shutdown and other auxiliary control functions, the control module may be set to operate as a dry contract relay. The control module shall provide address-setting means using DIP switches and shall also store an internal identifying code that the control panel shall use to identify the type of device. An LED shall be provided that shall flash under normal conditions, indicating that the control module is operational and is in regular communication with the control panel.
 - a. Configuration: The control module NAC circuit may be wired for Class B with up to 1 Amp of inductive A/V signal, or 2 Amps of resistive A/V signal operation, or as a dry contact (Form C)

- relay. The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.
- b. Power Source: Audio/visual power shall be provided by a separate supervised power loop from the main fire alarm control panel or from a supervised, 3rd party listed remote power supply. AN power sources and connections are not shown on the Drawings
 - c. Test Switch: A magnetic test switch shall be provided to test the module without opening or shorting its NAC wiring.
4. Isolator Module: Isolator Modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC loop. The Isolator Module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC Loop. Modules must be readily accessible (not above ceiling) and clearly labeled.
- a. Operation: Isolator Modules shall operate such that if a wire-to-wire short occurs, the Isolator module shall automatically open-circuit (disconnect) the SLC loop. When the short circuit condition is corrected, the Isolator Module shall automatically reconnect the isolated section. The Isolator Module shall not require any address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an Isolator Module after its normal operation.
 - b. The Isolator Modules shall provide a single LED that shall flash to indicate that the Isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.
 - c. Isolation modules must be provided in the following locations as a minimum.
 - 1) Immediately adjacent to the Main Fire Alarm Control Unit, at each end of the addressable loop. These two isolators must be within 15 feet of the Main Fire Alarm Control Unit.
 - 2) After each 20 initiating devices and control points on the addressable loop.
 - 3) For loops with 20 or less control points install isolation module in approximately the middle of the loop.
 - 4) Near the point where any addressable loop extends outside the building envelope.
 - 5) For loops covering more than one floor where addressable loop crosses between floors.
 - d. Each isolation module must be clearly labeled, readily accessible for convenient inspection.
5. Water Flow Switch: Flow switches shall be integral, mechanical, non-coded, non-accumulative retard type. Flow switches shall have an alarm transmission delay time that is conveniently adjustable from 0 to 60 seconds. Initial settings shall be 30-45 seconds. Flow switches shall be located a minimum of one (1) foot from a fitting that changes the direction of the flow and a minimum of three (3) feet from a valve as required per NFPA 13. Installation: Water Flow Switches shall be connected by the Division 26 (Electrical) Contractor but furnished and installed by the Division 23 (Mechanical) Contractor.
6. Sprinkler and Standpipe Valve Supervisory Switch: Supervisory switch mechanisms shall be contained in a weatherproof housing that shall provide a 3/4 inch tapped conduit entrance and shall incorporate the necessary facilities for attachment to the valves. Switch housing shall be finished in red baked enamel. Mounting: Mount switch so as not to interfere with the normal operation of the valve and adjust to operate within two revolutions toward the closed position of the valve control, or when the stem has

moved no more than one-fifth of the distance from its normal position.

7. Remote Annunciator Indicator Lights (RAIL): RAILS shall be provided with a key type switch for testing of the annunciated device. In addition, RAILS shall have the following features: Voltage: RAILS shall operate on 24 VDC nominal.
8. Door Hold-Open magnets:
 - a. Door hold open magnets shall be suitable for mounting in a single gang electrical device box.
 - b. Door hold open magnets shall be furnished with keepers, door chains, and other accessories as required to properly hold open doors as indicated on the Drawings.
 - c. Wall mounted magnetic door holders and separate heavy duty closers shall be used instead of combination door control units.
 - d. Holding force of the magnet shall be appropriate for the door to be held open. Door hold open magnets shall operate in a fail safe manner, i.e., the door shall release in event of a failure of voltage to the device.
 - e. Power Source: Door hold open magnets shall be configured to operate from a nominal 24 VDC system as supplied by the FACP or other power supply listed for the purpose.
 - f. All hold open magnet supply sources, whether a part of the FACP or whether derived from a separate power supply, shall be supervised.
 - g. Door hold open magnet circuits which use step-down transformers, 120 VAC, or local relays are not permitted.
 - h. Door shall close after 60 seconds of the power loss.
9. Battery Power Supply (BPS) &/or Supplementary Notification Appliance Circuit (SNAC): These types of panels shall be completely maintenance free, shall not require liquids, fluid level checks or refilling, and shall not be capable of producing spills and/or leaks. Batteries shall be sealed gel-cell type with expected life of 10 years. Battery voltage shall be as required by the FACP and related equipment. Battery shall have sufficient capacity to power the fire alarm system for not less than 60 hours plus 15 minutes of alarm upon a normal AC power failure. Battery cabinet shall be twice the size of the batteries it will contain. NAC circuits shall not exceed 75% of maximum current load allowed.
 - a. The voltage drop at EOL must not exceed 14% of the expected battery voltage after the required standby and alarm times. Determine worst case voltage at far end of each NAC circuit. The results must not be than the minimum listed rating on the device.
 - b. Where voltage drop or capacity limits are exceeded provide additional NAC panels as required for a fully functional system.
 - c. All power supplies shall be capable of withstanding prolonged short circuits in the field wiring, either line-to-line or line-to-ground, without damage.
 - d. All power supplies shall be equipped with battery charging using dual-rate charging techniques for fast battery recharge.
10. Enclosure: All equipment enclosures shall be third party listed suitable for surface or semi-flush mounting. Cabinet and front shall be corrosion resistant, given a rust-resistant prime coat, and manufacturer's standard finish. The door shall provide a key lock and a glass opening for viewing

indicators. Door hinge shall be field selectable (left or right).

M. Wiring

1. Addressable loop (signaling line) circuits shall be wired with type FPL/FPLR/FPLP fire alarm cable, AWG 18 minimum, low capacitance, twisted shielded copper pair. Cable shield drain wires are to be connected at each device on the loop to maintain continuity, taped to insulate from ground, and terminated at the FACP. Acceptable cables include Atlas 228-18-1-1STP, BSCC S1802s19 (same as EEC 7806LC), West Penn D975, D991 (AWG 16), D995 (AWG 14), or equal wire having capacitance of 30pf/ft. maximum between conductors. Belden 5320FJ acceptable if only FPL rating needed.
 - a. Unshielded cable, otherwise equal to the above, is permitted to be used if the manufacturer's installation manual requires, or states preference for, unshielded cable.
 - b. In underground conduit, use Type TC or PLTC cable (PE insulated) to avoid problems from moisture.
 - c. The following conductor color coding shall be maintained throughout the system:
 - 1) Initiating Circuits: Red (+)/White (-)
 - 2) Initiating Circuits, Smoke Only: Violet (+)/Grey (-)
 - 3) Signal Line Circuits: Red jacket with Red (+)/Black(-)
 - 4) Alarm Indicating Appliance Circuits: Blue (+)/Black(-)
 - 5) AHU Shutdown Circuits: Yellow (+)/Brown (-)
 - 6) Door Control Circuits: Orange
 - 7) Elevator Capture Circuits: Brown
2. Supervision must be provided between individual addressable modules and their associated contact type initiating devices.

N. Surge Protection: In accordance with IEEE C62.41.2 category B combination waveform and NFPA 70; except for optical fiber conductors.

1. For each AC power circuit that interfaces with fire alarm equipment install an AC suppressor in a listed enclosure near the electrical panelboard, and trim excess lead lengths. Wind small coil in the branch circuit conductor just downstream of the suppressor connection. Coil to be 5 to 10 turns, about 1" diameter, and securely tie-wrapped. This series impedance will improve the effectiveness of the suppressor in clipping fast rise time voltage transients.
2. Equipment Connected to Alternating Current Circuits: Maximum let through voltage of 350 V(ac), line-to-neutral, and 350 V(ac), line-to-line; do not use fuses.
3. Initiating Device Circuits, Notification Appliance Circuits, and Communications Circuits: Provide surge protection at each point where circuit exits or enters a building; rated to protect applicable equipment; for 24 V(dc) maximum dc clamping voltage of 36 V(dc), line-to-ground, and 72 V(dc), line-to-line.
4. On DC circuits extending outside the building: Provide surge protection at each point where circuit exits or enters a building, rated to protect applicable equipment.

O. Locks and Keys: Deliver keys to Owner.

-
- D. All system components shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load. Adhesives are not permitted to mount fire alarm system components to building surfaces or structure.
 - E. The system shall be electrically supervised for open or ground fault conditions in SLC, alarm and control circuits. Removal of any detection device, alarm appliance, plug-in relay, system module, or standby battery connection shall also result in a trouble signal.
 - F. When programming the system, activate the automatic drift compensation feature for all spot- type smoke detectors. Systems with alarm verification are not to have this feature activated without written direction from the owner's representative or the AHJ. Alarm verification must not be used with multi-sensor/multi-criteria detectors under any circumstances, as inadequate system response may result. Most applications of analog addressable smoke detectors do not require alarm verification to reduce nuisance alarms, as they are better able to discriminate between fire and common non-fire ambient events. A short operational test with normal occupancy can determine if transient ambient events are a problem
 - G. Provide photoelectric smoke detector within 15 feet of every Fire Alarm Control Panel, NAC Panel or other fire alarm control equipment. These detectors shall be provided weather shown on plans or not.
 - H. Set spot-type smoke detector sensitivities to normal/medium, unless directed otherwise by the design engineer/owner's rep. High sensitivity may be appropriate in relatively benign, clean environments such as art museums and libraries, to improve system response time without causing nuisance alarms.
 - I. Unless suitably protected against dust and other debris, spot type smoke detectors shall not be installed until final construction clean-up has been completed. In the even that detectors are damaged during construction due to failure to adequately protect devices, they shall be replaced by the contractor at no expense to the owner.
 - J. Print a complete System Status and Programming Report after the above steps have been done. This must include the program settings for each alarm initiating device and the current sensitivity of each analog addressable smoke detector.
 - K. Install instruction cards and labels.
 - L. Basic operating instructions shall be framed and permanently mounted at the Main Control Unit. The NFPA 72 record of completion must either be kept at the Main Control Unit or an alternate location may be permanently engraved at the Main Control Unit.
 - M. Provide engraved label at the Main Control Unit and secondary power supplies identifying the 120V power source including panelboard location, panelboard identifier, and branch circuit number.
 - N. Breaker serving fire alarm power supplies shall be protected with a fire alarm handle lock, Space Age Electronics ELOCK series or approved equal. Additionally the breaker handle shall be labeled with 1/4" permanent red dot.
 - O. Identification of individual initiating devices is required. Assign each initiating device a unique number as follows, sequence starting from the FACP: (Addressable Loop # -- Device #). Show device numbers on as built plans and permanently mark each detector base so that it is readable on the floor below without having to remove detector. Labels must be typewritten with black lettering and clear background.

3.2 CONDUIT AND WIRING

- A. All fire alarm system wiring shall be in metal conduit, minimum 3/4", or surface metal raceway. All fire alarm system raceway, couplers, and connectors must meet performance and installation requirements as identified

in other sections of this specification manual.

- B. Detection or alarm circuits must not be included in raceways containing AC power or AC control wiring. Within the Fire Alarm Control Panels, and 120V control wiring or other circuits must with an externally supplied voltage above 24 V must be properly separated from other circuits and have the appropriate warning label to alert service personnel to the potential hazard.
- C. There shall be no splices in the system other than at device terminal blocks, or on terminal blocks in cabinets.
- D. Permanent wire markers shall be used to identify all connections in the Main Fire Alarm Control Unit and other control equipment, at power supplies and terminal cabinets.
- E. In multistory buildings, all circuits leaving the riser on each floor shall feed through a labeled terminal block in a hinged enclosure accessible from the floor.
- F. All wiring terminal block screws shall have pressure wire connectors of the self-lifting or box lug type.
- G. All wiring shall be checked for grounds, opens, and shorts, prior to termination at panels and installation of detector heads. The minimum allowed resistance to ground between any two conductors shall be 10 megohms, as verified with an insulation resistance test. Provide Engineer with the results of these tests.
- H. The exterior of all junction boxes, including both sides of covers, containing fire alarm conductors shall be painted red. Box interior shall not be painted.
- I. Box covers shall be labeled to indicate the circuit(s) or function of the conductors contained within. Labels shall be neatly applied black lettering on clear background. Handwritten labels or embossed tape labels are not allowed.
- J. All conduits penetrating exterior walls must have internal sealing to prevent condensation from infiltrating humid air.

3.3 INSPECTION AND TESTING FOR COMPLETION

- A. Notify Owner 7 days prior to beginning completion inspections and tests.
- B. Notify State Construction Electrical Inspector at least 7 days in advance for observation by their personnel prior to final acceptance.
- C. Provide the services of the installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction, and adjustments.
- D. Prepare for testing by ensuring that all work is complete and correct; perform preliminary tests as required.
- E. Provide all tools, software, and supplies required to accomplish inspection and testing.
- F. Upon completion of the installation the Contractor and the Manufacturer's authorized installer together shall conduct a 100% performance test of each and every alarm initiating device for proper response. The system shall operate for 48 hours prior to start of test. The Contractor shall be present for the full 100% test.
- G. The A/E and owner must be given 7 days advance notice of the tests. All Audio Visual Device Testing shall be scheduled with the owner.
- H. 100% Test: The manufacturer or authorized distributor (by definition, "installer") must 100% test all site-specific software functions for the system and then provide a detailed report or check list showing the system's operational matrix. This documentation must be part of the "System Status and Programming Report".

1. Upon completion of the installation and its programming, the installer's technician shall test every alarm initiating device for proper response and indication, and all alarm notification appliances for effectiveness. Also, in coordination with the other building system contractors, all other system functions shall be verified, including (where applicable) elevator capture and the control of HVAC systems, door locks, pressurization fans, fire or smoke doors/dampers/shutters, etc. The engineer must be notified in advance of these 100% tests, to permit witnessing them if desired.
 2. If AHU shutdown occurs for any alarm, then the matrix would indicate the specific control relay(s) for that function being commanded to operate for alarm from any initiating device. If a rolling steel fire door is to drop only upon waterflow alarm from its sprinkler zone, or upon any two spot smoke detectors in adjacent spaces being simultaneously in alarm, the matrix would show the door's control relay activating upon alarm from the applicable waterflow switch(es), or from any two smoke detectors in the selected spaces (AND gate).
 3. The digital communicator shall be on-line and tested for proper communication to the receiving station.
 4. All supervised circuits must also be tested to verify proper supervision. (Control circuits and remote annunciation lines are among those required to be supervised.)
 5. All testing described above shall be repeated in the event that subsequent software or wiring modifications are determined necessary to meet the requirements of the contract documents. Such re-testing shall be included as part of the base bid and provided at no additional cost to the Owner.
- I. Test Documentation: The installer must fill out and submit the following documentation to the owner, through the engineer, prior to the AHJ's system acceptance inspection:
1. Written verification that this 100% system test was done with copy of print out generated during test.
 2. The NFPA 72, "Record of Completion" Form. Use this form (no substitutes) to detail the system installation and also to certify that: (a.) It was done per Code, and (b.) The Code- required 100% test was performed. The fire alarm installer (manufacturer or authorized distributor's technician) must sign this form. If a representative of the AHJ, owner, or engineer witnesses the tests, in whole or in part, they must also sign the form to signify that fact only (annotating the form as needed to clarify their limited role).
 3. For buildings with a smoke control or smoke purge system, an HVAC balance report, in the smoke control / smoke purge mode.
 4. The System Status and Programming Report described in NFPA 72. This must be generated on the day of the system acceptance inspection and shall include the measured sensitivity of each smoke detector.
 5. The purpose of doing Item above on the day of the inspection is to assure detector sensitivity has not been affected by construction dust. Prudent contractors will have taken measures to prevent detector contamination during construction, and will also have had the system do a detector sensitivity test and printout prior to the day of the inspection, to make certain all devices are properly programmed and operating within their limits.
- J. After completion of the 100% system test and submission of documentation as described above the installer is to request the engineer to set up an inspection. The system must operate for at least two days prior to this inspection. The responding Fire Department shall be notified of this, for pre-fire planning purposes. On local government projects, local fire authorities may also want to participate in system acceptance inspections. However, for State-owned property they have no inspection jurisdiction and, if present, are only to observe.
- K. PRE-FINAL INSPECTION: At the Owner's request and after passing the Designer's pre-final inspection, the Contractor and Manufacturer's authorized installer will conduct system test in the presence of the Owner and

the Designer.

- L. FINAL INSPECTION: The fire alarm system will be inspected, with portions of it functionally tested. This will normally include the use of appropriate means to simulate smoke for testing detectors, as well as functionally testing the system interface with building controls, fire extinguishing systems and any off-premises supervising station. Operation of any smoke removal system will be checked as instructed by the AHJ. This statistical (sampling) inspection is intended to assure that the contractor has properly installed the system and performed the 100% operational test as required by NFPA 72. The electrical contractor shall provide two-way radios, ladders, and any other materials needed for testing the system, including a suitable smoke source.
1. Smoke control and smoke management systems are normally tested by measuring air flow rates and pressure differentials, plus observing any effect the system has on the operation of exit, elevator, and stairway doors. Testing with smoke "bombs" (smoke candles) is NOT appropriate because they produce cold chemical smoke that lacks buoyancy and, therefore, does not rise like the smoke from a fire.
 2. The test will be conducted entirely by the Contractor. A copy of the final database software must be presented to the Owner before this test. The software shall be loaded from these disks into the system in the presence of the Owner. The review will then be conducted using this software. Any deficiencies shall be recorded and corrected. After the items have been corrected, the system shall be tested again.
 - a. In the event of malfunctions or excessive nuisance alarms, the Contractor must take prompt corrective action. The Owner may require a repeat of the Contractor's 100% system test, or other inspections.
 - b. Test Report: Upon successful completion of the Inspection and after the correction of all efficiencies, the manufacturer's authorized representative shall issue a test report to the Engineer and Owner, detailing and certifying the test.
 - c. System Acceptance: After successful completion of the Final Inspection and recommendation of the Engineer and concurrence of the State Construction Office that all criteria for Final Acceptance have been achieved, the system will be accepted by the Owner. At this time the warranty period begins.

3.4 OWNER PERSONNEL INSTRUCTION

- A. Provide the following instruction to designated Owner personnel:
1. Hands-On Instruction: On-site, using operational system.
 2. Classroom Instruction: Owner furnished classroom, on-site or at other local facility.
- B. Maintenance Technicians: Detailed training for electrical technicians, on programming, maintaining, repairing, and modifying; factory training:
1. Initial Training: Minimum of 8 hours of instruction, pre-closeout.
 - a. Training shall cover at a minimum the following:
 - 1) Preventative maintenance service techniques and schedules, including historical data trending of alarm and trouble records.
 - 2) Overall system concepts, capabilities, and functions. Training shall be in depth, so that owner shall be able to take any device out of service and return any device to service without the need of manufacturer's approval or assistance.

- 3) Explanation of all control functions, including training to program and operate the software.
 - 4) Methods and means of troubleshooting and replacement of all field wired devices.
 - 5) Methods and procedures for trouble shooting the main fire alarm control panel, including field peripheral devices as to programming, bussing systems, internal panel and unit wiring, circuitry, and interconnections.
 - 6) Manuals, drawings, and technical documentation. Actual system software used for training shall be provided in digital form and shall be left with the Owner at the completion of the training for the Owner's use in the future.
- C. Furnish the services of instructors and teaching aids; have copies of operation and maintenance data available during instruction.
- D. Provide two copies of bound training summary to be referenced by owner's maintenance staff in the future.

3.5 CLOSEOUT

- A. Closeout Demonstration: Demonstrate proper operation of all functions to Owner.
1. Be prepared to conduct any of the required tests.
 2. Have at least one copy of operation and maintenance data, preliminary copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
 3. Have authorized technical representative of control unit manufacturer present during demonstration.
 4. Demonstration may be combined with inspection and testing required by authority having jurisdiction; notify authority having jurisdiction in time to schedule demonstration.
 5. Repeat demonstration until successful.
- B. Occupancy of the project will not occur prior to Project Acceptance.
- C. Project Acceptance of the project cannot be achieved until inspection and testing is successful and:
1. Approved operating and maintenance data has been delivered.
 2. Spare parts, extra materials, and tools have been delivered.
 3. All aspects of operation have been demonstrated to Owner.
 4. Final acceptance of the fire alarm system has been given by authorities having jurisdiction.
 5. Occupancy permit has been granted.
 6. Specified pre-closeout instruction is complete.

3.6 MAINTENANCE

- A. Perform routine inspection, testing, and preventive maintenance required by NFPA 72, including:
1. Maintenance of fire safety interface and supervisory devices connected to fire alarm system.

2. Repairs required, unless due to improper use, accidents, or negligence beyond the control of the maintenance contractor.
 3. Record keeping required by NFPA 72 and authorities having jurisdiction.
- B. The manufacturer must maintain software version records on the system installed. The system software shall be upgraded free of charge if a new version is released during the warranty period.
- C. Provide trouble call-back service upon notification by Owner:
1. Provide on-site response within 2 hours of notification.
 2. Include allowance for call-back service during normal working hours at no extra cost to Owner.
 3. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.
- D. Provide a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.
- E. Maintain a log at each fire alarm control unit, listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced. Submit duplicate of each log entry to Owner's representative upon completion of site visit.
- F. Comply with Owner's requirements for access to facility and security.

END OF SECTION 28 46 00

**SECTION 28 46 01
FIRE DETECTION AND ALARM - VOICE EVACUATION**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. New Fire alarm system design and installation, including all components, wiring, and conduit for the new Building Expansions. This new system shall be integrated/interconnected with the existing Notifier 640 Fire Alarm System.
- B. Transmitters for communication with supervising station.

1.2 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; National Fire Protection Association, Including All Applicable Amendments and Supplements; 2020.
- B. NFPA 72 - National Fire Alarm and Signaling Code; 2013
- C. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.3 SCOPE

- A. A new complete and fully functional voice evacuation fire alarm and detection system. Contractor shall provide all parts and pieces required to achieve a fully functional system.

1.4 SUBMITTALS

- A. Proposal Documents: Submit the following with cost/time proposal:
 - 1. NFPA 72 "Record of Completion", filled out to the extent known at the time.
 - 2. Manufacturer's detailed data sheet for each control unit, initiating device, and notification appliance.
 - 3. Certification by Contractor that the system design will comply with the contract documents.
- B. Drawings must be prepared using the latest release of ACAD.
- C. Evidence of designer qualifications.
- D. Design Documents: Submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, riser diagrams, and description of operation:
 - 1. NFPA 72 "Record of Completion", filled out to the extent known at the time.
 - 2. Clear and concise description of operation, with input/output matrix similar to that shown in NFPA 72 Appendix A-7-5-2.2(9), and complete listing of software required.
 - 3. System zone boundaries and interfaces to fire safety systems.
 - 4. Location of all components, circuits, and raceways; mark components with identifiers used in control unit programming.

5. Circuit layouts; number, size, and type of raceways and conductors; conduit fill calculations; spare capacity calculations; notification appliance circuit voltage drop calculations.
 6. System response matrix.
 7. System riser diagram
 8. Battery calculations showing voltage drop after required standby time.
 9. List of all devices on each signaling line circuit, with spare capacity indicated.
 10. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.
 11. Description of power supplies; if secondary power is by battery include calculations demonstrating adequate battery power.
 12. Certification by either the manufacturer of the control unit or by the manufacturer of each other component that the components are compatible with the control unit.
 13. Certification by the manufacturer of the control unit that the system design complies with the contract documents.
 14. Certification by Contractor that the system design complies with the contract documents.
- E. Evidence of installer qualifications.
- F. Evidence of instructor qualifications; training lesson plan outline.
- G. Evidence of maintenance contractor qualifications, if different from installer.
- H. Inspection and Test Reports:
1. Submit inspection and test plan prior to closeout demonstration.
 2. Submit documentation of satisfactory inspections and tests.
 3. Submit NFPA 72 "Inspection and Test Form," filled out.
- I. Operating and Maintenance Data: have one set available during closeout demonstration:
1. Original copy of NFPA 72 with portions that are not relevant to this project neatly crossed out by hand; label with project name and date.
 2. Complete set of specified design documents, as approved by authority having jurisdiction.
 3. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
 4. List of recommended spare parts, tools, and instruments for testing.
 5. Replacement parts list with current prices, and source of supply.
 6. Detailed troubleshooting guide and large scale input/output matrix.

7. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to Owner.
 8. Detailed but easy to read explanation of procedures to be taken by non-technical administrative personnel in the event of system trouble, when routine testing is being conducted, for fire drills, and when entering into contracts for remodeling.
- J. Project Record Documents: Have one set available during closeout demonstration:
1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.
 2. "As installed" wiring and schematic diagrams, with final terminal identifications.
 3. "As programmed" operating sequences, including control events by device, updated input/output chart, and voice messages by event.
 4. Graphic Chart mounted behind plexiglass and secured to wall at FACP and remote annunciator(s). Graphic chart shall indicate all fire alarm devices including the programmed addresses for each device. Frame shall not be removable with standard philips or flat head screw drivers.
 5. A copy of the floor plans with device numbers shall be provided in the control panel. Provide a separate sheet for each floor scaled to be on 11 x17 sheets. All devices shall be clearly labeled and a legend provided on the drawings. Indicate locations of cabinets, modules, and end of line devices. Plans shall be bound and sheets laminated. Provide plan holder in panel or in locked box adjacent to panel keyed to match panel.
 6. Provide CD copy of complete configuration data (site specific programming) for the system submitted to the engineer for distribution to the owner.
 7. Contractor shall provide the following to the owner
 - a. All software required, both for the installed fire alarm system and personal computer necessary to access the fire alarm system for trouble shooting, programming, modifications, monitoring, debugging, or similar functions.
 - b. Complete documentation for all software for both the installed fire alarm system and for any interface PC software necessary for the functions described above.
 - c. Interconnection cable where such is required to connect the fire alarm system to a PC.
- K. Closeout Documents:
1. Certification by manufacturer that the system has been installed in compliance with his installation requirements, is complete, and is in satisfactory operating condition.
 2. NFPA 72 "Record of Completion", filled out completely and signed by installer and authorized representative of authority having jurisdiction.
 3. Certificate of Occupancy.
 4. System Report: Provide Engineer two bound copies of the following for transfer to the owner.
 - a. As-built wiring diagram showing all loop numbers and device addresses, plus terminal numbers and where they connect to control equipment.

- b. As-built wiring and conduit layout diagrams, including wire color code and/or label numbers, and showing interconnections in the system.
 - c. Electronic circuit diagrams of all control panels, modules, annunciators, communications panels, etc.
 - d. Manufacturer's detailed maintenance requirements.
 - e. Product data on all devices.
 - f. As-built calculation sheets showing system capacity and voltage drops.
- L. Maintenance Contract: The contractor shall submit a quote for a maintenance contract to provide all maintenance, test, and repair described in this specification and/or in accordance with NFPA 72. Include also a quote for unscheduled maintenance/repair, including hourly rates for technicians trained on this equipment, and response travel costs. Submittals that do not identify all post contract maintenance costs will not be accepted. Rates and costs shall be valid for a period of (5) years after expiration of the guaranty. Maintenance and testing shall be on a semiannual basis or as required whichever is most restrictive. A preventative maintenance schedule shall be provided by the Contractor that shall describe the protocol for preventative maintenance. The schedule shall include:
- 1. Semiannual systematic examination, adjustment and cleaning of all detectors, manual fire alarm stations, control panels, power supplies, relays, water flow switches and all accessories of the fire alarm system.
 - 2. Semiannual testing of each circuit in the fire alarm system.
 - 3. Semi annual testing of each smoke detector in accordance with the requirements of NFPA 72.
- M. Maintenance Materials, Tools, and Software: Furnish the following for Owner's use in maintenance of project.
- 1. Furnish spare parts of same manufacturer and model as those installed; deliver in original packaging, labeled in same manner as in operating and maintenance data.
 - 2. In addition to the items in quantities indicated in PART 2, furnish the following:
 - a. All tools, software, and documentation necessary to modify the fire alarm system using Owner's personnel; minimum modification capability to include addition and deletion of devices, circuits, and zones, and changes to system description, operation, and evacuation and instructional messages.
 - b. One copy, on CD-ROM, of all software not resident in read-only-memory.
 - c. Extra Fuses: Two for each installed fuse; store inside applicable control cabinet.

1.5 QUALITY ASSURANCE

- A. Designer Qualifications: NICET Level III or IV (3 or 4) certified fire alarm technician or registered fire protection engineer, employed by fire alarm control panel manufacturer, Contractor, or installer, with experience designing fire alarm systems in the jurisdictional area of the authorities having jurisdiction.
- B. Installer Qualifications: Firm with minimum 5 years documented experience installing fire alarm systems of the specified type and providing contract maintenance service as a regular part of their business.
 - 1. Authorized representative of control unit manufacturer; submit manufacturer's certification that installer is authorized; include name and title of manufacturer's representative making certification.

2. Installer Personnel: At least 2 years of experience installing fire alarm systems.
 3. Supervisor: NICET level III or IV (3 or 4) certified fire alarm technician; furnish name and address.
 4. Technician must be trained and individually certified by the manufacturer, for the Master Control Unit installed. Training must have occurred within the most recent 24 month. If NICET level III certification shall extend to 36 months.
 5. Contract maintenance office located within 50 miles of project site.
 6. Certified in the State in which the Project is located as fire alarm installer.
 7. Only the installer may make programming changes and must be present at the 100% test, Designer's pre-final review and Owner's final inspection.
- C. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.
- D. Instructor Qualifications: Experienced in technical instruction, understanding fire alarm theory, and able to provide the required training; trained by fire alarm control unit manufacturer.
- E. Product Listing Organization Qualifications: Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label Electrical and Mechanical Equipment.

1.6 WARRANTY

- A. Provide control panel manufacturer's warranty that system components other than wire and conduit are free from defects and will remain so for 1 year after Owner's acceptance.
- B. Provide installer's warranty that the installation is free from defects and will remain so for 1 year after date of Owner's acceptance.
- C. Warranty shall cover all parts and labor required to correct any deficient parts.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Addressable analog fire alarm system:
 1. Notifier (Johnston county Preferred system)

2.2 FIRE ALARM SYSTEM

- A. Fire Alarm System: Provide a new automatic one-way voice evacuation fire detection and alarm system:
 1. Provide all components necessary, regardless of whether shown in the contract documents or not.
 2. Protected Premises: Entire building shown on drawings.
 3. Comply with the following; where requirements conflict, order of precedence of requirements is as listed:
 - a. ADA Standards.
 - b. The requirements of the State Fire Marshal.

- c. The requirements of the local authority having jurisdiction.
 - d. Applicable local codes.
 - e. The contract documents (drawings and specifications).
 - f. NFPA 72; where the word "should" is used consider that provision mandatory; where conflicts between requirements require deviation from NFPA 72, identify deviations clearly on design documents.
- 4. Evacuation Alarm: Multiple smoke zones; allow for evacuation notification of any individual zone or combination of zones, in addition to general evacuation of entire premises.
 - 5. General Evacuation Zones: Each smoke zone is considered a general evacuation zone unless otherwise indicated, with alarm notification in all zones on the same floor, on the floor above, and the floor below.
 - 6. Hearing Impaired Occupants: Provide visible notification devices in all public areas.
- B. Supervising Stations and Fire Department Connections:
- 1. Public Fire Department Notification: By on-premises supervising station.
 - 2. On-Premises Supervising Station: Existing proprietary station operated by Owner, located at _____.
 - 3. Remote Supervising Station: UL-listed central station under contract to facility.
 - 4. Means of Transmission to On-Premises Supervising Station: Directly connected noncoded system.
 - 5. Means of Transmission to Remote Supervising Station: Multi-technology digital alarm communicator transmitter (DACT). DACT shall utilize one traditional phone line and be capable of IP phone and cellular communications to comply with the 2013 NFPA 72 requirements for multiple communication methods.
 - a. When IP communication method is selected as the alternative communication method contractor shall provide a rack mounted UPS at the location of the main IP phone system capable of supporting the IP phone system for a period of at least 24 hours. Coordinate with Owner/Fire marshal/and Supervising Station prior to selecting alternative communication method.
 - b. The following signals shall be reported as applicable
 - 1) Fire Alarm
 - 2) Sprinkler Waterflow Alarm
 - 3) Carbon Monoxide Alarm
 - 4) Fire Pump Running Alarm
 - 5) Fire Pump Abnormal Status Supervisory Signal
 - 6) Sprinkler Valve Tamper Supervisory Signal
 - 7) Sprinkler Low Temperature / Air pressure supervisory signal
 - 8) Burglary/Intrusion/Duress/Other Security or Emergency Alarm

- 9) Fire Alarm System AC Power Trouble (loss of power for 1 hour or more).
 - c. Sprinkler and fire pump supervisory signals are permitted to be combined by the DACT for transmission. Coordinate with the fire marshal and the supervising station.
 - d. Signal precedence to the supervising station shall be per NFPA 72 and as defined below.
 - 1) Fire Alarm
 - 2) Carbon Monoxide Alarm
 - 3) Supervisory Signal
 - 4) Trouble Signal
 - 5) Security Alarm
 - e. The contractor must provide a DACT that is compatible with the supervising station. Coordinate with the supervising station prior to ordering and installing DACT. Contractor shall verify proper signal receipt with supervising station and ensure compliance with NFPA 72.
- C. Circuits:
- 1. Initiating Device Circuits (IDC): Class A.
 - 2. Signaling Line Circuits (SLC): Class A with no T taps.
 - 3. Notification Appliance Circuits (NAC): Class B.
 - 4. Voice Signal Circuits: Class B
- D. Spare Capacity:
- 1. Initiating Device Circuits: Minimum 25 percent spare capacity.
 - 2. Notification Appliance Circuits: Minimum 25 percent spare capacity.
 - 3. Speaker Amplifiers: Minimum 25 percent spare capacity.
 - 4. Master Control Unit: Capable of handling all circuits utilized to capacity without requiring additional components other than plug-in control modules.
- E. Power Sources:
- 1. Primary: Dedicated branch circuits of the facility power distribution system.
 - 2. Secondary: Storage batteries.
 - 3. Capacity: Sufficient to operate entire system for period 60 hours in standby with 15 minutes of full alarm at the end of the 60 hours..

2.3 FIRE SAFETY SYSTEMS INTERFACES

- A. Supervision: Provide supervisory signals in accordance with NFPA 72 for the following:
 - 1. Sprinkler water control valves.

2. Fire pump(s).
 3. Elevator shut-down control circuits.
- B. Alarm: Provide alarm initiation in accordance with NFPA 72 for the following:
1. Sprinkler water flow.
 2. Kitchen hood suppression activation; also disconnect fuel source from cooking equipment.
 3. Elevator lobby, elevator hoistway, and elevator machine room smoke detectors.
 4. Duct smoke detectors.
- C. Elevators:
1. Elevator lobby, hoistway, and machine room smoke detectors: Elevator recall for fire fighters' service.
 2. Elevator Machine Room Heat Detector: Shut down elevator power prior to hoistway sprinkler activation.
 3. Sprinkler pressure or waterflow: Shut down elevator power prior to hoistway sprinkler activation.
- D. HVAC:
1. Duct Smoke Detectors: Close dampers indicated; shut down air handlers indicated.
- E. Doors:
1. Smoke Barrier Door Magnetic Holders: Release upon activation of smoke detectors in smoke zone on either side of door, upon alarm from manual pull station on same floor, and upon sprinkler activation on same floor. Refer to Section 08 71 00. Door hold open magnets may release 60 seconds after loss of 120V power.
- F. Sprinkler System Monitoring
1. The following sprinkler system alarm and supervisory functions shall be provided as part of the fire alarm system:
 - a. Waterflow alarm, by sprinkler zone (not to exceed one floor).
 - b. Supervision of each control valve.
 - c. Supervision of air pressure, if used.
 - d. Supervision of fire pump.
 2. Sprinkler supervisory monitoring of flow switches, tamper switches, and similar functions shall be accomplished with a separate system address for each activity monitored.
 3. Contractor shall be responsible for reviewing the fire protection drawings and providing the quantity of tamper switches, flow switches, air pressure sensors, monitor and relay modules as required by the fire protection system design.
- G. Kitchen exhaust hood extinguishing systems
1. Installation shall comply with the current accepted edition of NFPA 72 for the type of system installed.

2. System shall be interconnected with fire alarm system as a separate system address.

2.4 COMPONENTS

A. General:

1. Provide flush mounted units where installed in finish areas; in unfinished areas, surface mounted unit are acceptable.
2. Provide legible, permanent labels for each control device, using identification used in operation and maintenance data.
3. Consult with facility manager and local fire official prior to locating Master Control Unit, remote annunciator, or system printer.
4. System Capacity and General Operation: The system shall have the following capacities and general operation modes:
 - a. The FACP shall provide, or be capable of expansion to 198 intelligent/addressable devices per Signaling Line Circuits (SLC) and 2000 annunciation points, minimum, per system. The number of SLCs provided shall be as indicated on the Drawings. Total points shall be as indicated on the drawings or otherwise specified.
 - b. The FACP shall include a full featured operator interface control and annunciation panel that shall include a backlit, 80 minimum character liquid crystal display, individual, color coded system status LEDs, and an alphanumeric keypad for the field programming and control of the fire alarm system.
 - c. All programming or editing of the existing program in the system shall be achieved without special equipment and without interrupting the alarm monitoring functions of the fire alarm control panel.

B. Fire Alarm Control Units, Initiating Devices, and Notification Appliances: Analog, addressable type; listed, classified, and labeled as suitable for the purpose intended.

C. Master Control Unit shall have the following features:

1. The system shall be addressable type, with 24vdc nominal operating voltage.
2. Upload/Download to PC Computer
3. Charger Rate Control
4. Drift Compensation
5. Automatic Day/Night Sensitivity Adjust
6. Device Blink Control
7. Pre-alarm Control Panel Indication
8. Trouble Reminder
9. NFPA 72 Smoke Detector Sensitivity Test
10. System Status Reports
11. Periodic Detector Test

12. Alarm Verification, by device, with tally
13. Non-Alarm Module Reporting
14. Block Acknowledge
15. Smoke Detector Maintenance Alert
16. Control-By-Time
17. The control panel shall be capable of printing historical data and device parameters and shall include all equipment necessary to produce printouts, including an external printer and shall be U.L. listed as meeting the NFPA 72 sensitivity testing and maintenance requirements without the need for manually removing and testing each smoke detector. The control panel shall provide a display and a printed list of these sensitivity measurements as a permanent record of the required sensitivity testing. The system shall also annunciate a trouble condition when any smoke detector approaches 80% of its alarm threshold due to gradual contamination, with an annunciation of the location of the smoke detector requiring service. If any specialized equipment must be used to program any function of the smoke detector devices, then one must be furnished as part of the system.
18. The system shall perform time based control functions including automatic changes of specified smoke detector sensitivity settings.
19. System shall provide as a feature an alternate signal processing algorithm to verify the presence of smoke. The algorithm shall be selectable during system programming. The total effective delay created by the verification algorithm shall not exceed 60 second.
20. Audible evacuation signals
 - a. Speakers shall be capable of generating a temporal three alarm as well as voice messages as required.
 - b. Panel shall operate in one of the three evacuation signal modes identified below:
 - 1) Automatic: System operates in its pre-programmed mode with temporal three alarm and pre-recorded message.
 - 2) Manual: System activates temporal three alarm and pre-recorded message based on manual activation at the main panel.
 - 3) Paging: The temporal three alarm will sound continuously until the microphone button at the main panel or remote annunciator is pressed for a live voice message. Once button is released the temporal 3 alarm will resume.
 - c. Provide zone selector switches so that any or all voice evacuation zones may be manually paged at a time.
 - d. At a minimum the voice alarm zone shall be as described below. Coordinate with local fire marshal for additional zone requirements.
 - 1) Each Individual Floor
 - 2) Each Stairwell
 - 3) Elevator Lobbies/Area of Rescue Assistance

4) Elevator Cabs

21. A hand-held push to talk microphone with minimum of 5 foot coiled extension cable. Microphone shall be recessed in the main fire alarm panel enclosure.
- D. Central Processing Unit: The Central Processing Unit (CPU) shall communicate with, monitor, and control all other modules within the control panel. Removal, disconnection or failure of any control panel module shall be detected and reported to the system display by the CPU.
1. The CPU shall contain and execute all control-by-event (including ANDing, ORing, NOTing, CROSSZONEing) programs for specific action to be taken if an alarm condition is detected by the system. Such control-by-event programs shall be held in non-volatile programmable memory, and shall not be lost with system primary and secondary power failure. The CPU shall also provide a real-time clock for time annotation of all system displays. The Time-of-Day and date shall not be lost if system primary and secondary power supplies fail.
 2. Digitized electronic signals shall employ check digits or multiple polling. In general a single ground or open on any system signaling line circuit or initiating device circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
 3. The CPU shall be capable of being programmed on site without requiring the use of any external programming equipment. Systems that require the use of external programmers or change of EPROMs are not acceptable.
 4. Loss of power: Alarm signals arriving at the main FACP shall not be lost following a power failure (or outage) until the alarm signal is processed and recorded.
 5. The system shall have multiple access levels so owner's authorized personnel can disable individual alarm inputs or normal system responses (outputs) for alarms, without changing the system's executive programming or affecting operation of the rest of the system. The process on how to do this must be included in the training required to be given to the owner's designated personnel, and must also be part of the written documentation provided by the fire alarm equipment supplier.
- E. System Response Conditions.
1. Alarm Condition - When a fire alarm condition is detected and reported by one of the system initiating devices, the following functions shall immediately occur:
 - a. The system alarm LED shall flash.
 - b. A local piezo-electric signal in the control panel shall sound.
 - c. LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location.
 - d. On systems equipped with a printer, printing and history storage shall log the information associated with each new fire alarm signal, along with the time and date of occurrence.
 - e. All system outputs assigned via control-by-event equations to be activated by a particular point shall be executed.
 - f. Activate all fire alarm Notification Appliances.
 - g. Activate IP digital alarm communicator.

- h. Deactivate all door hold control relays.
 - i. Activate control relays to initiate AHU shutdown.
 - j. In buildings with elevators, activate elevator recall sequence when elevator initiating device is activated.
2. Trouble or Supervisory Condition - When a trouble condition is detected the following stipulations apply:
- a. System AC power trouble shall not be sent unless maintained for 3 hours or more. Provide additional relays as required for this purpose.
 - b. Provide adjustable time delay for all other trouble signals prior to transmission.
 - c. Supervise all initiating, signaling, and notification circuits throughout the facility by way of monitor and control modules.
 - d. Visually and audibly annunciate any trouble, supervisory condition on operator's terminals, panel display, and annunciators.
- F. Operators Control: Provide an operators interface which allows the following minimum functions. In addition, the operators interface shall support any other functions required for system control and/or operation:
- 1. Acknowledge (ACK/STEP) Switch
 - 2. Signal Silence Switch
 - 3. Alarm Silence Switch
 - 4. System Reset Switch
 - 5. System Test Switch
 - 6. Lamp Test Switch
 - 7. Elevator Recall Override Switch.
 - 8. AHU Shutdown Override Switch.
- G. Display: The system display shall provide all the controls and indicators used by the system operator and may also be used to program all system operational parameters. The display assembly shall contain, and display as required, custom alphanumeric labels for all intelligent detectors, addressable modules, and software zones.
- 1. The system display shall provide an 80 minimum-character back-lit alphanumeric Liquid Crystal Display (LCD).
 - 2. The Display shall also provide four Light-Emitting-Diodes (LEDS), that will indicate the status of the following system parameters: AC POWER, SYSTEM ALARM, SYSTEM TROUBLE, and SIGNAL SILENCE.
 - 3. The system display shall provide a touch key-pad with control capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels shall be accessible through the display interface assembly to prevent unauthorized system control or programming.

- H. Printer: For systems exceeding 100 addressable points, 3 occupied floors in height, or 60,000 square feet, Provide a printer to provide hard-copy printout of all changes in status of the system. The printers shall time stamp such printouts with the current time-of-day and date. The printer shall be standard carriage with 80 characters per line and shall use standard pin-feed paper. Thermal printers are not acceptable. The printer shall operate from a 120V, 60 Hz power source. Provide a table and stand for printer in main data room.

- I. Remote Annunciators: Annunciator shall communicate with the fire alarm control panel via an EIA-485 communications loop (four-wire) and shall individually annunciate all zones in the system. System zones shall be as indicated on the Drawings. Up to 10 annunciators may be co.
 - 1. Annunciator shall be capable of initiating manual paging to override the pre-recorded message. Provide individual speaker zone selector switches so that the first responder may select some or all of the zones to manually page at a time.
 - 2. Annunciator Indicators: The annunciator shall provide a red Alarm LED per zone, and a yellow Trouble LED per zone. The annunciator shall also have an "ON-LINE" LED, local piezo sounder, local acknowledge/lamp test switch, and custom zone/function identification labels. Annunciator switches may be used for System control such as, Global Acknowledge, Global Signal Silence, Alarm Resound, and Global System Reset. All annunciator switches and indicators shall be software programmable.
 - 3. LCD Alphanumeric Display Annunciator: The Alphanumeric Display Annunciator shall be a supervised, remotely located back-lit LCD display containing a minimum of eighty (80) characters for alarm annunciation in clear English text. The LCD Annunciator shall display all alarms and trouble conditions in the system.
 - 4. System Capacity: The system shall allow a minimum of four LCD annunciators. In addition to annunciation functions, each LCD annunciator shall be capable of the following software programmed system functions: Acknowledge, Signal Silence, Alarm Resound, and Reset.
 - 5. Connections: The annunciator shall connect to a two-wire EIA-485 interface. The two-wire connection shall be capable operation at distances of 6,000 feet. Provide interface to fiber optic cable systems and/or repeater units where such are indicated on the Drawings.
 - 6. Annunciator shall be equipped with a hand-held push to talk microphone with minimum of 5 foot coiled extension cable. Microphone shall be recessed in the main fire alarm panel enclosure.

- J. Initiating Devices:
 - 1. Addressable Devices - General: All initiating devices shall be individually addressable. Addressable devices shall comply with the following requirements:
 - a. All addressable spot type and duct smoke detectors shall be the analog type and the alarm system shall automatically compensate for detector sensitivity changes due to ambient conditions and dust build-up within detectors. This feature must be armed and sensitivities set prior to acceptance of the system.
 - b. Address Setting: Addressable devices shall provide an address-setting means.
 - c. Connections: Addressable devices shall be connected to a Signaling Line Circuit (SLC) with two (2) wires.
 - d. Operational Indications: Addressable initiation devices shall provide dual alarm and power LEDs. Both LEDs shall flash under normal conditions, indicating that the device is operational and in regular communication with the control panel. Both LEDs shall be placed into steady illumination by the FACP to indicate that an alarm condition has been detected. The flashing mode operation of

the detector LEDs shall be optional through the system field program. An output connection shall also be provided in the device base to connect an external remote alarm LED.

- e. Intelligent Initiation Devices: All smoke detectors shall be the "intelligent" in that smoke detector sensitivity shall be set through the FACP and shall be adjustable in the field through the field programming of the system. Sensitivity shall be capable of being automatically adjusted by the FACP on a time-of-day basis. Using software in the FACP, detectors shall be capable of automatically compensating for dust accumulation and other slow environmental changes that may affect performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72.
 - f. Spot-type detectors must be the plug-in type, with a separate base (not a mounting ring), to facilitate their replacement and maintenance. The base shall have integral terminal strips for circuit connections, rather than wire pigtails. Each detector or detector base shall incorporate an LED to indicate alarm.
2. Smoke Detectors General Requirements:
- a. Spot-type detectors must be the plug-in type, with a separate base (not a mounting ring), to facilitate their replacement and maintenance. The base shall have integral terminal strips for circuit connections, rather than wire pigtails. Each detector or detector base shall incorporate an LED to indicate alarm.
 - b. Device mounting Base: Unless otherwise specified all detectors shall be ceiling-mount and shall include a separate twist-lock base with locking tamper proof feature.
 - c. Sounder Base: Where indicated on plans provide bases with a built-in (local) sounder rated at 85 dBA minimum, measured at 10 ft. Configure sounder bases such that sounders are activated under conditions as described in the Matrix.
 - d. Test Means: The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel when in the "test" condition.
 - e. Device Identification: Detectors shall store an internal identifying type code that the control panel shall use to identify the type of device. Device identifications shall be either ION, PHOTO, or THERMAL.
 - f. Photoelectric Smoke Detectors: Photoelectric smoke detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.
 - g. Ionization Smoke Detector: Ionization smoke detectors shall use the dual-chamber ionization principal to measure products of combustion and shall, on command from the control panel, send data to the panel representing the analog level of products of combustion.
3. Thermal Detectors: Thermal Detectors shall be intelligent addressable devices rated at 135°F (58°C) and shall have a rate-of-rise element rated at 15° F. (9.4°C) per minute. It shall connect via two wires to the Fire Alarm Control Panel Signaling Line Circuit. Up to 99 intelligent heat detectors may connect to one SLC loop. Thermal detectors shall use an electronic sensor to measure thermal conditions caused by a fire and shall, on command from the control panel, send data to the panel representing the analog level of such thermal measurements.

4. Duct Smoke Detector: In-Duct Smoke Detector Housings shall accommodate a velocity rated photoelectric detector. The device, independent of the type used, shall provide continuous analog monitoring and alarm verification from the panel. When sufficient smoke is sensed, an alarm signal shall be initiated at the FACP. Proper installation and physical location of each duct detector and access door shall be coordinated between the electrical, the mechanical and the fire alarm sub-contractors and approved by the electrical and mechanical engineers prior to equipment installation.
 - a. Each Duct detector shall have a hinged duct access panel, 12 x 12 inches minimum for sampling tube inspection and cleaning. Indicate airflow direction on the duct adjacent to detector using permanent decal.
 - b. Duct detector sampling tubes shall extend the full width of the duct. Sampling tubes over 36 inches long must be provided with far end support for stability. Install sampling tube per manufacturer's instructions.
 - c. All duct detectors shall be programmed for alarm.
 5. Remote annunciator Indicator Lights (RAIL): RAILS shall be provided for initiating devices where indicated on the plans. RAILS shall be provided with a key type switch for testing of the annunciated device. All RAILS shall be 24 VDC.
 6. Addressable Pull Stations - General: Addressable pull stations shall, on command from the Control Panel, send data to the panel representing the state of the manual switch. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key. All pull stations shall be dual-action, have a positive, visual indication of operation and utilize a key type reset. The Glass-break rods are not allowed.
- K. Notification Appliances:
1. Speakers: Speakers located outdoors or in damp or wet locations shall be listed for use in wet locations. Electric speakers shall operate with synchronized audible output and have the following specifications: .
 - a. Voltage: Programmable electronic speakers shall operate on dual voltage 24/70 VRMS nominal.
 - b. Ceiling speakers: 8" round, field selectable taps 1/8 to 8 watts.
 - c. Ceiling speaker/strobes: 8" round, field selectable taps 1/8 to 8 watts, field selectable candela settings 15-177 CD
 - d. Cluster speakers/strobe: equal to Cooper Wheelock Series STH or equal.
 - e. Wall Mounted Speakers: Selectable taps 1/8 to 8 watts, frequency response 400-4000Hz and low current design, when used in exterior application provide as weatherproof.
 - f. Speakers shall be tapped to meet intelligibility criteria meeting average DB requirements of 15DB above ambient for each space. The adjustments shall also meet the Acoustically Distinguished Space (ADS) measurement STI/CIS range (good-excellent).
 2. Strobes: shall be located as shown on the Drawings and provided per the requirements of the NCSBC chapter #11 and ICC A117.1-2009. Strobe lights indicated for use exterior to the building shall be mounted at the indicated elevation and listed for use in wet locations. Strobe lights shall operate with synchronized flash output and have the following specifications:

- a. Voltage: Strobe lights shall operate on 24 VDC nominal.
 - b. Maximum pulse duration: 2/10ths of one second.
 - c. Strobe intensity and flash rate: Must meet minimum requirements of UL 1971. Provide strobe lights with minimum intensity Candela (Cd) rating of 15/75 Cd, or greater if shown otherwise on drawings.
3. Audible/Visual Combination Devices shall comply with all applicable requirements for both Programmable Electronic Sounders and Strobe Lights.

L. Miscellaneous System Items

1. Addressable Dry Contact Monitor Module: Addressable Monitor Modules shall be provided to connect one supervised zone of non-addressable Alarm Initiating Devices (any Normally Open [N.O.] dry contact device) to one of the Fire Alarm Control Panel Signaling Line Circuit Loops. Monitor modules shall be installed as required by the system configuration. All required monitor modules may not be shown on the Drawings.
 - a. Indication of Operation: An LED shall be provided that shall flash under normal conditions, indicating that the Monitor Module is operational and in regular communication with the control panel.
 - b. Supervision: Unless specifically noted otherwise on the drawings provide one monitor module for each sprinkler switch.
2. Two Wire Detector Monitor Module: Addressable Monitor Modules shall be provided to connect one supervised IDC zone, Class A or alarm initiating devices (any N.O. dry contact device) to one of the Fire Alarm Control Panel Signaling Line Circuit Loops. Monitor modules shall be installed as required by the system configuration. All required monitor modules may not be shown on the Drawings. Indication of Operation: Unless otherwise indicated on the Drawings an LED shall be provided that shall flash under normal conditions, indicating that the Monitor Module is operational and in regular communication with the control panel.
3. Addressable Control Module: Addressable Control Modules shall be provided to supervise and control the operation of one conventional Notification Appliance Circuit (NAC) of compatible, 24 VDC powered, polarized Audio/Visual (A/V) Notification Appliances. For fan shutdown and other auxiliary control functions, the control module may be set to operate as a dry contract relay. The control module shall provide address-setting means using DIP switches and shall also store an internal identifying code that the control panel shall use to identify the type of device. An LED shall be provided that shall flash under normal conditions, indicating that the control module is operational and is in regular communication with the control panel.
 - a. Configuration: The control module NAC circuit may be wired for Class B with up to 1 Amp of inductive A/V signal, or 2 Amps of resistive A/V signal operation, or as a dry contact (Form C) relay. The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.
 - b. Power Source: Audio/visual power shall be provided by a separate supervised power loop from the main fire alarm control panel or from a supervised, 3rd party listed remote power supply. AN power sources and connections are not shown on the Drawings

- c. Test Switch: A magnetic test switch shall be provided to test the module without opening or shorting its NAC wiring.
4. Isolator Module: Isolator Modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC loop. The Isolator Module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC Loop. Modules must be readily accessible (not above ceiling) and clearly labeled.
- a. Operation: Isolator Modules shall operate such that if a wire-to-wire short occurs, the Isolator module shall automatically open-circuit (disconnect) the SLC loop. When the short circuit condition is corrected, the Isolator Module shall automatically reconnect the isolated section. The Isolator Module shall not require any address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an Isolator Module after its normal operation.
 - b. The Isolator Modules shall provide a single LED that shall flash to indicate that the Isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.
 - c. Isolation modules must be provided in the following locations as a minimum.
 - 1) Immediately adjacent to the Main Fire Alarm Control Unit, at each end of the addressable loop. These two isolators must be within 15 feet of the Main Fire Alarm Control Unit.
 - 2) After each 20 initiating devices and control points on the addressable loop.
 - 3) For loops with 20 or less control points install isolation module in approximately the middle of the loop.
 - 4) Near the point where any addressable loop extends outside the building envelope.
 - 5) For loops covering more than one floor where addressable loop crosses between floors.
 - d. Each isolation module must be clearly labeled, readily accessible for convenient inspection.
5. Water Flow Switch: Flow switches shall be integral, mechanical, non-coded, non-accumulative retard type. Flow switches shall have an alarm transmission delay time that is conveniently adjustable from 0 to 60 seconds. Initial settings shall be 30-45 seconds. Flow switches shall be located a minimum of one (1) foot from a fitting that changes the direction of the flow and a minimum of three (3) feet from a valve as required per NFPA 13. Installation: Water Flow Switches shall be connected by the Division 26 (Electrical) Contractor but furnished and installed by the Division 23 (Mechanical) Contractor.
6. Sprinkler and Standpipe Valve Supervisory Switch: Supervisory switch mechanisms shall be contained in a weatherproof housing that shall provide a 3/4 inch tapped conduit entrance and shall incorporate the necessary facilities for attachment to the valves. Switch housing shall be finished in red baked enamel. Mounting: Mount switch so as not to interfere with the normal operation of the valve and adjust to operate within two revolutions toward the closed position of the valve control, or when the stem has moved no more than one-fifth of the distance from its normal position.
7. Remote Annunciator Indicator Lights (RAIL): RAILs shall be provided with a key type switch for testing of the annunciated device. In addition, RAILs shall have the following features: Voltage: RAILs shall operate on 24 VDC nominal.
8. Door Hold-Open magnets:
- a. Door hold open magnets shall be suitable for mounting in a single gang electrical device box.

- b. Door hold open magnets shall be furnished with keepers, door chains, and other accessories as required to properly hold open doors as indicated on the Drawings.
 - c. Wall mounted magnetic door holders and separate heavy duty closers shall be used instead of combination door control units.
 - d. Holding force of the magnet shall be appropriate for the door to be held open. Door hold open magnets shall operate in a fail safe manner, i.e., the door shall release in event of a failure of voltage to the device.
 - e. Power Source: Door hold open magnets shall be configured to operate from a nominal 24 VDC system as supplied by the FACP or other power supply listed for the purpose.
 - f. All hold open magnet supply sources, whether a part of the FACP or whether derived from a separate power supply, shall be supervised.
 - g. Door hold open magnet circuits which use step-down transformers, 120 VAC, or local relays are not permitted.
 - h. Door shall close after 60 seconds of the power loss.
9. Battery Power Supply (BPS) &/or Supplementary Notification Appliance Circuit (SNAC): These types of panels shall be completely maintenance free, shall not require liquids, fluid level checks or refilling, and shall not be capable of producing spills and/or leaks. Batteries shall be sealed gel-cell type with expected life of 10 years. Battery voltage shall be as required by the FACP and related equipment. Battery shall have sufficient capacity to power the fire alarm system for not less than 60 hours plus 15 minutes of alarm upon a normal AC power failure. Battery cabinet shall be twice the size of the batteries it will contain. NAC circuits shall not exceed 75% of maximum current load allowed.
- a. The voltage drop at EOL must not exceed 14% of the expected battery voltage after the required standby and alarm times. Determine worst case voltage at far end of each NAC circuit. The results must not be than the minimum listed rating on the device.
 - b. Where voltage drop or capacity limits are exceeded provide additional NAC panels as required for a fully functional system.
 - c. All power supplies shall be capable of withstanding prolonged short circuits in the field wiring, either line-to-line or line-to-ground, without damage.
 - d. All power supplies shall be equipped with battery charging using dual-rate charging techniques for fast battery recharge.
10. Voice Amplifier Cabinets
- a. Provide voice amplifier cabinets as identified on plans and as need to support the number of devices shown on the drawings. All amplifier cabinets shall be UL listed to operate with the system provided. Amplifier cabinets shall work in conjunction with the NAC panels and control panels to form a complete system.
 - b. Provide a minimum of 25% spare amplifier capacity for future growth.
11. Enclosure: All equipment enclosures shall be third party listed suitable for surface or semi-flush mounting. Cabinet and front shall be corrosion resistant, given a rust-resistant prime coat, and manufacturer's standard finish. The door shall provide a key lock and a glass opening for viewing indicators. Door hinge shall be field selectable (left or right).

M. Wiring

1. Addressable loop (signaling line) circuits shall be wired with type FPL/FPLR/FPLP fire alarm cable, AWG 18 minimum, low capacitance, twisted shielded copper pair. Cable shield drain wires are to be connected at each device on the loop to maintain continuity, taped to insulate from ground, and terminated at the FACP. Acceptable cables include Atlas 228-18-1-1STP, BSCC S1802s19 (same as EEC 7806LC), West Penn D975, D991 (AWG 16), D995 (AWG 14), or equal wire having capacitance of 30pf/ft. maximum between conductors. Belden 5320FJ acceptable if only FPL rating needed.
 - a. Unshielded cable, otherwise equal to the above, is permitted to be used if the manufacturer's installation manual requires, or states preference for, unshielded cable.
 - b. In underground conduit, use Type TC or PLTC cable (PE insulated) to avoid problems from moisture.
 - c. The following conductor color coding shall be maintained throughout the system:
 - 1) Initiating Circuits: Red (+)/White (-)
 - 2) Initiating Circuits, Smoke Only: Violet (+)/Grey (-)
 - 3) Signal Line Circuits: Red jacket with Red (+)/Black(-)
 - 4) Alarm Indicating Appliance Circuits: Blue (+)/Black(-)
 - 5) AHU Shutdown Circuits: Yellow (+)/Brown (-)
 - 6) Door Control Circuits: Orange
 - 7) Elevator Capture Circuits: Brown
2. All voice signal cabling shall be a minimum of #18 AWG twisted shielded pair cable. The shield shall be continuously connected from the amplifiers to the end of line.
3. Supervision must be provided between individual addressable modules and their associated contact type initiating devices.

N. Surge Protection: In accordance with IEEE C62.41.2 category B combination waveform and NFPA 70; except for optical fiber conductors.

1. For each AC power circuit that interfaces with fire alarm equipment install an AC suppressor in a listed enclosure near the electrical panelboard, and trim excess lead lengths. Wind small coil in the branch circuit conductor just downstream of the suppressor connection. Coil to be 5 to 10 turns, about 1" diameter, and securely tie-wrapped. This series impedance will improve the effectiveness of the suppressor in clipping fast rise time voltage transients.
2. Equipment Connected to Alternating Current Circuits: Maximum let through voltage of 350 V(ac), line-to-neutral, and 350 V(ac), line-to-line; do not use fuses.
3. Initiating Device Circuits, Notification Appliance Circuits, and Communications Circuits: Provide surge protection at each point where circuit exits or enters a building; rated to protect applicable equipment; for 24 V(dc) maximum dc clamping voltage of 36 V(dc), line-to-ground, and 72 V(dc), line-to-line.
4. On DC circuits extending outside the building: Provide surge protection at each point where circuit exits or enters a building, rated to protect applicable equipment.

- D. All system components shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load. Adhesives are not permitted to mount fire alarm system components to building surfaces or structure.
- E. The system shall be electrically supervised for open or ground fault conditions in SLC, alarm, voice, and control circuits. Removal of any detection device, alarm appliance, plug-in relay, system module, or standby battery connection shall also result in a trouble signal.
- F. When programming the system, activate the automatic drift compensation feature for all spot- type smoke detectors. Systems with alarm verification are not to have this feature activated without written direction from the owner's representative or the AHJ. Alarm verification must not be used with multi-sensor/multi-criteria detectors under any circumstances, as inadequate system response may result. Most applications of analog addressable smoke detectors do not require alarm verification to reduce nuisance alarms, as they are better able to discriminate between fire and common non-fire ambient events. A short operational test with normal occupancy can determine if transient ambient events are a problem
- G. Provide photoelectric smoke detector within 15 feet of every Fire Alarm Control Panel, NAC Panel or other fire alarm control equipment. These detectors shall be provided weather shown on plans or not.
- H. Set spot-type smoke detector sensitivities to normal/medium, unless directed otherwise by the design engineer/owner's rep. High sensitivity may be appropriate in relatively benign, clean environments such as art museums and libraries, to improve system response time without causing nuisance alarms.
- I. Unless suitably protected against dust and other debris, spot type smoke detectors shall not be installed until final construction clean-up has been completed. In the even that detectors are damaged during construction due to failure to adequately protect devices, they shall be replaced by the contractor at no expense to the owner.
- J. Print a complete System Status and Programming Report after the above steps have been done. This must include the program settings for each alarm initiating device and the current sensitivity of each analog addressable smoke detector.
- K. Install instruction cards and labels.
- L. Basic operating instructions shall be framed and permanently mounted at the Main Control Unit. The NFPA 72 record of completion must either be kept at the Main Control Unit or an alternate location may be permanently engraved at the Main Control Unit.
- M. Provide engraved label at the Main Control Unit and secondary power supplies identifying the 120V power source including panelboard location, panelboard identifier, and branch circuit number.
- N. Breaker serving fire alarm power supplies shall be protected with a fire alarm handle lock, Space Age Electronics ELOCK series or approved equal. Additionally the breaker handle shall be labeled with 1/4" permanent red dot.
- O. Identification of individual initiating devices is required. Assign each initiating device a unique number as follows, sequence starting from the FACP: (Addressable Loop # -- Device #). Show device numbers on as built plans and permanently mark each detector base so that it is readable on the floor below without having to remove detector. Labels must be typewritten with black lettering and clear background.

3.2 CONDUIT AND WIRING

- A. All fire alarm system wiring shall be in metal conduit, minimum 3/4", or surface metal raceway. All fire alarm system raceway, couplers, and connectors must meet performance and installation requirements as identified
-

in other sections of this specification manual.

- B. Detection or alarm circuits must not be included in raceways containing AC power or AC control wiring. Within the Fire Alarm Control Panels, and 120V control wiring or other circuits must with an externally supplied voltage above 24 V must be properly separated from other circuits and have the appropriate warning label to alert service personnel to the potential hazard.
- C. There shall be no splices in the system other than at device terminal blocks, or on terminal blocks in cabinets.
- D. Permanent wire markers shall be used to identify all connections in the Main Fire Alarm Control Unit and other control equipment, at power supplies and terminal cabinets.
- E. In multistory buildings, all circuits leaving the riser on each floor shall feed through a labeled terminal block in a hinged enclosure accessible from the floor.
- F. All wiring terminal block screws shall have pressure wire connectors of the self-lifting or box lug type.
- G. All wiring shall be checked for grounds, opens, and shorts, prior to termination at panels and installation of detector heads. The minimum allowed resistance to ground between any two conductors shall be 10 megohms, as verified with an insulation resistance test. Provide Engineer with the results of these tests.
- H. The exterior of all junction boxes, including both sides of covers, containing fire alarm conductors shall be painted red. Box interior shall not be painted.
- I. Box covers shall be labeled to indicate the circuit(s) or function of the conductors contained within. Labels shall be neatly applied black lettering on clear background. Handwritten labels or embossed tape labels are not allowed.
- J. All conduits penetrating exterior walls must have internal sealing to prevent condensation from infiltrating humid air.

3.3 INSPECTION AND TESTING FOR COMPLETION

- A. Notify Owner 7 days prior to beginning completion inspections and tests.
- B. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.
- C. Provide the services of the installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction, and adjustments.
- D. Prepare for testing by ensuring that all work is complete and correct; perform preliminary tests as required.
- E. Provide all tools, software, and supplies required to accomplish inspection and testing.
- F. Upon completion of the installation the Contractor and the Manufacturer's authorized installer together shall conduct a 100% performance test of each and every alarm initiating device for proper response. The system shall operate for 48 hours prior to start of test. The Contractor shall be present for the full 100% test.
- G. The A/E and owner must be given 7 days advance notice of the tests. All Audio Visual Device Testing shall be scheduled with the owner.
- H. 100% Test: The manufacturer or authorized distributor (by definition, "installer") must 100% test all site-specific software functions for the system and then provide a detailed report or check list showing the system's operational matrix. This documentation must be part of the "System Status and Programming Report".

1. Upon completion of the installation and its programming, the installer's technician shall test every alarm initiating device for proper response and indication, and all alarm notification appliances for effectiveness. Also, in coordination with the other building system contractors, all other system functions shall be verified, including (where applicable) elevator capture and the control of HVAC systems, door locks, pressurization fans, fire or smoke doors/dampers/shutters, etc. The engineer must be notified in advance of these 100% tests, to permit witnessing them if desired.
 2. If AHU shutdown occurs for any alarm, then the matrix would indicate the specific control relay(s) for that function being commanded to operate for alarm from any initiating device. If a rolling steel fire door is to drop only upon waterflow alarm from its sprinkler zone, or upon any two spot smoke detectors in adjacent spaces being simultaneously in alarm, the matrix would show the door's control relay activating upon alarm from the applicable waterflow switch(es), or from any two smoke detectors in the selected spaces (AND gate).
 3. The digital communicator shall be on-line and tested for proper communication to the receiving station.
 4. All supervised circuits must also be tested to verify proper supervision. (Control circuits and remote annunciation lines are among those required to be supervised.)
 5. All testing described above shall be repeated in the event that subsequent software or wiring modifications are determined necessary to meet the requirements of the contract documents. Such re-testing shall be included as part of the base bid and provided at no additional cost to the Owner.
- I. Test Documentation: The installer must fill out and submit the following documentation to the owner, through the engineer, prior to the AHJ's system acceptance inspection:
1. Written verification that this 100% system test was done with copy of print out generated during test.
 2. The NFPA 72, "Record of Completion" Form. Use this form (no substitutes) to detail the system installation and also to certify that: (a.) It was done per Code, and (b.) The Code- required 100% test was performed. The fire alarm installer (manufacturer or authorized distributor's technician) must sign this form. If a representative of the AHJ, owner, or engineer witnesses the tests, in whole or in part, they must also sign the form to signify that fact only (annotating the form as needed to clarify their limited role).
 3. For buildings with a smoke control or smoke purge system, an HVAC balance report, in the smoke control / smoke purge mode.
 4. The System Status and Programming Report described in NFPA 72. This must be generated on the day of the system acceptance inspection and shall include the measured sensitivity of each smoke detector.
 5. The purpose of doing Item above on the day of the inspection is to assure detector sensitivity has not been affected by construction dust. Prudent contractors will have taken measures to prevent detector contamination during construction, and will also have had the system do a detector sensitivity test and printout prior to the day of the inspection, to make certain all devices are properly programmed and operating within their limits.
- J. After completion of the 100% system test and submission of documentation as described above the installer is to request the engineer to set up an inspection. The system must operate for at least two days prior to this inspection. The responding Fire Department shall be notified of this, for pre-fire planning purposes. On local government projects, local fire authorities may also want to participate in system acceptance inspections. However, for State-owned property they have no inspection jurisdiction and, if present, are only to observe.
- K. PRE-FINAL INSPECTION: At the Owner's request and after passing the Designer's pre-final inspection, the Contractor and Manufacturer's authorized installer will conduct system test in the presence of the Owner and

the Designer.

- L. FINAL INSPECTION: The fire alarm system will be inspected, with portions of it functionally tested. This will normally include the use of appropriate means to simulate smoke for testing detectors, as well as functionally testing the system interface with building controls, fire extinguishing systems and any off-premises supervising station. Operation of any smoke removal system will be checked as instructed by the AHJ. This statistical (sampling) inspection is intended to assure that the contractor has properly installed the system and performed the 100% operational test as required by NFPA 72. The electrical contractor shall provide two-way radios, ladders, and any other materials needed for testing the system, including a suitable smoke source.
 - 1. Smoke control and smoke management systems are normally tested by measuring air flow rates and pressure differentials, plus observing any effect the system has on the operation of exit, elevator, and stairway doors. Testing with smoke "bombs" (smoke candles) is NOT appropriate because they produce cold chemical smoke that lacks buoyancy and, therefore, does not rise like the smoke from a fire.
 - 2. The test will be conducted entirely by the Contractor. A copy of the final database software must be presented to the Owner before this test. The software shall be loaded from these disks into the system in the presence of the Owner. The review will then be conducted using this software. Any deficiencies shall be recorded and corrected. After the items have been corrected, the system shall be tested again.
 - a. In the event of malfunctions or excessive nuisance alarms, the Contractor must take prompt corrective action. The Owner may require a repeat of the Contractor's 100% system test, or other inspections.
 - b. Test Report: Upon successful completion of the Inspection and after the correction of all efficiencies, the manufacturer's authorized representative shall issue a test report to the Engineer and Owner, detailing and certifying the test.
 - c. System Acceptance: After successful completion of the Final Inspection and recommendation of the Engineer, the system will be accepted by the Owner. At this time the warranty period begins.

3.4 OWNER PERSONNEL INSTRUCTION

- A. Provide the following instruction to designated Owner personnel:
 - 1. Hands-On Instruction: On-site, using operational system.
 - 2. Classroom Instruction: Owner furnished classroom, on-site or at other local facility.
- B. Maintenance Technicians: Detailed training for electrical technicians, on programming, maintaining, repairing, and modifying; factory training:
 - 1. Initial Training: Minimum of 8 hours of instruction, pre-closeout.
 - a. Training shall cover at a minimum the following:
 - 1) Preventative maintenance service techniques and schedules, including historical data trending of alarm and trouble records.
 - 2) Overall system concepts, capabilities, and functions. Training shall be in depth, so that owner shall be able to take any device out of service and return any device to service without the need of manufacturer's approval or assistance.
 - 3) Explanation of all control functions, including training to program and operate the software.

- 4) Methods and means of troubleshooting and replacement of all field wired devices.
 - 5) Methods and procedures for trouble shooting the main fire alarm control panel, including field peripheral devices as to programming, bussing systems, internal panel and unit wiring, circuitry, and interconnections.
 - 6) Manuals, drawings, and technical documentation. Actual system software used for training shall be provided in digital form and shall be left with the Owner at the completion of the training for the Owner's use in the future.
- C. Furnish the services of instructors and teaching aids; have copies of operation and maintenance data available during instruction.
- D. Provide two copies of bound training summary to be referenced by owner's maintenance staff in the future.

3.5 CLOSEOUT

- A. Closeout Demonstration: Demonstrate proper operation of all functions to Owner.
1. Be prepared to conduct any of the required tests.
 2. Have at least one copy of operation and maintenance data, preliminary copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
 3. Have authorized technical representative of control unit manufacturer present during demonstration.
 4. Demonstration may be combined with inspection and testing required by authority having jurisdiction; notify authority having jurisdiction in time to schedule demonstration.
 5. Repeat demonstration until successful.
- B. Occupancy of the project will not occur prior to Project Acceptance.
- C. Project Acceptance of the project cannot be achieved until inspection and testing is successful and:
1. Approved operating and maintenance data has been delivered.
 2. Spare parts, extra materials, and tools have been delivered.
 3. All aspects of operation have been demonstrated to Owner.
 4. Final acceptance of the fire alarm system has been given by authorities having jurisdiction.
 5. Occupancy permit has been granted.
 6. Specified pre-closeout instruction is complete.

3.6 MAINTENANCE

- A. Perform routine inspection, testing, and preventive maintenance required by NFPA 72, including:
1. Maintenance of fire safety interface and supervisory devices connected to fire alarm system.
 2. Repairs required, unless due to improper use, accidents, or negligence beyond the control of the maintenance contractor.

SECTION 28 46 01 - FIRE DETECTION AND ALARM - VOICE EVACUATION

3. Record keeping required by NFPA 72 and authorities having jurisdiction.
- B. The manufacturer must maintain software version records on the system installed. The system software shall be upgraded free of charge if a new version is released during the warranty period.
- C. Provide trouble call-back service upon notification by Owner:
 1. Provide on-site response within 2 hours of notification.
 2. Include allowance for call-back service during normal working hours at no extra cost to Owner.
 3. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.
- D. Provide a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.
- E. Maintain a log at each fire alarm control unit, listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced. Submit duplicate of each log entry to Owner's representative upon completion of site visit.
- F. Comply with Owner's requirements for access to facility and security.

END OF SECTION 28 46 01

**DIVISION 31
EARTHWORK**

SECTION 31 10 00 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Standards set forth by the North Carolina Department of Environmental Quality (NCDEQ) Division of Energy, Mineral and Land Resources.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Removal of trees and other vegetation.
 - 2. Clearing and grubbing.
 - 3. Removing above-grade improvements.
 - 4. Removing below-grade improvements.
- B. Related Sections:
 - 1. Division 31 Section "Earth Moving".
 - 2. Division 31 Section "Erosion Controls".

1.3 PROJECT CONDITIONS

- A. Traffic: Conduct site-clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks, or other occupied or used facilities without permission from authorities having jurisdiction.
- B. Protection of Existing Improvements: Provide protections necessary to prevent damage to existing improvements indicated to remain in place.
 - 1. Protect improvements on adjoining properties and on Owner's property.
 - 2. Restore damaged improvements to their original condition, as acceptable to property owners.
 - 3. All erosion control measures shall be in place prior to commencement of clearing operations.
- C. Protection of Existing Trees and Vegetation: Protect existing trees and other vegetation indicated to remain in place against unnecessary cutting, breaking or skinning of roots, skinning or bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary guards to protect trees and vegetation to be left standing.
 - 1. Water trees and other vegetation to remain within limits of contract work as required to maintain their health during course of construction operations.
 - 2. Provide protection for roots over 1-1/2 inch (38 mm) in diameter that are cut during construction operations. Coat cut faces with an emulsified asphalt or other acceptable coating formulated to use on damaged plant tissues. Temporarily cover exposed roots with wet burlap to prevent roots from drying out; cover with earth as soon as possible.
 - 3. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations in a manner acceptable to Engineer. Employ a licensed arborist to repair damage to trees and shrubs.
 - 4. Replace trees that cannot be repaired and restored to full-growth status, as determined by arborist.
- D. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated or directed.

1.4 EXISTING SERVICES

- A. General: Indicated locations are approximate; determine exact locations before commencing Work.

- B. Arrange and pay for disconnecting, removing, capping, and plugging utility services. Notify affected utility companies in advance and obtain approval before starting this Work.
- C. Place markers to indicate location of disconnected services. Identify service lines and capping locations on Project Record Documents.

1.5 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

PART 2 – PRODUCTS

None Used.

PART 3 – EXECUTION

3.1 SITE CLEARING

- A. General: Remove trees, shrubs, grass, and other vegetation, improvements, or obstructions, as required, to permit installation of new construction. Remove similar items elsewhere on site or premises as specifically indicated. Removal includes digging out and off-site removal of stumps and roots.
 - 1. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
 - 2. Existing trees within clearing limits may be chipped and stockpiled on-site but shall NOT be used as landscaping mulch or fill.
- B. Clearing and Grubbing: Clear site of trees, shrubs, and other vegetation, except for those indicated to be left standing.
 - 1. Completely remove stumps, roots, and other debris protruding through ground surface.
 - 2. Use only hand methods for grubbing inside drip line of trees indicated to remain.
 - 3. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.
 - a. Place fill material in horizontal layers not exceeding 6 inches (150 mm) loose depth, and thoroughly compact each layer to a density equal to adjacent original ground.
- C. Topsoil Stripping: Strip and stockpile existing topsoil within construction limits for re-spreading. Should the Contractor elect to remove topsoil from the site, suitable topsoil from off-site sources shall be provided for re-spreading at no cost to the Owner.
 - 1. Remove sod and grass before stripping topsoil.
 - 2. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials. All surface topsoil, regardless of thickness encountered, shall not be considered Unsuitable Soil.
 - 3. Remove subsoil and non-soil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.
 - 4. Stockpile topsoil materials within construction limits and away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 5. Do not stockpile topsoil within tree protection zones.
 - 6. Dispose of excess topsoil off-site.
- D. Removal of Improvements: Remove existing above-grade and below-grade improvements as indicated and as necessary to facilitate new construction.
 - 1. Abandonment or removal of certain underground pipe or conduits may be indicated on mechanical or electrical drawings and is included under work of related Division 22 Sections. Removing abandoned underground piping or conduits interfering with construction is included under this section.

3.2 DEMOLITION PREPARATION

- A. Conduct demolition operations and remove debris to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations or as shown on the drawings.
- B. Conduct demolition operations to prevent injury to people and damage to adjacent buildings and facilities to remain. Ensure safe passage of people around selective site demolition area.
 - 1. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction or as shown on the plans.
 - 2. Protect existing site improvements, appurtenances, and landscaping to remain.
 - 3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
 - 4. Provide temporary weather protection, during interval between demolition and removal of existing construction, on exterior surfaces and new construction to ensure that no water leakage or damage occurs to structure or interior areas.
- C. Provide and maintain exterior shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of building to be selectively demolished.
 - 1. Strengthen or add new supports when required during progress of selective demolition.
- D. Protect trees, fences, poles, mailboxes, and all other property unless their removal is authorized. Any property damaged, that is not authorized for removal, shall be restored or replaced to the Owner's satisfaction.

3.3 UTILITY SERVICES

- A. Maintain existing utilities indicated to remain in service and protect them against damage during selective site demolition operations.
 - 1. Do not interrupt existing utilities serving occupied or operating facilities, except when authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to governing authorities.
 - a. Provide not less than 72 hours' notice to Owner if shutdown of service is required during changeover.
- B. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services serving building to be selectively demolished.
 - 1. Arrange to shut off indicated utilities with utility companies.
 - 2. Where utility services are required to be removed, relocated, or abandoned, provide bypass connections to maintain continuity of service to other parts of the building before proceeding with selective demolition.
- C. Utility Requirements: Refer also to Division 21, 22, 23 and 26 Sections for additional requirements for shutting off, disconnecting, removing, and sealing or capping utility services. Do not start selective site demolition work until utility disconnecting and sealing have been completed and verified in writing.
- D. Utility Adjustments and Relocations: Adjust locations, elevations and routes of existing utility lines, poles, guys, vaults, handholes, boxes, and other related appurtenances as required to facilitate new construction. Coordinate adjustments and relocations with utility companies.

3.4 POLLUTION CONTROLS

- A. Use water mist, temporary enclosures, and other suitable methods to limit the spread of dust and dirt. Comply with governing environmental protection regulations.

1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
- B. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- C. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective site demolition operations. Return adjacent areas to condition existing before start of selective demolition.

3.5 SELECTIVE SITE DEMOLITION

- A. Demolish and remove existing construction only to the extent required by new construction and as indicated on the drawings. Use methods required to complete Work within limitations of governing regulations.
 1. Dispose of demolished items and materials promptly. On-site storage or sale of removed items is prohibited.
 2. Return elements of construction and surfaces to remain to condition existing before start of selective demolition operations.
 3. Comply with all applicable regulations during demolition, handling and disposal of all items indicated to be removed or necessary to be removed to allow construction of new work.
- B. Demolish asphalt, concrete and masonry in small sections. Cut concrete and masonry at junctures with construction to remain, using power-driven masonry saw or hand tools; do not use power-driven impact tools.
- C. Remove sawcut concrete and asphalt, including aggregate base, to a depth of 12-inches below existing, adjacent grade, or as indicated. Provide neat sawcut at limits of pavement removal as indicated.

3.6 PATCHING AND REPAIRS

- A. Promptly patch and repair holes and damaged surfaces caused to adjacent construction by selective site demolition operations.
- B. Where repairs to existing surfaces are required, match previous work as closely as possible.
 1. Completely fill holes and depressions in existing masonry walls to remain with an approved masonry patching material, applied according to manufacturer's printed recommendations.
- C. Restore exposed finishes of patched areas and extend finish restoration into adjoining construction to remain in a manner that eliminates evidence of patching and refinishing.

3.7 CLEANING

- A. Keep the site free from debris and hazards and inspect the site at the end of each day for trash. All adjacent roads and drives outside of the construction fencing shall remain in operation during construction and shall remain free of all construction materials and debris.

3.8 DISPOSAL OF WASTE MATERIALS

- A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
- B. Burning on Owner's Property: Burning is not permitted on Owner's property.
- C. Removal from Owner's Property: Remove waste materials and unsuitable or excess soils and mulch from Owner's property. Transport demolished materials off Owner's property and legally dispose of them.

END OF SECTION 31 00 00

SECTION 31 20 00 – EARTH MOVING

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.
- B. Report of Subsurface Investigation.
 - 1. The geotechnical report is available to bidders as general information with regard to project and site conditions. However, the geotechnical report is not a part of the contract documents and is not a warranty or guarantee of subsurface conditions. Variations in subsurface conditions should be anticipated. Bidders should carefully inspect the site prior to bidding and will be provided reasonable access to perform independent explorations of subsurface conditions, if requested.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Preparing and grading subgrades for walks, lawn areas, and landscaping.
 - 2. Excavating, filling and backfilling for structures.
 - 3. Base course for walks and pavements.
 - 4. Subsurface drainage backfill for trenches.
 - 5. Excavating and backfilling trenches.
- B. Related Sections: The following Sections contain requirements that relate to this Section.
 - 1. Division 01 Sections for allowances, definitions and procedures.
 - 2. Division 31 Section "Site Clearing" for site stripping, grubbing, topsoil removal, and tree protection.
 - 3. Division 33 Section "Storm Drainage Utilities" for storm drainage.
 - 4. Division 32 Section "Planting" for finish grading, including placing and preparing topsoil for permanent and temporary grass seeding.
 - 5. Division 31 "Erosion and Sediment Controls", for all areas of the site that are graded or disturbed by any construction operations

1.3 UNIT PRICES

- A. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the following:
 - 1. 24 inches outside of concrete forms other than at footings.
 - 2. 12 inches outside of concrete forms at footings.
 - 3. 6 inches outside of minimum required dimensions of concrete cast against grade.
 - 4. 6 inches beneath bottom of concrete slabs on grade.
 - 5. 6 inches beneath invert elevation of pipe in trenches and 12 inches wider than pipe outside diameter.
 - 6. Additional rock removed beyond the limits outlined above to accommodate trench boxes, other removal methods, compaction equipment or other reasons shall not be included in the payment volume.
 - 7. Any materials paid by Unit Prices to replace excavated rock shall utilize these same measurement limits.
- B. Unsuitable Soil Measurement: Volume of soil actually removed, measured in original position, but not to exceed the limits directed by the Owner's Independent Testing Agency.
 - 1. Additional soil excavated beyond the limits directed by the Owner's Independent Testing Agency; including lay-back of excavation walls, excavation to accommodate trench boxes or other shoring, etc.; shall not be considered Unsuitable Soil.
- C. Replacement Material Measurement: Volume exactly equal to that of the unsuitable soil or rock that was removed, measured in original position.
- D. Unit prices for unsuitable soil and rock removal shall include all work and materials as defined in Division 01 sections.

1.4 DEFINITIONS

- A. Excavation consists of the removal of material encountered to subgrade elevations and the reuse or disposal of materials removed. Refer to the following section for additional definitions of classified excavations.
- B. Subgrade: The uppermost surface of an excavation or the top surface of a fill or backfill immediately below base course, drainage fill, or topsoil materials.
- C. Borrow: Soil material obtained off-site when sufficient approved soil material is not available from excavations.
- D. Surface Course: The top layer of the pavement structure placed on base course or subgrade.
- E. Base Course: Layer placed between the subgrade elevation and asphalt paving courses.
- F. Bedding Course: Layer placed over excavated subgrade in a trench before laying pipe.
- G. Unauthorized excavation consists of removing materials beyond indicated subgrade elevations or dimensions without direction by the Architect. Unauthorized excavation, as well as remedial work directed by the Architect, shall be at the Contractor's expense.
- H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below ground surface.
- I. Structural Areas: Areas containing Structures and pavement and extending 10-ft beyond the limits of structures and pavements. Structural Areas in fill shall also include the area supporting the fill slope along a 1:1 slope to existing grade. Pavement areas include but are not limited to roads, driveways, parking lots, curbs, sidewalks, dumpster pads, equipment pads, concrete pads, tracks, tennis courts, and other similar above grade improvements.
- J. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within building lines.

1.5 EXCAVATION CLASSIFICATIONS

- A. Excavation Classifications: All excavation is classified as General Excavation except for Mass Rock, Trench Rock and Unsuitable Soil Materials as defined in this section.
 - 1. General Excavation: Excavation, removal and/or disposal of pavements and other obstructions visible on surface; underground structures, utilities, and other items indicated to be demolished and/or removed; together with soil, boulders, and other materials encountered that are not classified as rock, unsuitable soil, or unauthorized excavation.
 - a. Intermittent drilling, blasting, or ripping to increase production and not necessary to permit excavation of material encountered will be considered general excavation.
 - b. Soil (regardless of nature) or other debris encountered above proposed subgrade elevations shall be considered general excavation unless determined by the Architect to meet the definition of rock.
 - 2. Unsuitable Soil Excavation: Removal and disposal of soil materials or other debris encountered below proposed subgrade elevations which is deemed unsuitable to remain in place by the Architect or Owner's Independent Testing Agency.
 - a. Soil and/or other debris encountered above proposed subgrade elevations shall be considered general excavation.
 - b. Soil material which, in the opinion of the Architect or Owner's independent testing agency, can be repaired by scarifying, drying and recompacting or material which is made unsuitable by delay of work, lack of protection or other actions of the Contractor or his Sub-Contractors shall not be considered as unsuitable soil and shall be repaired or replaced by the Contractor at no additional cost to the Owner. Moisture content alone shall not be the determining factor as to the presence of unsuitable soil.
 - c. Any material moved or removed without the measurement by the Owner's independent testing agency and approval by the Architect will be considered as general excavation.
 - d. Surface topsoil, regardless of thickness encountered, shall not be considered unsuitable soil.
 - e. Stones, rocks and boulders not meeting classifications of rock shall not be considered unsuitable soil. Stones, rocks and boulders shall be removed from soil as necessary if soil is to be used as fill or backfill. Removed stones, rocks and boulders shall be removed from the site.

- f. The unsuitable soil allowances shall be for unsuitable soils only and not for repair of weather related deterioration of subgrade. These Allowances are not for required on-site cut and off-site fill necessary to bring subgrades and grades to elevations shown on drawings. Contractor shall be responsible for proper drying and dewatering procedures, as necessary, as part of his normal operations.
3. Mass rock Excavation: Removal, in Open Excavations, of rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1.5-cu.yd. that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted. In the event rock (as defined above) is encountered, the Contractor shall immediately notify the Architect.
- a. Mass Rock Excavation Equipment: Late-model, track-type CAT D-8 crawler tractor operating at one mile per hour in the lowest available gear, and at the highest normal operating rpm pulling a sharp, single-toothed ripper. The Contractor shall provide equipment specification and test data verifying that the equipment to be used for demonstration purposes complies with the minimum requirements. The equipment shall be in good repair and in proper working condition. The Owner reserves the right to inspect and approve the equipment to be used for demonstration purposes. The Contractor shall demonstrate (at no additional cost) to the Architect or Owner's independent testing agency that the rock cannot be practically ripped with equipment equivalent that specified above without systematic drilling and blasting. Mass rock is defined as material which, after 1 hour of continuous ripping using the equipment described above, produces less than 30 cubic yards of removable material.
4. Trench Rock Excavation: Removal, in Trench Excavations, of rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1.0-cu.yd. that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted. In the event rock (as defined above) is encountered, the Contractor shall immediately notify the Architect.
- a. Trench rock excavation equipment: Late-model, track mounted CAT 330 or equivalent hydraulic excavator equipped with a narrow (36" max) bucket with new rock teeth and operating at the highest normal operating RPM. The Contractor shall provide equipment specification and test data verifying that the equipment to be used for demonstration purposes complies with the minimum requirements. The equipment shall be in good repair and in proper working condition. The Owner reserves the right to inspect and approve the equipment to be used for demonstration purposes. Trench rock is defined as material which, after 1 hour of continuous digging using the equipment described above, removes less than 10 cubic yards of material.
5. Classified excavation requirements:
- a. Excavations more than both 10 feet in width and more than 30 feet in length are defined as Open Excavations. Excavations less than both 30 feet in width and less than 30 feet in length are defined as Trench Excavations.
- b. Contractor shall expose and clean the rock material for inspection and measurement by the Architect.
- c. Do not excavate rock or unsuitable soil until it has been classified and cross-sectioned by the Owner's independent testing agency or Architect. Any material moved or removed without the measurement by the Owner's independent testing agency and approval by the Architect will be considered as General Excavation.
- d. The Architect shall be the final judge on what is classified as unsuitable or rock excavation.
- e. The contractor may be required to provide equipment specification data verifying that the above minimum-rated equipment will be used for demonstration purposes. The equipment shall be in good repair and in proper working condition.
- f. Rippable rock, weathered rock or overburden which is not classified as rock according to the above definitions shall be considered General Excavation.

1.6 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Test Reports: In addition to test reports required under field quality control, submit the following:
1. Laboratory analysis of each soil material proposed for fill and backfill from on-site and borrow sources.
 2. One optimum moisture-maximum density curve for each soil material.

3. Reports of all laboratory and field tests including evaluations of subgrades and foundation bearing conditions.
4. As-built survey of athletic fields, courts and tracks demonstrating compliance with specified tolerances.
5. Reports of Special Inspections.

- C. Blasting plan approved by authorities having jurisdiction if applicable due to on-site rock.
- D. Report of rock or unsuitable soil removal with quantities confirmed in writing by the Architect or Owner's independent testing agency.

1.7 QUALITY ASSURANCE

- A. Codes and Standards: Perform earthwork complying with requirements of authorities having jurisdiction. Any earthwork required for preparation of parking areas and drives shall comply with current NCDOT Standard Specifications as per the North Carolina Construction Manual.
- B. Comply with applicable requirements of NFPA 495--Explosive Materials Code.
- C. Testing and Inspection Service: Owner will employ a qualified independent geotechnical engineering testing agency to classify proposed on-site and borrow soils to verify that soils comply with specified requirements and to perform required field and laboratory testing.
- D. Special Inspections: Owner will employ a qualified Special Inspector or Special Inspection Agency to perform verification and inspection of earthwork construction in accordance with NC State Building Code.
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1
 1. Before commencing earthwork, meet with representatives of the governing authorities, Owner, Architect, consultants, Geotechnical Engineer, independent testing agency, and other concerned entities. Review earthwork procedures and responsibilities including testing and inspection procedures and requirements. Notify participants at least 3 working days prior to convening conference. Record discussions and agreements and furnish a copy to each participant.

1.8 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt existing utilities serving facilities occupied by the Owner or others except when permitted in writing by the Architect and then only after acceptable temporary utility services have been provided.
 1. Provide a minimum 48-hours' notice to the Architect and receive written notice to proceed before interrupting any utility.
- B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shutoff services if lines are active.

1.9 PAYMENT

- A. General Excavation: All general excavation to the lines and grades indicated on the drawings including all necessary off-site disposal of excess materials and/or off-site borrow of fill materials shall be included in the base bid.
 1. No statement is made or implied that the on-site grading and earthwork indicated on the drawings is balanced.
- B. Unsuitable Soil Material Excavation: Unsuitable soil material excavation will be paid by unit prices included in the Contract Documents.
 1. Unused amounts of monies included under allowances shall be credited to the Owner by deduct change order.
- C. Rock Excavation: Mass rock and Trench rock excavation will be paid by unit prices included in the Contract Documents.
 1. Unused amounts of monies included under allowances shall be credited to the Owner by deduct change order.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide approved borrow soil materials from off-site when sufficient approved soil materials are not available from excavations.
- B. Satisfactory Soil Materials: ASTM D 2487 soil classification groups GW, GC, GP, GM, ML, CL, SW, SP, SC, and SM; free of rock or gravel larger than 2 inches (50 mm) in any dimension, debris, waste, frozen materials, vegetation and other deleterious matter. Additionally, satisfactory soil for use in structural fill areas shall meet the following:
 - 1. Have a Plasticity Index of 25 or less and a Liquid Limit of 50 or less.
 - 2. Satisfactory soil materials obtained from off-site borrow sources shall meet all requirements listed above and possess a Standard Proctor Maximum Dry Density of 100-lb/cf or greater, shall contain at least 20% fines, and have a Plasticity Index of less than 25.
 - 3. Soils having a Plasticity Index greater than 25 and a Liquid Limit greater than 50 may be used as fill in approved non-structural areas.
- C. Unsatisfactory Soil Materials: ASTM D 2487 soil classification groups MH, CH, OL, OH, and PT. Soils having a Plasticity Index greater than 22 and a Liquid Limit greater than 50 are also unsatisfactory within structural (pavement and building) areas.
- D. Unsuitable Soil: Refer to paragraph 1.5 of this Section.
- E. Backfill and Fill Materials: Satisfactory soil materials.
- F. Impervious Fill & Clay Liner for Constructed Wetlands: Clayey or silty soil mixtures capable of compacting to a dense state with a maximum permeability of 0.01-in/hr and compacted to at least 95% of the maximum dry density per ASTM D-698. ASTM D 2487 soil classification groups CH, CL, SC, MH, and ML; free of rock, brush, roots, and other organic material subject to decomposition.

2.2 PROCESSED AGGREGATE MATERIALS

- A. Base Course Material: Type A aggregate base course meeting the requirements of Section 520 of NCDOT "Standard Specifications for Roads and Structures."
- B. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- C. Bedding Material: #57 washed stone.
- D. Drainage Fill: #57 washed stone.
- E. Filtering Material: #57 washed stone.
- F. Coarse Sand: Grain Size Distribution (ASTM C136-95A):

<u>Sieve Size</u>	<u>Percent Passing</u>
3/8"	100
#4	95-100
#8	85-97
#16	60-80
#30	10-20
#50	5-15
#100	0-5

2.3 LEAN CONCRETE FILL

- A. Lean concrete fill shall consist of a mixture of portland cement, aggregate and water. Water reducing and air-entraining admixtures may be added at the option of the Contractor.

1. Material shall comply with the requirements of Division 03 Section, Cast-in-Place Concrete.
2. The proportions of the mix shall be determined by the Contractor to obtain a compressive strength of 700-psi at 7-days.

2.4 FLOWABLE FILL

- A. Flowable fill shall consist of a lean concrete mixture of portland cement, aggregate and water. Water reducing and air-entraining admixtures may be added at the option of the Contractor.
1. Material shall comply with the requirements of Division 03 Section, Cast-in-Place Concrete.
 2. The proportions of the mix shall be determined by the Contractor to obtain a compressive strength of 100-300-psi at 28-days.

2.5 ACCESSORIES

- A. Drainage (Filter) Fabric: Woven monofilament filtration geotextile, specifically manufactured as a drainage geotextile; made from polypropylene yarns; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods.
1. Tensile Strength: 200 lb; ASTM D 4632.
 2. Tear Strength: 60 lb; ASTM D 4533.
 3. CBR Puncture: 700 lb; ASTM D 6241.
 4. Water Flow Rate: 18 gpm per sq. ft.; ASTM D 4491.
 5. Apparent Opening Size: No. 70; ASTM D 4751
 6. Percent Open Area: 4%; CW-02215
- B. Separation/Stabilization Fabric: Woven geotextile, specifically manufactured for use as a separation and or stabilization geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:
1. Grab Tensile Strength: 200 lbf (890 N); ASTM D 4632.
 2. Tear Strength: 75 lbf (333 N); ASTM D 4533.
 3. Puncture Resistance: 90 lbf (400 N); ASTM D 4833.
 4. Water Flow Rate: 4 gpm per sq. ft. (2.7 L/s per sq. m); ASTM D 4491.
 5. Apparent Opening Size: No. 30 (0.6 mm); ASTM D 4751.
- C. Biaxial Geogrid: Integrally formed biaxial geogrid, specifically manufactured for use as a base reinforcement for subgrade improvement. Tensar BX1100, Mirafi BXG-110, or approved equal with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:
1. Aperture Dimensions: 1-in (25-mm) nominal.
 2. Minimum Rib Thickness: 0.03-in (0.76-mm) nominal.
 3. Tensile Strength @ 2% Strain: 280-lb/ft (4.1 kN/m); ASTM D-6637.
 4. Tensile Strength @ 5% Strain: 580-lb/ft (8.5 kN/m); ASTM D-6637.
 5. Ultimate Tensile Strength: 850-lb/ft (12.4 kN/m); ASTM D-6637.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.
- C. Provide erosion control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- D. Site Maintenance: The Contractor shall be responsible to take whatever measures are necessary to ensure reasonable accessibility to and on the construction site so that undue delays are avoided under normal weather conditions. These measures shall include, but not be limited to, the following:

1. Maintaining the surface of the soils in a manner to promote drainage runoff and avoid ponding of water, especially prior to predicted rain events.
2. Avoiding operation of temporary water sources or hoses in a manner which will cause unnecessary and repeated wetting of the site.
3. Fill in severely rutted areas which are ponding water during the construction activities or after rain events with drainage fill material to assist drying and allow construction activities to continue.
4. Provide drying of surface soils and soils intended for filling or backfilling as required to promote accelerated drying of those materials.
5. After successful drying efforts or prior to predicted rain events, grade the areas back to a smooth condition to promote drainage runoff.
6. Controlling vehicular traffic, both construction and personal on the site in a manner to prevent undue damage to soils whenever possible and practical.
7. Providing temporary staging areas of crushed stone or other materials around the construction site which will better withstand the weather and traffic and keep the site accessible immediately or shortly after rain events.
8. Provide de-watering equipment for any areas collecting water which may affect construction or soil densities under built areas.
9. Any claims for weather related delays considered shall be considered with particular attention paid to the Contractor's efforts in regard to the above requirements

3.2 DEWATERING

- A. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
 2. Install a dewatering system to keep subgrades dry and convey groundwater away from excavations. Maintain until dewatering is no longer required.
- C. Design, furnish, install, test, operate, monitor, and maintain temporary dewatering systems of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.
 1. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls as needed.
 2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.
 3. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, prevention of flooding in excavation, and prevention of damage to subgrades and permanent structures.
 4. Prevent surface water from entering excavations by grading, dikes, or other means.
 5. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
 6. Remove dewatering system when no longer required for construction.
- D. Soft wet soils, if present at the surface, shall be dried and compacted in place by the Contractor and be stable under proofrolling prior to placing fill. Drying shall be accomplished by discing, plowing or other means necessary and shall be included in the Contractor's bid. Site soils are typical of the area and susceptible to loss of strength if they become wet, resulting in softening and rutting during construction. Site soils are extremely moisture sensitive, therefore, the Contractor shall take active and aggressive steps to dry soil materials wet of optimum to maintain construction progress through the work and to maintain access to and around the construction. The Contractor, at his option and cost may remove unstable, wet materials and replace with available fill materials in lieu of accomplishing soil drying procedures.

3.3 EXPLOSIVES

- A. Explosives shall not be used.

3.4 STABILITY OF EXCAVATIONS

- A. Comply with local codes, ordinances, and requirements of authorities having jurisdiction to maintain stable excavations. Contractor is responsible for ensuring all excavation operations and other construction comply with applicable OSHA requirements. Contractor shall provide temporary shoring and bracing as needed to construct the proposed improvements and comply with the above requirements.

3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
- B. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades.

3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated slopes, lines, depths, and invert elevations.
 - 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- B. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit, unless otherwise indicated.
 - 1. Clearance: As indicated
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove stones and sharp objects to avoid point loading.
 - 1. For pipes or conduit less than 6 inches (150 mm) in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
 - 2. For pipes and conduit 6 inches (150 mm) or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
 - 3. Where encountering rock or another unyielding bearing surface, carry trench excavation 6 inches (150 mm) below invert elevation to receive bedding course.

3.8 APPROVAL OF SUBGRADE PRIOR TO PLACING FILL OR OTHER IMPROVEMENTS

- A. Notify Architect or Owner's independent testing agency when excavations have reached required subgrade.
- B. After stripping is complete the exposed subgrade shall be proofrolled with a fully loaded dual wheel tandem axle dump truck or similar construction equipment. Four passes shall be made in each orthogonal direction. The proofrolling operation shall be observed by the Architect or Owner's independent testing agency. Should any area fail to tighten up after proofrolling and continue to rut and/or pump, the soil shall be scarified and moistened or aerated and recompact. Repeat proofrolling operations.
- C. When Architect or Owner's independent testing agency determines that unforeseen unsuitable soil is present, continue excavation and replace with compacted backfill or fill material as directed.
 - 1. Unforeseen additional excavation and replacement with suitable material approved by the Architect will be considered unsuitable material and will be paid by unit prices included in the Contract Documents. Refer to Division 1 Sections.
- D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect. Install french drains at design subgrade if directed by the Owner's independent testing agency and approved by the Architect.

3.9 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending indicated bottom elevation of concrete foundation or footing to excavation bottom, without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position when acceptable to the Architect.
 - 1. Fill unauthorized excavations under other construction as directed by the Architect or the Owner's independent testing agency.

- B. Where indicated widths of utility trenches are exceeded, provide stronger pipe, or special installation procedures, as required by the Architect.

3.10 STORAGE OF SOIL MATERIALS

- A. Stockpile excavated materials acceptable for backfill and fill soil materials, including acceptable borrow materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent wind-blown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

- A. Backfill excavations promptly, but not before completing the following:
 - 1. Acceptance of construction below finish grade including, where applicable, damp-proofing, waterproofing, and perimeter insulation.
 - 2. Surveying locations of underground utilities for record documents.
 - 3. Testing, inspecting, and approval of underground utilities.
 - 4. Concrete formwork removal.
 - 5. Removal of trash and debris from excavation.
 - 6. Removal of temporary shoring and bracing, and sheeting.
 - 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
 - 8. Removal of objectionable materials, including rocks larger than acceptable size, from backfill soils.

3.12 UTILITY TRENCH BACKFILL

- A. Place and compact bedding course on rock and other unyielding bearing surfaces and to fill unauthorized excavations. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- B. Pipe sleeves and concrete backfill trenches that carry below or pass under footings and that are excavated within 18 inches (450 mm) of footings. Place concrete to level of bottom of footings. Contact the Architect or the Owner's independent testing agency to coordinate details, procedures and possible alternatives.
- C. Provide 4 inch (100 mm) thick concrete base slab support for piping or conduit less than 30 inches (750 mm) below surface of roadways. After installation and testing, completely encase piping or conduit in a minimum of 4 inches (100 mm) of concrete before backfilling or placing roadway base course.
- D. Place and compact initial backfill of satisfactory soil material or base course material, free of particles larger than 1 inch (25 mm), to a height of 12 inches (300 mm) over the utility pipe or conduit.
 - 1. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.
- E. Coordinate backfilling with utilities testing.
- F. Fill voids with approved backfill materials as shoring and bracing, and sheeting is removed.
- G. Place and compact final backfill of satisfactory soil material to final subgrade.
- H. Install detectable warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.13 FILL

- A. Preparation: Remove vegetation, topsoil, debris, wet, frozen, and unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placing fills.
 - 1. Plow, strip or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing surface.
- B. Obtain approval of subgrade as specified prior to placing fill.
- C. Obtain approval of fill materials. Remove all objectionable materials, including stones larger than acceptable size, from fill materials.
- D. Place fill material in layers to required subgrade elevations for each location listed below.
 - 1. Under grass, use satisfactory excavated or borrow soil material.
 - 2. Under walks, pavements, buildings and other structural areas use base course material, or satisfactory excavated or borrow soil material.
 - 3. In pond/wetland embankments, use impervious fill for core/cut-off trench and suitable soil for remainder of embankment.
- E. Following placement of fill the subgrade of building and pavement areas shall be proofrolled as described in the Field Quality Control section. The proofrolling operation shall be observed by the Owner's testing agency. Should any area fail to tighten up after proofrolling and continue to rut and/or pump, the soil shall be scarified and moistened or aerated and recompacted. Repeat proofrolling operations.
- F. Overbuild Deep Fill Slopes: Fill slopes shall be overbuilt a sufficient distance and then cut back to achieve required compaction at the design slope surface.

3.14 MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.
 - 1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace or scarify and air-dry satisfactory soil material that is too wet to compact to specified density.
 - a. Stockpile or spread and dry removed wet satisfactory soil material.

3.15 COMPACTION

- A. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill materials evenly on all sides of structures to required elevations. Place backfill and fill uniformly along the full length of each structure.
- C. Percentage of Maximum Dry Density Requirements: Compact soil to not less than the following percentages of maximum dry density according to ASTM D698 Standard Proctor:
 - 1. Under structures, steps, walks, and pavements:
 - a. Compact each layer of backfill or fill material at 98% of the standard Proctor Density (ASTM D-698).
 - b. Moisture content of the fill during placement shall be kept within +/-2% of optimum.
 - c. Under pavements within NCDOT rights-of-way or new pavement to be constructed to NCDOT standards compact the top 8 inches below pavement subgrade to at least 100% density in accordance with AASHTO T-99 as modified by NCDOT.
 - 2. Under lawn or unpaved areas, compact the top 6 inches below subgrade and each layer of backfill or fill material at 80 percent maximum dry density.
 - 3. In pond embankments, compact each layer of backfill or fill material at 95% of the standard Proctor Density (ASTM D-698). Moisture content of the fill during placement shall be kept within 0% to +3% of optimum.
 - 4. Compact each layer of aggregate base material under pavement to 100% density in accordance with AASHTO T-180 as modified by NCDOT or to at least 98% of the nuclear target density as specified in section 520 of the NCDOT Standard Specifications for Roads and Structures.

3.16 GRADING

- A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
1. Provide a smooth transition between existing adjacent grades and new grades.
 2. Cut out soft spots, fill low spots, and trim high spots to conform to required surface tolerances.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
1. Lawn or Unpaved Areas: Plus or minus 1.2 inches (0.10 foot).
 2. Walks: Plus or minus 1.2 inches (0.10 foot).
 3. Pavements: Plus or minus 1/2 inch (0.05 foot).
 4. Pond Embankments: Construct embankment to an elevation 10% higher than the design height to allow for settling.
 5. Athletic/Play Fields:
 - a. Subgrade: Plus or minus 1.2 inches (0.10 foot).
 - b. Final Grade (Topsoil): Plus or minus 1/2 inch (0.05 foot) when tested with a 10 foot straightedge.
- C. Lawn & Play/Athletic Field Fine Grading: Finish grade lawn and field areas to a smooth, even surface with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future. Remove trash, debris, stones larger than 1/2 inch in any dimension, and other objects that may interfere with planting or maintenance operations. Remove all glass, wire or other objects of any size which may cause injury. Surfaces shall be top dressed with sterile sand following establishment of grass as necessary to obtain smooth, consistent surface.

3.17 SUBSURFACE / FOUNDATION DRAINAGE

- A. Drainage Piping: Drainage pipe is specified in Division 33 Section "Site Storm Drainage Utilities."
- B. Subsurface Drain: Place a layer of drainage fabric around perimeter of drainage trench as indicated. Place a course of drainage fill material on drainage fabric to support drainage pipe. Encase drainage pipe in drainage fill material and wrap in drainage fabric, overlapping sides and ends at least 6 inches.
1. Compact each course of drainage fill material.
 2. Place satisfactory excavated or borrow soil material or topsoil fill material (as appropriate) over drain to final grade.

3.18 BASE COURSES

- A. Under pavements, walks, courts and tracks, place base course material on prepared subgrades.
1. Where indicated, place biaxial geogrid directly on prepared subgrade under all asphalt and concrete pavement without wrinkles or folds. Seams shall be overlapped a minimum of 12-in. Geogrid placement shall be observed by the Owner's Independent Testing Agency prior to covering. Place compacted base course over geogrid and control traffic and operation of equipment over geogrid and base course in accordance with manufacturer's instructions.
 2. Compact base courses at optimum moisture content to required grades, lines, cross sections and thickness to not less than 100 percent density in accordance with AASHTO T-180 as modified by NCDOT or to at least 98% of the nuclear target density as specified in section 520 of the NCDOT Standard Specifications for Roads and Structures.
 3. Shape base course to required crown elevations and cross-slope grades.
 4. When thickness of compacted base course is 6 inches or less, place materials in a single layer.
 5. When thickness of compacted base course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick when compacted.
 6. Following compaction testing and within 48 hours prior to the application of asphalt or concrete pavement, the aggregate base course shall be proofrolled with a fully loaded dual wheel tandem axle dump truck or similar construction equipment. Four passes shall be made in each orthogonal direction. The proofrolling operation shall be observed by the Architect or Owner's independent testing agency. Should any area fail to tighten up after proofrolling and continue to rut and/or pump, the base course shall be scarified and moistened or aerated and recompacted. Repeat proofroll testing.

- B. Pavement Shoulders: Place shoulders along edges of base course to prevent lateral movement. Construct shoulders at least 12 inches (300 mm) wide of acceptable soil materials and compact simultaneously with each base course layer.

3.19 FIELD QUALITY CONTROL

- A. Owner's Independent Testing Agency Services: Allow testing agency to evaluate and test each subgrade and each fill or backfill layer. Do not proceed until test results for previously completed work verify compliance with requirements.
1. Perform testing and evaluation of borrow or fill soils for compliance with material specifications of this Section.
 2. Perform field in-place density tests according to ASTM D 1556 (sand cone method), ASTM D6938 (nuclear gauge method) or equal as determined by the Owner's independent testing agency.
 - a. Building Areas: See Special Inspections section.
 - b. Paved Areas: At subgrade and at each compacted fill, backfill layer, and aggregate base course layer, perform at least one field in-place density test for every 10,000 sq. ft. or less of paved area, but in no case fewer than two tests per lift. Observe proofrolling of finished subgrade and aggregate base course.
 - c. Trench Backfill: Perform at least one field in-place density test per 2 feet of backfill per 100 linear feet or less of trench outside of limits of buildings, but no fewer than two tests per trench per day.
 - d. Pond Embankments: At subgrade and at each compacted fill and backfill layer, perform at least one field in-place density test for every 200 linear ft. or less of embankment, but in no case fewer than ten tests. Observe use of impervious fill as embankment materials. Perform evaluation of soils to be used as embankment fill for compliance with material specifications herein.
 - e. Non-Structural Areas: Field density and moisture content tests shall be performed on the fill and backfill at a rate of at least one test per every 15,000 square feet of area being filled.
 3. Observe proof-rolling as described herein.
 4. Refer to Special Inspections section below for testing within building limits.
- B. When testing agency reports that subgrades, fills, or backfills are below specified density, scarify and moisten or aerate, or remove and replace soil to the depth required, recompact and retest until required density is obtained. Contractor shall be responsible for all costs associated with re-testing required due to failed compaction.
- C. Proofrolling: Subgrade to receive fill, finish subgrade of building or pavement areas, and aggregate base courses shall be proofrolled with a fully loaded dual wheel tandem axle dump truck or similar construction equipment. Four passes shall be made in each orthogonal direction. The proofrolling operation shall be observed by the Owner's testing agency. Should any area fail to tighten up after proofrolling and continue to rut and/or pump, the soil shall be scarified and moistened or aerated and recompact. Repeat proofrolling operations.
- D. Pond and Wetland Imperviousness: Following completion of new permanent detention ponds or constructed wetlands, fill pond or wetland with water, measure and record water level every 24-hrs for a period of three days with no precipitation with time/date stamped photos. Provide water level measurements to Architect. Do not proceed with final planting until imperviousness is confirmed by Architect.

3.20 SPECIAL INSPECTIONS

- A. Allow Special Inspections and tests to be performed by the Special Inspector or Special Inspection Agency.
- B. Verification and inspection of earthwork construction shall be in accordance with Section 1705 of the North Carolina State Building Code 2018, and as follows:
1. Review laboratory test reports, certificates of compliance, or other data submitted to show compliance with specifications, and conduct field inspections and tests during earthwork operations as necessary to verify compliance with the contract documents.
 2. All site stripping and proofrolling operations shall be observed and monitored. Verify suitability of subgrade prior to installation of fill.
 3. At footing subgrades, test each soil stratum to verify design bearing capacities. Verification and approval of footing subgrades may be based on a comparison of subgrade with test data. Perform additional testing as necessary.
 4. Test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:

- a. Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of building slab, but in no case fewer than three tests.
 - b. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 50 feet or less of wall length, but no fewer than two tests.
 - c. Trench Backfill in Building Areas: At each compacted initial and final backfill layer, at least one test for every 50 feet or less of trench length, but no fewer than two tests.
- C. Allow Special Inspector to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements
- D. When subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.
- E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- F. Additional testing performed to determine compliance of corrected work with specified requirements shall be at Contractor's expense.

3.21 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and re-establish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace material to depth directed by the Architect or Owner's independent testing agency; reshape and recompact at optimum moisture content to the required density.
- C. Settling: Where settling occurs during the Project correction period, remove finished surfacing, backfill with additional approved material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.22 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off the Owner's property.

END OF SECTION 31 20 00

SECTION 31 25 00 - EROSION & SEDIMENT CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following: Soil erosion and sedimentation control for all areas of the site that are graded or disturbed by any construction operations and elsewhere as indicated on the Drawings or specified herein. Erosion control shall be as specified herein and as may be required by actual conditions and governing authorities.
- B. The Contractor is fully responsible for all applicable permits and approvals for off-site borrow and waste areas.
- C. The Contractor shall have full responsibility for the construction and maintenance of erosion control and sedimentation control facilities as shown on the Drawings and as specified herein. The Contractor shall at all times provide the operation and maintenance necessary to operate the permitted sediment and erosion controls at optimum efficiency.
- D. The Contractor shall provide permanent or temporary ground cover as soon as possible over disturbed areas of the site, and shall provide permanent or temporary ground cover in no more than 14 days after construction activities have permanently or temporarily ceased over the disturbed area. Temporary or permanent ground cover shall be provided on slopes within 7 days after construction activities have permanently or temporarily ceased.
- E. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 31 Section "Site Clearing"
 - 2. Division 31 Section "Earth Moving"
 - 3. Division 32 Section "Planting"

1.3 PRODUCT HANDLING

- A. Deliver seed, fertilizer and other packaged materials in unopened original packages with labels legible and intact. Seed packages shall bear a guaranteed analysis by a recognized authority.
- B. On-site storage of materials shall be kept to a minimum. Wet or damaged seed or other material shall be removed from the project site immediately.

1.4 MONITORING AND RECORD KEEPING

- A. Contractor shall abide by all conditions of the General Permit to Discharge Stormwater under the National Pollutant Discharge Elimination System (NPDES), Permit No. NCG010000 (obtain copy from Owner) and the general requirements listed below. NPDES General Permit No. NCG010000 can be viewed at: https://files.nc.gov/ncdeq/Energy%20Mineral%20and%20Land%20Resources/Stormwater/NCG010000_Final_Permit_2019_04_01.pdf
- B. All sediment and erosion control devices and facilities shall be inspected at least once every seven (7) calendar days and within 24 hours after any storm event of greater than 0.5 inches of rain per 24 hour period.
- C. Stormwater discharges shall be inspected by observation for stormwater discharge characteristics (as listed below) at the above frequency to evaluate the effectiveness of the sediment control facilities, devices or practices. Observations shall be made at all stormwater discharge outfalls and other locations where concentrated stormwater discharges from the site. Observations shall be qualitative, no analytical testing or sampling is required. If any visible off-site sedimentation is leaving the site, corrective action shall be taken to reduce the discharge of sediments.
 - 1. Color.
 - 2. Odor.
 - 3. Clarity.
 - 4. Floating solids.
 - 5. Suspended solids.

6. Foam.
7. Oil sheen.
8. Other obvious indicators of stormwater pollution.

- D. The contractor shall perform and keep records of the above inspections. Visible sedimentation found off the site shall be recorded with a brief explanation as the measures taken to prevent future releases as well as any measures taken to clean up the sediment that has left the site. This record shall be made available to the Owner, Architect and governmental authorities.

PART 2 - PRODUCTS

2.1 SOIL AMENDMENTS AND SEED

- A. Refer to Division 32 Section "Planting".

2.2 MISCELLANEOUS

- A. Gravel for Stone Filters: Washed No. 57 stone or as indicated on the drawings.
- B. Silt Fence Fabric: A synthetic filter fabric or a pervious sheet of polypropylene, nylon, polyester, or polyethylene yarn, which is certified by the manufacturer or supplier as conforming to the following requirements.
1. Tensile Strength (Grab): 90 x 90-lbs. min., ASTM D 4632.
 2. Permittivity: 0.05-sec⁻¹ min., ASTM D 4491.
 3. Apparent Opening Size: #30 US Sieve (0.60-mm) max., ASTM D 4751.
 4. UV Resistance (500-hrs): 70%, ASTM D 4355.
- C. Filter Fabric (for installation under riprap): Woven geotextile fabric, apparent opening size no larger than US Standard Sieve no. 70, min. grab strength of 120-lbs.
- D. Polyacrylamide (PAM) Turbidity Control Log: Soil specific tailored, solid form PAM product containing blends of water treatment components and polyacrylamide co-polymer for water clarification (25 NTU max. at outlet of sediment basin) and erosion control. Product shall be designed for site specific soil and water conditions. APS-700 Series Floc Log by Applied Polymer Systems, Inc. or approved equal.
- E. Dewatering Silt Bag: Permeable, non-woven geotextile bag manufactured to accept and filter pumped, sediment-laden water from dewatering activities. Silt bag shall be sized as appropriate for the dewatering pump discharge rate and shall be fitted with a fill spout large enough to accommodate the discharge piping of the dewatering pump. Silt bag shall be Dirtbag as manufactured by ACF Environmental, Inc. or approved equal.
- F. Compost Filter Sock: Three-dimensional tubular sediment control device comprised of an organic compost filter media contained in a tubular knitted mesh sock.
1. Filter media shall be mature compost that has been certified by the US Composting Council's Seal of Testing Assurance Program and meeting the following specifications.
 - a. pH: 5.0 – 8.5.
 - b. Moisture Content: < 60%.
 - c. Organic Matter: >25%, dry weight.
 - d. Particle Size: 99% passing 2-in sieve, 30-50% passing 3/8-in sieve.
 2. Filter sock netting shall be 5-mm thick continuous HDPE filament, tubular knitted mesh with 3/8-in openings. Filled sock shall be a minimum of 12-in in diameter.
 3. Stakes shall be 2x2-in x 3-ft wooden stakes.

2.3 INLET PROTECTION MEASURES

- A. Manufactured Inlet Sediment Control Device: Storm drainage inlet sediment control device shall be manufactured from woven polypropylene geotextile to fit the opening of a catch basin or drop inlet to filter sediment from runoff entering the inlet. The device shall be a High Flow Siltsack as manufactured by ACF Environmental, Inc. or approved equal. Device shall be provided with an integral curb deflector if installed at a catch basin with a vertical opening adjacent to a horizontal grate.

- B. Floor Drain / Area Drain Sediment Filter Device: Small size storm drainage inlet sediment control device shall be manufactured from woven polypropylene geotextile to fit into small diameter floor drains to filter sediment from runoff entering the inlet. The device shall be a Round Drain Insert as manufactured by New Pig Corp. or approved equal.

2.4 CHANNEL AND SLOPE MATTING

- A. Channel Matting: Erosion Control blankets for installation in channels shall be a machine-produced mat of curled wood fiber (excelsior) or synthetic polypropylene fiber as specified below. The blanket shall be of consistent thickness with the fiber evenly distributed over the entire area of the mat. The blanket shall be covered with a photo degradable plastic netting secured to the fiber mat. Channel liners shall be excelsior mat unless otherwise indicated on the drawings.

- 1. Excelsior Mat:
 - a. Fiber: Curled wood excelsior of 80% six inch or longer fiber length with a consistent width of fibers evenly distributed throughout the mat. Mat shall be smolder resistant with no chemical additives.
 - b. Top and Bottom Netting: Photo degradable extruded plastic netting with maximum mesh size of 3/4" x 3/4".
- 2. Wire Staples: 16 gauge steel wire, with minimum of 3" top and 6" long legs. 1.75 staples per square yard of matting minimum.

- B. Slope Matting: Erosion Control blankets for installation on slopes (not channels) shall be a machine-produced mat of crimped wood fiber and/or other degradable fibers manufactured without nets or threads. Staples or stakes used to secure the mat shall be wood or 100% biodegradable natural material. No nets or metal staples shall be used on any areas other than within channels.

- 1. Excelsior Mat:
 - a. Fiber: Net-free, curled wood excelsior of 80% six inch or longer fiber length with a consistent width of fibers evenly distributed throughout the mat. Mat shall be smolder resistant with no chemical additives.
- 2. Stakes or Staples: Wood or 100% biodegradable natural material with additive to cause breakdown and 100% degradation within 24-36 months after installation.

2.5 RIPRAP

- A. Riprap: Provide riprap of the class and quantity indicated on the Drawings. While no specific gradation is required, the various sizes of the stone shall be equally distributed within the required size range. The size of an individual stone shall be determined by measuring its long dimension. Stone shall meet the requirements of the following table for class and size distribution. No more than 5% of the material furnished can be less than the minimum size specified nor no more than 10% of the material can exceed the maximum size specified.

REQUIRED STONE SIZES - INCHES			
CLASS	MINIMUM	MIDRANGE	MAXIMUM
A	2	4	6
B	5	8	12
1	5	10	17
2	9	14	23

PART 3 - EXECUTION

3.1 GENERAL

- A. Existing Structures and Facilities
 - 1. Existing structures, facilities, and water courses shall be protected from sedimentation.
 - 2. The Contractor shall be responsible for the construction of necessary measures, and all costs shall be at the expense of the Contractor.

3. Items to be protected from sedimentation deposits shall include, but are not limited to, all downstream property, natural waterways, streams, lakes and ponds, catch basins, drainage ditches, road gutters, and natural buffer zones.
4. Control measures such as the erection of silt fences, barriers, dams, or other structures shall begin prior to any land disturbing activity. Additional measures shall be constructed as required during the construction.
5. All facilities installed shall be maintained continuously during construction until the disturbed areas are stabilized. Contractor shall remove all erosion control measures at the end of the project at his expense unless otherwise directed by the Owner or his representative.
6. Perform monitoring and record keeping as specified in this section.

3.2 PROTECTIVE MEASURES

- A. Protective measures shall conform to all State and Local requirements.
- B. Construction and maintenance of sediment and erosion control measures shall be in accordance with all applicable laws, codes, ordinances, rules and regulations.
 1. Silt Fence: Hog wire or wire mesh fastened to posts as recommended by the Manufacturer and covered with silt fabric.
 2. Berms and Diversion Ditches: These shall be graded channels with a supporting ridge on the lower side constructed across a sloping land surface. Diversion ditches and berms shall be planted in vegetative cover as soon as completed.
 3. Mulching: Mulching shall be used to prevent erosion and to hold soil and seed in place during the establishment of vegetation.
 4. **Matting: Temporary slope and channel matting shall be used for temporary stabilization during the establishment of seeded cover in all grassed ditches, channels, long slopes, and steep banks (6:1 or steeper) and additional areas as indicated on plans.** Matting shall be installed on any area on site as needed to provide temporary stabilization whether or not matting is indicated on the plan. Install as indicated or per manufacturer's instructions. The installation of matting may be waived by the Architect if surface stabilization is obtained by other methods within the appropriate and agreed time frames. If adequate stabilization is not obtained, the Contractor shall install matting where required at no additional cost to the Owner.
 5. Build Berm, Pits and Gravel Filter as shown on Drawings. Maintain during construction to keep erosion and sedimentation to a minimum. When it is necessary to remove berm, pits, and gravel, return area to required profiles and condition.
 6. Construction Entrances: Construct all entrances in accordance with plans. Maintain all ingress/egress points to prevent tracking of soil onto the Owner's, public or private roads. Any soil that is tracked onto the roads shall be removed immediately.
 7. Riprap: Stone shall be graded so that the smaller stones are uniformly distributed throughout the mass. Stone may be placed by mechanical methods, augmented by hand placing where necessary, provided that when the riprap is completed it forms a properly graded, dense, neat layer of stone.
 8. Manufactured Inlet Sediment Control Device: Install device in accordance with manufacturer's instructions and install a curb deflector if appropriate. Inspect device after each rain event and at intervals not exceeding two weeks during construction. Remove, empty, clean, and replace the device as needed during construction. Empty collected sediment in approved, protected location. Remove and dispose of device following full and permanent stabilization of the contributing drainage area.
 9. PAM Turbidity Logs: At a minimum, install logs in drainage structures located immediately upstream of sediment basins and traps. Install additional logs in any other locations indicated on the drawings. Install per manufacturer's instructions. Check logs regularly and after every runoff producing rainfall and replace as needed throughout the duration of construction.
 10. Dewatering Silt Bag: Install silt bag on an undisturbed slope so incoming water flows downhill through the bag without causing erosion. Remove and replace silt bag when device no longer drains efficiently due to accumulated sediment in bag. Empty bag within disturbed limits of the site protected by other sediment control measures.
 11. Compost Filter Logs: Stake filter log every 10-ft. Drive stakes through the center of the log and 1-ft into the ground. If sock netting must be joined, fit beginning of the new sock over the end of the old sock, overlapping by 1-2 ft. Fill with compost and stake the joint.
 12. Other Measures: Other methods of protecting existing structures and facilities, such as vegetative filter strips, diversions, rip-rap, baffle boards, and ditch checks used for reduction of sediment movement and erosion, may be used at the option of the Contractor when approved by the appropriate State or local authorities.
- C. Provide the following, at a minimum, to prevent windblown dust.

1. Apply straw mulch and establish temporary or permanent ground cover on exposed soil where work is not being actively performed.
2. Cover or establish vegetative cover on stockpiles.
3. Apply water or other approved dust suppressant as needed to soil surfaces before they become excessively dry.
4. Sweep and collect soil that has been tracked onto paved surfaces.

3.3 STABILIZATION

- A. Permanently protect stabilized areas prior to the removal of protective devices.
- B. After the final establishment of permanent stabilization, remove temporary sediment control measures. Re-spread accumulated sediments as specified.
- C. Permanently stabilize all areas disturbed by the removal and re-spreading operations immediately.

3.4 TEMPORARY SEEDING

- A. In accordance with the schedule as detailed on the drawings.

3.5 PERMANENT SEEDING

- A. In accordance with the schedule as detailed on the drawings.

3.6 MULCHING AND MATTING

- A. Apply mulch or matting to retain soil and grass.
- B. Mulch areas with slope greater than 5% by spreading a light cover of mulch over seeded area at the rate of not less than 85 lbs. per 1000 sq. ft.
- C. Install temporary matting in all grassed ditches, channels, long slopes, and steep banks (6:1 or steeper) and additional areas indicated on plans or where extra protection from erosion is needed.

END OF SECTION 31 25 00

SECTION 31 31 16 – TERMITE CONTROL**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following for termite control:
 - 1. Soil treatment.

1.2 DEFINITIONS

- A. EPA: Environmental Protection Agency.
- B. PCO: Pest Control Operator.

1.3 SUBMITTALS

- A. Product Data: Treatments and application instructions, including EPA-Registered Label.
- B. Product Certificates: Signed by manufacturers of termite control products certifying that treatments furnished comply with requirements.
- C. 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.
- D. 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.
- E. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

- A. Applicator Qualifications: A PCO 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.
- B. Regulatory Requirements: Formulate and apply termiticides, and label with a Federal registration number, to comply with EPA regulations and North Carolina Department of Agriculture, Structural Pest Control Division.

1.5 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.

1.6 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.

1.7 WARRANTY

- A. General Warranty: Special warranty 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, 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.
- C. Warranty Period: Three years from date of Substantial Completion.

1.8 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 SOIL TREATMENT

- A. Termiticide: Provide an EPA-registered termiticide complying with requirements of authorities having jurisdiction, in a soluble or emulsible, concentrated formulation that dilutes with water or foaming agent, and formulated to prevent termite infestation. Use only soil treatment solutions that are not harmful to plants. 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.

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. 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, Footings, and Basement Slabs: Under ground-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: Adjacent soil including soil along entire inside perimeter of foundation walls, along both sides of interior partition walls, around plumbing pipes and electric conduit penetrating slab, and around interior column footers, piers, and chimney bases; and along entire outside perimeter, from grade to bottom of footing. Avoid soil washout around footings.
 - 3. Crawlspace: Soil under and adjacent to foundations as previously indicated. Treat adjacent areas including around entrance platform, porches, and equipment bases. Apply overall treatment only where attached concrete platform and porches are on fill or ground.
 - 4. Masonry: Treat voids.
 - 5. Penetrations: At expansion joints, control joints, and areas where slabs will be penetrated.
- B. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.
- C. 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.
- D. Post warning signs in areas of application.

- E. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

END OF SECTION 31 31 16

SECTION 31 20 00 – EXCAVATION AND PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes temporary excavation support and protection systems.
- B. Related Requirements:
 - 1. Section 013233 "Photographic Documentation" for recording preexisting conditions and excavation support and protection system progress.
 - 2. Section 312000 "Earth Moving" for excavating and backfilling, for controlling surface-water runoff and ponding, and for dewatering excavations.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review geotechnical report.
 - 2. Review existing utilities and subsurface conditions.
 - 3. Review coordination for interruption, shutoff, capping, and continuation of utility services.
 - 4. Review proposed excavations.
 - 5. Review proposed equipment.
 - 6. Review monitoring of excavation support and protection system.
 - 7. Review coordination with waterproofing.
 - 8. Review abandonment or removal of excavation support and protection system.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, performance properties, and dimensions of individual components and profiles, and calculations for excavation support and protection system.
- B. Shop Drawings: For excavation support and protection system, prepared by or under the supervision of a qualified professional engineer.
 - 1. Include plans, elevations, sections, and details.
 - 2. Show arrangement, locations, and details of soldier piles, piling, lagging, underpinning, tiebacks, bracing, and other components of excavation support and protection system according to engineering design.
 - 3. Indicate type and location of waterproofing.
 - 4. Include a written plan for excavation support and protection, including sequence of construction of support and protection coordinated with progress of excavation.
- C. Delegated-Design Submittal: For excavation support and protection systems, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. After the delegated design submittal has been approved by the design team and before beginning fabrication, submit to the university Building Official for review.

1.5 MATIONAL SUBMITTALS

- A. Qualification Data: For the following:
 1. Land surveyor.
 2. Professional Engineer: Experience with providing delegated-design engineering services of the type indicated, including documentation that engineer is licensed in the state in which Project is located.
- B. Contractor Calculations: For excavation support and protection system. Include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Existing Conditions: Using photographs or video recordings, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by inadequate performance of excavation support and protection systems. Submit before Work begins.

1.6 CLOSEOUT SUBMITTALS

- A. Record Drawings: Identify locations and depths of capped utilities, abandoned-in-place support and protection systems, and other subsurface structural, electrical, or mechanical conditions.

1.7 FIELD CONDITIONS

- A. Interruption of Existing Utilities: Do not interrupt any utility-serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
 1. Notify Architect no fewer than two days in advance of proposed interruption of utility.
 2. Do not proceed with interruption of utility without Architect's written permission.
- B. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design excavation support and protection systems to resist all vertical and lateral loading and surcharge, including but not limited to, retained soil, groundwater pressure, existing building loads, adjacent building loads, adjacent traffic loads, construction traffic loads, material stockpile loads, and seismic loads, based on the following:
 1. Compliance with OSHA Standards and interpretations, 29 CFR 1926, Subpart P.
 2. Compliance with AASHTO Standard Specification for Highway Bridges or AASHTO LRFD Bridge Design Specification, Customary U.S. Units.
 3. Compliance with requirements of authorities having jurisdiction.
 4. Compliance with utility company requirements.
 5. Compliance with railroad requirements.

2.2 MATERIALS

- A. Provide materials that are either new or in serviceable condition.
- B. Structural Steel: ASTM A36/A36M, ASTM A690/A690M, or ASTM A992/A992M.
- C. Steel Sheet Piling: ASTM A328/A328M, ASTM A572/A572M, or ASTM A690/A690M; with continuous interlocks.
 - 1. Corners: Site-fabricated mechanical interlock or Roll-formed corner shape with continuous interlock.
- D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of size and strength required for application.
- E. Shotcrete: Comply with Section 033713 "Shotcrete" for shotcrete materials and mixes, reinforcement, and shotcrete application.
- F. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.
- G. Reinforcing Bars: ASTM A615/A615M, Grade 60 , deformed.
- H. Tiebacks: Steel bars, ASTM A722/A722M.
- I. Tiebacks: Steel strand, ASTM A416/A416M.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.
 - 1. Shore, support, and protect utilities encountered.

3.2 INSTALLATION - GENERAL

- A. Locate excavation support and protection systems clear of new permanent construction, so that construction and finishing of other work is not impeded.
- B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.

3.3 SOLDIER PILES AND LAGGING

- A. Install steel soldier piles before starting excavation.
 - 1. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement.
 - 2. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging.
 - 3. Accurately align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.
- B. Install wood lagging within flanges of soldier piles as excavation proceeds.
 - 1. Trim excavation as required to install lagging.
 - 2. Fill voids behind lagging with soil, and compact.
- C. Install wales horizontally at locations indicated on Drawings and secure to soldier piles.

3.4 SHEET PILING

- A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock vertical edges to form a continuous barrier.
- B. Accurately place the piling using templates and guide frames unless otherwise recommended in writing by the sheet piling manufacturer.
 - 1. Limit vertical offset of adjacent sheet piling to 60 inches.
 - 2. Accurately align exposed faces of sheet piling to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.
- C. Cut tops of sheet piling to uniform elevation at top of excavation.

3.5 TIEBACKS

- A. Drill, install, grout, and tension tiebacks.
- B. Test load-carrying capacity of each tieback, and replace and retest deficient tiebacks.
 - 1. Have test loading observed by a qualified professional engineer responsible for design of excavation support and protection system.
- C. Maintain tiebacks in place until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.6 BRACING

- A. Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.
 - 1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by Architect.
 - 2. Install internal bracing if required to prevent spreading or distortion of braced frames.
 - 3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.7 UNDERPINNING

- A. Install underpinning under existing structures as required to provide permanent vertical and lateral support for the existing construction during the process of excavation and construction for the new adjacent structures
- B. Underpinning shall consist of solid concrete the full width of the existing foundations to be underpinned from the bottom of the existing footing to the appropriate grade.
 - 1. Install the underpinning in vertical and horizontal unit dimensions as required for safe installation.
 - 2. Install tie backs as required.
 - 3. Ensure there are no voids under the existing structure.

3.8 MAINTENANCE

- A. Monitor and maintain excavation support and protection system.
- B. Prevent surface water from entering excavations by grading, dikes, or other means.
- C. Continuously monitor vibrations, settlements, and movements to ensure stability of excavations and constructed slopes and to ensure that damage to permanent structures is prevented.

3.9 FIELD QUALITY CONTROL

- A. Survey-Work Benchmarks: Resurvey benchmarks regularly during installation of excavation support and protection systems, excavation progress, and for as long as excavation remains open.
 - 1. Maintain an accurate log of surveyed elevations and positions for comparison with original elevations and positions.
 - 2. Promptly notify Architect if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.
- B. Promptly correct detected bulges, breakage, or other evidence of movement to ensure that excavation support and protection system remains stable.
- C. Promptly repair damages to adjacent facilities caused by installation or faulty performance of excavation support and protection systems.

3.10 REMOVAL AND REPAIRS

- A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and earth and hydrostatic pressures.
 - 1. Remove in stages to avoid disturbing underlying soils and rock or damaging structures, pavements, facilities, and utilities.
 - 2. Remove excavation support and protection systems to a minimum depth of 48 inches below overlying construction, and abandon remainder.
 - 3. Fill voids immediately with approved backfill compacted to density specified in Section 312010 "Earth Moving for Buildings."
 - 4. Repair or replace, as approved by Architect, adjacent work damaged or displaced by removing excavation support and protection systems.
- B. Leave excavation support and protection systems permanently in place.

END OF SECTION 315000

DIVISION 32
EXTERIOR IMPROVEMENTS

SECTION 32 12 16 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes provisions for hot-mixed asphalt paving over prepared subbase.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Material Certificates signed by material producer and Contractor, certifying that each material item complies with or exceeds specified requirements of NCDOT "Standard Specifications for Roads and Structures".
- C. Job Mix Formula: Provide Geotechnical consultant with two copies of the proposed job mix formula at least ten days prior to beginning work. This formula shall be approved by NCDOT for the type of pavement specified.
- D. Recycled Content: 15% minimum, or as approved by NCDOT except as noted below.
 - 1. No Recycled Asphalt Pavement (RAP) shall be used in the asphalt pavement mix for exterior athletic surfacing.
- E. Manufacturer's product data sheet for paved play area striping for all colors.

1.4 SITE CONDITIONS

- A. Weather Limitations for Prime and Tack Coats: Apply prime and tack coats only when the surface to be treated is dry and when the atmospheric temperature measured at the location of paving operations away from artificial heat are in compliance with current NCDOT Standard Specifications for Roads and Structures. Do not apply tack coat when weather is foggy or rainy.
- B. Weather Limitations for Asphalt Courses: Apply hot-mixed asphalt surface, intermediate and base courses when surface and air temperatures are in compliance with current NCDOT Standard Specifications for Roads and Structures and when base is dry.
- C. Grade Control: Establish and maintain required lines and elevations.
- D. Traffic Control: Provide traffic control devices, lane closures, positive protection and/or any other warning or positive protection devices necessary for the safety of road users and pedestrians during construction.
 - 1. Traffic control shall be performed in conformance with the latest NCDOT Roadway Standard Drawings and Standard Specifications for Roads and Structures and the Manual on Uniform Traffic Control Devices for Streets and Highways.
 - 2. Sidewalk closures shall be installed as necessary. Pedestrian traffic shall be detoured around these closures and shall be signed appropriately and in accordance with ADA guidelines.
 - 3. Two-way traffic shall be maintained at all times through use of flagmen when necessary.
 - 4. Maintain access for fire-fighting equipment and access to fire hydrants.

1.5 QUALITY ASSURANCE

- A. All materials, construction methods and testing shall comply with the requirements of the latest editions of the North Carolina Department of Transportation (NCDOT) "Standard Specifications for Roads and Structures" and the Asphalt Handbook Manual Series No. 4 (MS-4).
- B. All work within any NCDOT right-of-way shall conform to the provisions and conditions of the NCDOT encroachment agreement(s) and driveway permit(s) and other applicable NCDOT standards and policies. The encroachment agreement(s) and driveway permit(s) are considered part of the project specifications by reference. Copies of the agreement(s) and permit(s) will be provided upon request from the Architect.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Use locally available materials and gradations that comply with the requirements of the NCDOT "Standard Specifications for Roads and Structures" and exhibit a satisfactory record of previous installations.
- B. Aggregate Base Course (ABC): Type A aggregate base course meeting the requirements of the latest version of NCDOT "Standard Specifications for Roads and Structures."
- C. Superpave Asphalt Paving Mix: Superpave base, intermediate and surface asphalt paving mix meeting the requirements of the latest version of NCDOT "Standard Specifications for Roads and Structures." Types as indicated on the drawings.
- D. Tack Coat: Asphalt material meeting the requirement of the latest version of NCDOT "Standard Specifications for Roads and Structures."
- E. Parking Lot Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than 45 minutes.
 - 1. Color: White for parking and bus lot striping.
 - 2. Color: Yellow for fire lanes and service area striping.
- F. Roadway Pavement Marking Paint: Thermoplastic Alkyd/Maleic and Hydrocarbon type, meeting the requirements of Section 1087 of NCDOT "Standard Specifications for Roads and Structures."
 - 1. Color: As indicated on the drawings.
- G. Paved Play Pavement Marking Paint: Acrylic or latex, lead and chromate free, low VOC traffic marking paint.
 - 1. Color: As indicated on the drawings.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. General: Remove loose material from compacted subbase surface immediately before applying base courses of asphalt.
- B. Proof-roll prepared subgrade surface as described in Section "Earth Moving" to check for unstable areas and areas requiring additional compaction.
- C. Do not begin paving work until deficient subbase areas have been corrected and are ready to receive paving. Ensure subgrade is graded for proper drainage. Repair as needed to avoid ponding on final pavement surfaces.
- D. Cold mill surfaces of existing pavements in locations and to depths as indicated on the drawings and as follows.
 - 1. At edges of existing pavement to be overlaid: Cold mill surfaces of existing pavements to a minimum depth of 1.5-inches at longitudinal terminus of asphalt overlays for a minimum width of 10 feet (extend terminus milling width to 100-ft on public roads) and at horizontal terminus (including along gutter line of existing curbs adjacent to asphalt overlays) for a minimum width of 6 feet to allow a smooth transition from full-depth thickness of overlay course to existing pavement or gutter surface. Thoroughly remove all loose material from milled surface before placing tack coat.
 - 2. At pavement to be wedge overlaid: Cold mill surfaces of existing pavements to required depths at edges of asphalt wedge sections on public roads for widths needed to allow minimum depth thickness of wedge course. Thoroughly remove all loose material from milled surface before placing tack coat.
 - 3. At butt joint of new asphalt to existing asphalt: Cold mill surfaces of existing pavements to a minimum depth of 1.5-inches for a minimum width of 12-inches along length of new joint to allow new asphalt surface to be keyed-in to the existing pavement. Thoroughly remove all loose material from milled surface before placing tack coat.
- E. Thoroughly remove all dust and loose material from surfaces of that which the tack coat is to be applied along with adjacent surfaces before placing tack coat.

- F. Apply tack coat to all contact surfaces of milled asphalt, existing asphalt to be overlaid, and surfaces abutting or projecting into hot-mixed asphalt pavement including the vertical face of adjacent concrete gutter. Distribute evenly and thoroughly at a rate of 0.04 to 0.08 gallons per sq. yd. of surface.
1. Apply only as much tack coat as can be covered during the same day's operation.
 2. Take necessary precautions to limit the tracking and/or accumulation of tack coat material on either existing or newly constructed pavements. Excessive accumulation of tack may require corrective measures.
 3. Apply tack coat material with a distributor spray bar that can be adjusted to uniformly coat the entire surface at the directed rate. Use hand hose attachments only on irregular area and areas inaccessible to the spray bar. Cover these areas uniformly and completely.
 4. Apply tack coat to contact surfaces of gutters, concrete pavements, manholes, vertical faces of old pavements, and all exposed transverse and longitudinal edges of each course before mixture is placed adjacent to such surfaces.
 5. Cover curbs, adjacent concrete, and all other appurtenances to protect them from tracking or splattering tack coat material.
 6. Do not place any asphalt mixture until the tack coat has sufficiently cured.
- G. Allow to dry until at proper condition to receive paving.
- H. Exercise care in applying bituminous materials to avoid smearing of adjoining concrete surfaces. Remove and clean damaged surfaces.
- I. Place aggregate base courses as specified in Section "Earth Moving".

3.2 PLACING MIX

- A. Limitations: Do not produce or place asphalt mixtures during rainy weather, when the subgrade or base course is frozen, or when the moisture on the surface to be paved would prevent proper bond. Comply with all NCDOT weather and temperature limitations.
- B. General: Place hot-mixed asphalt mixture on prepared surface, spread, and strike off. Spread mixture at minimum temperature of 225 deg F. Place areas inaccessible to equipment by hand. Place each course to required grade, cross-section, and compacted thickness.
- C. Paver Placing: Place in strips not less than 10 feet wide, unless otherwise acceptable to Architect. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete base course for a section before placing surface course.
- D. Immediately correct surface irregularities in finish course behind paver. Remove excess material forming high spots with shovel or lute.
- E. Joints: Make joints between old and new pavements, or between successive days' work, to ensure continuous bond between adjoining work. Construct joints to have same texture, density, and smoothness as other sections of hot-mixed asphalt course. Clean contact surfaces and apply tack coat.

3.3 ROLLING

- A. General: Begin rolling when mixture will bear roller weight without excessive displacement.
- B. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.
- C. Breakdown Rolling: Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling and repair displaced areas by loosening and filling, if required, with hot material.
- D. Second Rolling: Follow breakdown rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been evenly compacted.
- E. Finish Rolling: Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained required density. Compact the asphalt to at least the minimum percentage of the maximum specific gravity listed below unless otherwise allowed by NCDOT.
1. SF-9.5A: 90.0% of Maximum Specific Gravity

2. S-9.5B/C, I-19.0B/C, B-25.0B/C: 92.0% of Maximum Specific Gravity.

- F. Patching: Remove and replace paving areas mixed with foreign materials and defective areas. Cut out such areas and fill with fresh, hot hot-mixed asphalt. Compact by rolling to specified surface density and smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.4 TRAFFIC MARKINGS

- A. Cleaning: Sweep and clean surface to eliminate loose material and dust.
- B. Materials: Use thermoplastic marking for permanent markings on public streets and stop bars and crosswalks on private drives and parking lots. Use marking paint for parking and fire lane striping and other markings on private drives and parking lots.
- C. Apply traffic paint with mechanical equipment to produce uniform straight edges. Apply at manufacturer's recommended rates to provide minimum 12 to 15 mils dry thickness.
- D. Apply thermoplastic markings using application equipment constructed to assure continuous uniformity in the thickness and width of the thermoplastic pavement marking. Use equipment that provides multiple width settings ranging from 4 inches to 12 inches and multiple thickness settings to achieve the pavement marking thickness ranging from 0.090 inch to 0.120 inch. Comply with all applicable NCDOT standards.

3.5 PAVED PLAY STRIPING

- A. Cleaning: Remove all oil, dust, grease, dirt, loose rust, and other foreign material to ensure adequate adhesion.
- B. Surface Preparation: Surfaces shall be cured, clean, dry and sound. Remove all peeling paint from existing surfaces. Concrete surfaces shall cure minimum 30 days, asphalt surfaces shall cure minimum 6 weeks. Concrete sealers or efflorescence of new concrete should be removed by extended weathering, etching or abrasive blasting.
- C. Application Conditions: 50° min., 90° maximum (air, surface, and materials) at least 5° above dew point. Relative humidity 85% maximum.
- D. Tinting: Mix colors per manufacturer's specification. Only mix like paints (do not mix latex with acrylic or interior paints with exterior paints) to achieve required colors.
- E. Apply at manufacturer's recommended rates to provide minimum 15 mils dry thickness. Special care shall be given to laps and edges of stencils to prevent excessive film thickness.

3.6 FIELD QUALITY CONTROL

- A. General: Testing of asphalt concrete mix and in-place hot-mixed asphalt courses for compliance with requirements for thickness and surface smoothness will be done by Owner's testing laboratory in accordance with Division 1 Section "Quality Control." Repair or remove and replace unacceptable paving as directed by Architect.
 1. Owner's Independent Testing Agency will conduct and interpret tests and state in each report whether tested work complies with or deviates from the specified requirements.
- B. Thickness: In-place compacted thickness of each layer of asphalt shall be tested in accordance with ASTM D 3549. Results shall be considered unacceptable if the compacted thickness of any one core sample is greater than 1/2-inch below the thickness specified on the drawings or if the average thickness of all core samples is less than the thickness specified on the drawings.
- C. Surface Smoothness: Test finished surface of each hot-mixed asphalt course for smoothness, using 10 feet straightedge applied parallel with and at right angles to centerline of paved area. Surfaces will not be acceptable if exceeding the following tolerances for smoothness:
 1. Base Course Surface: 1/4 inch.
 2. Wearing Course Surface: 3/16 inch.
 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

- D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979 or AASHTO T 168.
 - 1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
 - 2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
 - a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.
 - b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.
- E. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.
- F. Contractor shall repair all test core holes with full depth asphalt patch.
- G. Perform ponding water tests. Repair areas of pavement that pond water.
- H. Check surface areas at intervals as directed by Architect.

END OF SECTION 32 12 16

SECTION 32 13 13 - CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes exterior portland cement concrete paving for the following:
 - 1. Curbs and gutters, pavement, walkways, service court, dumpster pads.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 31 Section "Earth Moving" for subgrade preparation, grading and subbase course.
 - 2. Division 03 Section "Cast-in-Place Concrete" for general building applications of concrete.
 - 3. Division 07 Section "Sealants and Caulking" for joint fillers and sealants within concrete paving and at joints with adjacent construction.

1.3 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Product data for proprietary materials and items, including reinforcement and forming accessories, admixtures, joint systems, curing compounds, dry-shake finish materials, and others if requested by Architect.
- C. Design mixes for each class of concrete. Include percentage of recycled content (20% minimum). Include revised mix proportions when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
- D. Scaled plan of proposed construction, expansion and control joint locations in concrete pavement and concrete sidewalk. Submittal of plans for joints in curb and gutter or longitudinal sidewalk 6-feet or less in width is not required.

1.4 QUALITY ASSURANCE

- A. Concrete Standards: Comply with provisions of the following standards, except where more stringent requirements are indicated.
 - 1. American Concrete Institute (ACI) 301, "Specifications for Structural Concrete for Buildings."
 - 2. ACI 318, "Building Code Requirements for Reinforced Concrete."
 - 4. Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice."
- B. Concrete Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
- C. Concrete Testing Service: Engage a qualified independent testing agency to perform materials evaluation tests and to design concrete mixes.
- D. All work within any NCDOT right-of-way shall conform to the requirements of the current version of the NCDOT's Policies and Procedures for Accommodating Utilities on Highway Rights of Way, the provisions and conditions of the encroachment agreement(s), and other applicable NCDOT standards and policies. The encroachment agreement(s) are considered part of the project specifications by reference. Copies of the agreement(s) will be provided upon request from the Architect.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
 1. Use flexible or curved forms for curves with a radius 100 feet or less.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

- A. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
- B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.
- C. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60, deformed bars; assembled with clips.
- D. Plain Steel Wire: ASTM A 82, as drawn.
- E. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs. Electroplated zinc steel plates, ASTM A 108, ASTM B633 with corresponding pocket former.
- F. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.
- G. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete, and as follows:
 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use one of the following cementitious materials, of the same type, brand, and source throughout the Project:
 1. Portland Cement: ASTM C 150, portland cement, Type I, II, or III.
 - a. Fly Ash: ASTM C 618, Class F. Up to 30% by weight of required cement content, with 1.0-lbs Fly Ash per 1-lb of cement replaced.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120 with 1-lb slag per 1-lb of cement replaced.
- B. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate, uniformly graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar pavement applications and service conditions using similar aggregates and cementitious materials.
 1. Maximum Coarse-Aggregate Size: 1-1/2 inches nominal.
 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94/C 94M, potable.
- D. Air-Entraining Admixture: ASTM C 260.

- E. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.5 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.
- E. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

2.6 RELATED MATERIALS

- A. Expansion and Isolation Joint Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Wheel Stops: Precast, air-entrained concrete; 2500-psi minimum compressive strength; approximately 6 inches high, 9 inches wide, and 84 inches long. Provide chamfered corners and drainage slots on underside and provide holes for dowel-anchoring to substrate.
 1. Dowels: Galvanized steel, diameter of $\frac{3}{4}$ inch, minimum length 10 inches.
- C. Slip Resistive Aggregate Finish: Factory-graded, packaged, rustproof, non-glazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 25 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.
- D. Bonding Agent: ASTM C 1059, Acrylic or styrene butadiene.
- E. Epoxy Adhesive: ASTM C 881, two-component material suitable for dry or damp surfaces. Provide material type, grade, and class to suit requirements.

2.7 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.
 1. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs for the trial batch method.
- B. Proportion mixtures to provide normal-weight concrete with the following properties:
 1. Compressive Strength (28 Days): 4,500-psi, 4000 psi, 3500 psi, or 3000 psi as indicated on the drawings.
 2. Maximum Water-Cementitious Materials Ratio at Point of Placement: As specified by NCDOT Standard Specifications for class of concrete indicated.
 3. Slump Limit: Maximum 3.5 inches for non-vibrated, maximum 4 inches for vibrated.
- C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
 1. Air Content: 5-1/2 percent plus or minus 1.5 percent for 1-1/2-inch (38-mm) nominal maximum aggregate size.

2. Air Content: 6 percent plus or minus 1.5 percent for 1-inch (25-mm) nominal maximum aggregate size.
3. Air Content: 6 percent plus or minus 1.5 percent for 3/4-inch (19-mm) nominal maximum aggregate size.

D. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use admixtures 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.

E. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements as follows:

1. Fly Ash: 30 percent.
2. Ground Granulated Blast-Furnace Slag: 50 percent.
3. Combined Fly Ash, and Ground Granulated Blast-Furnace Slag: 50 percent, with fly ash not exceeding 20 percent.

F. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 deg F 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.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For concrete mixes of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For concrete mixes larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

2.9 JOINT SEALANTS

A. Type SL Silicone Sealant for Concrete and Asphalt: Single-component, low modulus, neutral-curing, self-leveling silicone sealant complying with ASTM D 5893 for Type SL.

B. Round Backer Rod for Cold-Applied Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depths and pavement bottom-side adhesion of sealant.

2.10 PAVEMENT MARKINGS

A. Paved Play Pavement Marking Paint: Acrylic or latex, lead and chromate free, low VOC traffic marking paint formulated for concrete surfaces.

1. Color: As indicated on the drawings.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

A. Proof-roll prepared subbase surface to check for unstable areas and verify need for additional compaction. Do not begin paving work until such conditions have been corrected and are ready to receive paving. Ensure subgrade is graded for proper drainage. Repair as needed to avoid ponding on final pavement surfaces.

B. Remove loose material from compacted subbase surface immediately before placing concrete.

- C. Herbicide Treatment: Apply chemical weed control agent in strict compliance with manufacturer's recommended dosages and application instructions. Apply to compacted, dry subbase.
- D. Place aggregate base courses as specified in Division 31 Section "Earth Moving".

3.2 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for paving to required lines, grades, and elevations. Install forms to allow continuous progress of work and so that forms can remain in place at least 24 hours after concrete placement. Set forms to ensure positive drainage and compliance with ADA and Building Code requirements.
- B. Check completed formwork and screeds for grade and alignment to following tolerances:
 1. Top of Forms: Not more than 1/8 inch in 10 feet.
 2. Vertical Face on Longitudinal Axis: Not more than 1/4 inch in 10 feet.
- C. Clean forms after each use and coat with form release agent as required to ensure separation from concrete without damage.

3.3 PLACING REINFORCEMENT

- A. General: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars" for placing and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded wire fabric in lengths as long as practicable at mid depth of concrete. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.4 JOINTS

- A. General: Refer to the project plans and details for additional requirements.
 1. Construct contraction, construction, and isolation joints true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to the centerline, unless indicated otherwise.
 2. When joining existing paving, place transverse joints to align with previously placed joints, unless indicated otherwise.
- C. Contraction (Control) Joints: Provide weakened-plane contraction joints, sectioning concrete into areas as indicated below unless shown otherwise on Drawings. Construct contraction joints for a depth equal to at least 1/4 of the concrete thickness, as follows:
 1. Tooled Joints: Form contraction joints in fresh concrete by grooving and finishing each edge of joint with a radiused jointer tool.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into hardened concrete when cutting action will not tear, abrade, or otherwise damage surface and before development of random contraction cracks.
 3. Inserts: Form contraction joints by inserting premolded plastic, hardboard, or fiberboard strips into fresh concrete until top surface of strip is flush with paving surface. Radius each joint edge with a jointer tool. Carefully remove strips or caps of two-piece assemblies after concrete has hardened. Clean groove of loose debris.
 4. Spacing:
 - a. Concrete Pavement (4-in to 4.5-in thick slabs): Locate contraction joints at 10-ft max. intervals, each way in concrete pavement.
 - b. Concrete Pavement (5-in to 5.5-in thick slabs): Locate contraction joints at 12.5-ft max. intervals, each way in concrete pavement.
 - c. Concrete Pavement (6-in and greater thick slabs): Locate contraction joints at 15-ft max. intervals, each way in concrete pavement.

- d. Sidewalk & Patios (4-in thick slabs): Locate contraction joints at 5-ft max. intervals, each way in concrete sidewalks/patios unless shown otherwise. Locate contraction joints in sidewalks less than 8-ft in width at 5-ft intervals across the walk. Locate contraction joints in sidewalks of 8-ft and greater width at 5-ft intervals across the walk and equally section the walk lengthwise with joints at 5-ft. max. intervals (example: an 8-ft wide walk shall have contraction joints at 5-ft. spacing across the walk and one joint dividing the walk lengthwise into two, equal 4-ft sections.)
 - e. Curbs or Curb & Gutter: Locate contraction joints at 10-ft max. intervals in concrete curbs or concrete curb and gutter.
5. Dowels: Some concrete pavement applications in very heavy load locations (such as fire stations) require dowels at contraction joints. Refer to the drawings for specific details for such requirements.
- C. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than 1/2 hour, unless paving terminates at isolation joints.
- 1. Continue reinforcement across construction joints unless indicated otherwise. Do not continue reinforcement through sides of strip paving unless indicated.
 - 2. Provide tie bars at sides of paving strips where indicated.
 - 3. Use bonding agent on existing concrete surfaces that will be joined with fresh concrete.
- D. Isolation (expansion) Joints: Form isolation joints of preformed joint filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
- 1. General spacing: Locate additional expansion joints at the following intervals unless indicated otherwise on the drawings.
 - a. Pavement (greater than 4-in thick slabs): None in addition to located specified above.
 - b. Sidewalks (4-in thick slabs): 30-ft each way.
 - c. Curbs or Curb & Gutter: 90-ft spacing.
 - 2. Extend joint fillers full width and depth of joint 1/2 inch below finished surface where joint sealant is indicated. Place top of joint filler flush with finished concrete surface when no joint sealant is required.
 - 3. Furnish joint fillers in one-piece lengths for full width being placed wherever possible. Where more than one length is required, lace or clip joint filler sections together.
 - 4. Protect top edge of joint filler during concrete placement with a metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- E. Dowel Joints: Install dowel sleeves and dowels or dowel bar and support assemblies at joints where indicated
- 1. Use dowel sleeves or lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.
 - 2. Diamond Dowel System is acceptable in lieu of round dowels. Contractor to provide submittal information to Engineer for review/approval. Install per manufacturer recommendations.

3.5 CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work. Ensure forms are set to ensure water will not pond on final surface.
- B. Remove snow, ice, or frost from base surface and reinforcing before placing concrete. Do not place concrete on surfaces that are frozen.
- C. Moisten base to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.
- D. Comply with requirements and with ACI 304R for measuring, mixing, transporting, and placing concrete.
- E. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- F. Form and pour concrete pavement with thickened edges along all edges that could be subject to vehicle wheel loads, do not abut a building or wall, or are not doweled to the adjacent pavement or structure.

- G. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- H. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures to consolidate concrete complying with ACI 309R.
1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocating reinforcing, dowels, and joint devices.
- I. Screed paved surfaces with a straightedge and strike off. Use bull floats or darbies to form a smooth surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces prior to beginning finishing operations.
- J. Place concrete in two operations; strike off initial pour for entire width of placement and to the required depth below finish surface. Lay welded wire fabric or fabricated bar mats immediately in final position. Place top layer of concrete, strike off, and screed.
1. Remove and replace portions of bottom layer of concrete that have been placed more than 15 minutes without being covered by top layer or use bonding agent if acceptable to Architect.
- K. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete.
1. Spill Gutters: Form and install curb and gutter with gutter pans that spill at ¼" per foot slope away from the curb in the following locations. Do not install curb and gutter that will pond water.
 - a. Outside of the Public Right of Way: Provide spill gutter where curb and gutter is located adjacent to pavement surfaces that slope away from curb.
 - b. Within the Public Right of Way: Slope gutter per NCDOT Standard Drawing 846.01.
- L. Cold-Weather Placement: Comply with provisions of ACI 306R and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When air temperature has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
 2. Do not use frozen materials or materials containing ice or snow.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.
- M. Hot-Weather Placement: Place concrete complying with ACI 305R and as specified when hot weather conditions exist.
1. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 deg F (32 deg C). Mixing water may be chilled or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.
 3. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.6 CONCRETE FINISHING

- A. Float Finish: Begin floating when bleed water sheen has disappeared and the concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Finish surfaces to true planes within a tolerance of 1/4 inch in 10 feet as determined by a 10-foot-long straightedge placed anywhere on the surface in any direction. Cut down high spots and fill low spots to ensure positive drainage and eliminate ponding. Refloat surface immediately to a uniform granular texture.

1. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across all site concrete sidewalk and pavement surfaces perpendicular to line of traffic to provide a uniform fine line texture finish.
 2. Very Fine Textured Broom Finish: Draw a very fine soft bristle broom across all concrete Play Area and Basketball Court surfaces perpendicular to direction of play to provide a uniform fine line texture finish for concrete.
- B. Final Tooling: Tool edges of paving, gutters, curbs, and joints formed in fresh concrete with a jointing tool to a radius of ¼-inch unless indicated otherwise on the drawings. Repeat tooling of edges and joints after applying surface finishes. Eliminate tool marks on concrete surfaces.
- C. Step Tread Grooves: Tool three (3) parallel grooves along entire top front edge of new concrete stair treads.

3.7 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with the recommendations of ACI 306R for cold weather protection and ACI 305R for hot weather protection during curing.
- B. Evaporation Control: In hot, dry, and windy weather, protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply according to manufacturer's instructions after screeding and bull floating, but before floating.
- C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- D. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:
1. Moisture Curing: Keep surfaces continuously moist for not less than 7 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 a 12-inch lap over adjacent absorptive covers.
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.8 FIELD QUALITY CONTROL TESTING

- A. The Owner shall employ an independent testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement in accordance with Division 01 Section "Quality Control" and as follows:
1. When total quantity of a given class of concrete is less than 50 cu. yd., Architect may waive strength testing if adequate evidence of satisfactory strength is provided.
 2. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
 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; 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 it is 80 deg F and above, and one test for each composite sample.
 5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
 6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mixture will be satisfactory if 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.
- D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within one week of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
- G. Concrete paving will be considered defective if it does not pass tests and inspections.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.9 REPAIRS AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective, or does not meet the requirements of this Section.
- B. Drill test cores where directed by Architect when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep concrete paving not more than 2 days prior to date scheduled for Substantial Completion inspections.
- E. Remove and replace concrete paving or curb and gutter that ponds water.

END OF SECTION 32 13 13

SECTION 32 31 13 - 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. This Section includes the following:
 - 1. Galvanized-steel chain link fabric.
 - 2. Galvanized-steel framework.
 - 3. Swing Gates.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 31, Section "Earth Moving" for filling and grading work.
 - 2. Division 03, Section "Cast-in-Place Concrete" for concrete for post footings.

1.3 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Product data in the form of manufacturer's technical data, specifications, and installation instructions for fence and gate posts, gates and accessories.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has at least three years' experience and has completed at least five chain link fence projects with same material and of similar scope to that indicated for this Project with a successful construction record of in-service performance.
- B. Single-Source Responsibility: Obtain chain link fences and gates, including accessories, fittings, and fastenings, from a single source.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify layout information for fences and gates shown on the Drawings in relation to the property survey and existing structures. Verify dimensions by field measurements.

PART 2 - PRODUCTS

2.1 FABRIC

- A. Steel Chain-Link Fence Fabric: Fabricated in one-piece widths for fencing 12 feet and less in height to comply with Chain Link Fence Manufacturers Institute (CLFMI) "Product Manual" and with requirements indicated below:
 - 1. Mesh and Wire Size: Shall be as follows:
 - a. Standard Fence: 2-inch mesh, 0.148-inch diameter (#9 gauge) inner core, knuckled selvage top and bottom. Do not extend fabric above the top rail.
 - b. Temporary Construction Fence: Maximum 2-1/4 inch mesh, minimum 0.106-inch diameter (#12 gauge) inner core.
 - 2. Standard Fence Fabric shall be zinc or aluminum coated with final vinyl-coated unless otherwise indicated on the drawings. Vinyl coating is not required on Temporary Construction Fence fabric.

SECTION 32 31 13 – CHAIN LINK FENCES AND GATES

- a. Zinc-coated: Galvanized, ASTM A 392, Class II, with not less than 2 oz. zinc per sq. ft. of surface.
- b. Aluminum-coated: ASTM A 491, Type I, 0.40 oz./sq. ft. (122 g/sq. m).
- c. Vinyl-coated: ASTM F668, Class 2b thermally fused and bonded. Color: black unless noted otherwise. Coating shall be applied in addition to zinc or aluminum coating. Required mesh wire gauge shall be inner core gauge.

2.2 FITTINGS AND ACCESSORIES

- A. Galvanized, ASTM A 153.
- B. Polymer coating over galvanized. Provide electro-statically applied, 3-mil color polymer-coating on all fittings and accessories with the exception of Temporary Construction Fence.

2.3 FRAMING AND ACCESSORIES

- A. Manufacture framing of galvanized steel, ASTM A 120 or ASTM A 123, with not less than 1.8 oz. Zinc per sq. ft. of surface. Provide electro-statically applied, 3-mil color polymer-coating on all framing and accessories where "PVC" or "vinyl" coated fence is indicated on the drawings.

- 1. End, corner and pull posts: Shall have minimum sizes and weights as follows:

Up to 6' fabric height (without privacy slats or wind screens), 2.375" OD steel pipe, 3.65 lbs. per linear foot or 3.5" x 3.5" roll-formed sections, 4.85 lbs. per linear foot.

Up to 6' height (with privacy slats or wind screens), 2.875" OD steel pipe, 5.79 lbs. per linear foot, or 3.5" x 3.5" roll-formed sections, 4.85 lbs. per linear foot.

Over 6' height, 2.875" OD steel pipe, 5.79 lbs. Per linear foot, or 3.5" x 3.5" roll-formed sections, 4.85 lbs. Per linear foot.

- 2. Line Post: Space line posts 10' o.c. maximum for standard fence and 8' o.c. for fence with privacy slats or wind screens, unless otherwise indicated, of following sizes and weights:

Up to 6' fabric height (without privacy slats or wind screens), 1.9" OD steel pipe, 2.7 lbs. per linear feet, or 1.875" x 1.625" C-sections, 2.28 lbs. per linear foot.

Up to 6' fabric height (with privacy slats or wind screens), 2.375" OD steel pipe, 3.65 lbs. per linear foot, or 2.25" x 1.875" H-sections, 2.64 lbs. per linear foot.

Over 8' fabric height, 2.875" OD steel pipe, 5.79 lbs. per linear foot, or 2.25" x 1.875" H-Sections, 3.26 lbs. per linear foot.

- 3. Swing Gate Posts: Furnish gate posts for supporting single gate leaf, or one leaf of a double gate installation, for nominal gate widths as follows:

<u>Leaf Width</u>	<u>Gate Post</u>	<u>Lbs./Linear Foot</u>
Up to 6 ft.....	2.875" OD pipe	5.79
Over 6' to 13'	4.000" OD pipe	9.11
Over 13' to 18'	6.625" OD pipe	18.97
Over 18'	8.625" OD pipe	28.55

- 4. Top, Intermediate and Bottom Rails: Rail pipe sections shall not be less than 18' long and shall be fitted with couplings for connected lengths into a continuous run. The couplings shall be not less than 6' long, with 0.070 minimum wall thickness, and shall allow for expansion and contraction of the rail. Open seam outside sleeves shall be permitted only with a minimum wall thickness of 0.100". The rail shall pass through the line post tops. Rails shall be securely fastened to terminal posts by either pressed steel or malleable steel galvanized connections. Tension wire may be used in lieu of top and bottom rails for temporary construction fence only.

5. Tension Wire: Provide 7-gauge, coated coil spring tension wire (metal and finish to match fabric) and located at bottom and top of fabric.
6. Post Brace Assembly: Provide manufacturer's standard adjustable brace at end and gate posts and at both sides of corner and pull posts, with horizontal brace located at mid-height of fabric. Use 1.66" OD pipe, 2.27 lbs. per linear foot, or equal, for brace, and truss to line posts with 0.375" diameter rod and adjustable tightener.
7. Post Tops: Provide weather tight closure cap with loop to receive tension wire or top rail, one cap for each post.
8. Stretcher Bars: One-piece lengths equal to full height of fabric, with minimum cross-section of 3/16" x 3/4". Provide one stretcher bar for each gate and end post, and for each corner and pull post, except where fabric is integrally woven into post. Space stretcher bar bands not over 15" o.c. to secure stretcher bars to end, corner, pull and gate posts.
9. Swing Gates: Fabricate perimeter frames of gates from minimum 1.9" OD pipe with finish to match fence framework. Assemble gate frames by welding or with special fittings and rivets for rigid connections, providing security against removal or breakage connections. Provide horizontal and vertical members to ensure proper gate operation and attachment of fabric, hardware and accessories. Space frame members maximum of 8' apart unless otherwise indicated. Provide same fabric as for fence, unless otherwise indicated. Install fabric with stretcher bars at vertical edges and at top and bottom edges. Attach stretcher bars to gate frame at not more than 15" o.c. Install diagonal cross-bracing, consisting of 3/8" diameter adjustable length truss rods on gates to ensure frame rigidity without sag or twist.
10. Swing Gate Hardware: Provide hardware and accessories for each gate, galvanized per ASTM A 153. Hinges shall be size and material to suit gate size, non-lift-off type, offset nominal height. Latch shall be forked type or plunger-bar type to permit operation from either side of gate, with padlock eye as integral part of latch. Provide keeper for vehicle gates, which automatically engages gate leaf and holds it in open position until manually released. For double gates, provide gate stops consisting of mushroom type flush plate with anchors, set in concrete, and designed to engage center drop rod or plunger bar. Include locking device and padlock eyes as integral part of latch, permitting both gate leaves to be locked with single padlock.
11. Wire ties: For tying fabric to line posts, use wire ties spaces 12" o.c. For tying fabric to rails and braces, use wire ties spaced 24" o.c. For tying fabric to tension wire, use hog rings spaced 24" o.c. Manufacturer's standard procedure will be accepted if of equal strength and durability.
12. Pre-K Gate Panic Bar: Provide panic bar and hardware to allow immediate egress from school side of outdoor Pre-K play area. Bar shall have surface-mount strike with no open space gaps to eliminate pinching fingers anywhere on the bar. Assembly shall be weather resistant, anodized aluminum finish, stainless steel latch mechanism.

2.4 CONCRETE

- A. Concrete: Provide concrete consisting of portland cement per ASTM C 150, aggregates per ASTM C 33, and potable water. Mix materials to obtain concrete with a minimum 28-day compressive strength of 3000 psi. Use at least four sacks of cement per cu. yd., 1-inch maximum size aggregate, 3-inch maximum slump.
- B. Packaged Concrete Mix: Mix dry-packaged normal-weight concrete conforming to ASTM C 387 with clean water to obtain a 2- to 3-inch slump.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install fence to comply with ASTM F 567. Do not begin installation and erection before final grading is completed, unless otherwise permitted.
 1. Apply fabric to outside of framework of Standard Site Fence

SECTION 32 31 13 – CHAIN LINK FENCES AND GATES

2. Cut all bolts flush with nut. Leave no sharp protruding edges.
- B. Excavation: Drill or hand-excavate (using post-hole digger) holes for posts to diameters and spacings indicated, in firm, undisturbed or compacted soil.
1. If not indicated on Drawings, excavate holes for each post to minimum diameter recommended by fence manufacturer, but not less than four times the largest cross section of post.
- C. Setting Posts: Center and align posts in holes 3 inches above bottom of excavation. Space a maximum of 10 feet o.c., unless otherwise indicated. Space posts a maximum of 8 feet o.c. where privacy slats or wind screens are to be installed.
1. Protect portion of posts above ground from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment and hold in position during placement and finishing operations.
 - a. Unless otherwise indicated, finish concrete footings 4 inches below grade and trowel to a crown to shed water.
 - b. Post of temporary construction fence may be driven directly into the ground provided adequate support can be maintained. Concrete footings shall be provided if fence posts become loose, unsecure, or otherwise unsafe.

3.2 GATE INSTALLATION

- A. Install gates plumb, level, and secure for full opening without interference. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary. Install gates according to manufacturer's instructions, plumb, level, and secure. Install Pre-K panic bar on gates providing egress from outdoor Pre-K play areas.

3.3 GATE ADJUSTING

- A. Gate: Adjust gate 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.

END OF SECTION 32 31 13

SECTION 32 31 19 – ORNAMENTAL FENCE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Ornamental picket fencing and accessories.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 3, Section 03300 "Cast-in-Place Concrete" for concrete for post footings.

1.3 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data in the form of manufacturer's technical data, specifications, and installation instructions for fence and gate posts, gates and accessories.
- C. Shop drawings: Layout and elevations of fences and gates with dimensions, details, and finishes of components, accessories, and post foundations.
- D. Samples: Manufacturer's standard color selections.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has at least three years' experience and has completed at least five ornamental fence projects with same material and of similar scope to that indicated for this Project with a successful construction record of in-service performance.
- B. Single-Source Responsibility: Obtain fences and gates, including accessories, fittings, and fastenings, from a single source.
- C. Manufacturer: Ameristar Fence Products, Inc., Tulsa, OK or approved equal. Products from qualified manufacturers having a minimum of 5 years experience manufacturing ornamental picket fencing will be acceptable by the architect as equal if they meet the following specifications for design, size, gauge of metal parts and fabrication.
- D. Warranty: Provide manufacturer's standard 20 year warranty that the ornamental fence system is free from defects in material and workmanship including cracking, peeling, blistering and corroding. Reimbursement for labor necessary to restore or replace components that have been found to be defective under the terms of manufacturer's warranty shall be guaranteed for five (5) years from date of original purchase.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify layout information for fences and gates shown on the Drawings in relation to the property survey and existing structures. Verify dimensions by field measurements.

PART 2 – PRODUCTS

2.1 ORNAMENTAL PICKET FENCE

- A. General: The fence system shall be 48-in high Montage II® Welded and Rackable (ATF – All Terrain Flexibility) Ornamental Steel, Majestic™ design, flush bottom rail treatment, 3-Rail style manufactured by Ameristar Fence Products, Inc., in Tulsa, Oklahoma or approved equal.

- B. Material: Steel for fence panels and posts shall conform to the requirements of ASTM A653/A653M, with a minimum yield strength of 45,000 psi (310 MPa) and a minimum zinc (hot-dip galvanized) coating weight of 0.90 oz/ft² (276 g/m²), Coating Designation G-90.
- C. Pickets: Steel, 14 Ga. Thick, 1-in square tubular members, Space pickets 3-1/2-in maximum face to face.
- D. Rails: Steel, 0.105-in thick top wall, 0.105-in thick side wall, 1-3/4-in square tubular members.
- E. Line Posts: Steel, 0.06-in thick, 2-1/2-in square tubular members. Space posts at 96-in on center.
- F. Finish: Black, duplex application of an epoxy primer and an acrylic topcoat finish applied by manufacturer.

2.2 FABRICATION

- A. Pickets, rails and posts shall be pre-cut to specified lengths. Rails shall be pre-punched to accept pickets.
- B. Pickets shall be inserted into the pre-punched holes in the rails and shall be aligned to standard spacing using a specially calibrated alignment fixture. The aligned pickets and rails shall be joined at each picket-to-rail intersection by Ameristar's proprietary fusion welding process, thus completing the rigid panel assembly (Note: The process produces a virtually seamless, spatter-free good-neighbor appearance, equally attractive from either side of the panel).
- C. The manufactured panels and posts shall be subjected to an inline electrodeposition coating (E-Coat) process consisting of a multi-stage pretreatment/wash (with zinc phosphate), followed by a duplex application of an epoxy primer and an acrylic topcoat. The minimum cumulative coating thickness of epoxy and acrylic shall be 2 mils (0.058 mm). The color shall be Black. The coated panels and posts shall be capable of meeting the performance requirements for each quality characteristic shown in Table 2 (Note: The requirements in Table 2 meet or exceed the coating performance criteria of ASTM F2408).
- D. The manufactured fence system shall be capable of meeting the vertical load, horizontal load, and infill performance requirements for Industrial weight fences under ASTM F2408.
- E. Swing gates shall be fabricated using 1.75" x 14ga Forerunner double channel rail, 2" sq. x 11ga. gate ends, and 1" sq. x 14ga. pickets. Gates that exceed 6' in width will have a 1.75" sq. x 14ga. intermediate upright. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined by welding. Gusset plates will be welded at each upright to rail intersection. Cable kits shall be provided for additional trussing for all gates leaves over 6'.

2.3 SETTING CONCRETE

- A. Concrete: Provide concrete consisting of portland cement per ASTM C 150, aggregates per ASTM C 33, and potable water. Mix materials to obtain concrete with a minimum 28-day compressive strength of 3000 psi. Use at least four sacks of cement per cu. yd., 1-inch maximum size aggregate, 3-inch maximum slump.
- B. Packaged Concrete Mix: Mix dry-packaged normal-weight concrete conforming to ASTM C 387 with clean water to obtain a 2- to 3-inch slump.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install fence in accordance with manufacturer's instructions.
 - 1. Cut all bolts flush with nut. Leave no sharp protruding edges.
- B. Space posts uniformly unless otherwise indicated.
- C. Concrete Set Posts: Drill hole in firm undisturbed or compacted soil. Holes shall have diameter 4 times greater than nominal outside dimension of post, and depths approximately 6" (152 mm) deeper than post bottom. Excavate deeper as required for adequate support in soft and loose soils, and for posts with heavy lateral loads. Set post bottom 36" (914 mm) below surface when in firm, undisturbed soil. Place concrete around post in a continuous pour. Trowel finish around posts and slope to direct water away from posts.

- D. Check each post for vertical and top alignment, and maintain in position during placement and finishing operation.
- E. Align fence panels between posts. Firmly attach rail brackets to posts with manufacturer supplied hardware, ensuring panels and posts remain plumb.

END OF SECTION 32 31 19

SECTION 32 40 00 - SITE FURNISHINGS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Round Concrete Bench.
2. Bicycle racks.
3. Trash receptacles.
4. Basketball Goals.
5. Flagpoles.
6. Drop Shot Basketball Hoops.

1.2 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Samples: For each type of exposed finish and for each color and texture required.
- C. Material Certificates: For the following:
1. Recycled plastic.
- D. Maintenance data.

PART 2 - PRODUCTS

2.1 CONCRETE BENCH

- A. Products:
1. WAUSA Made, (800) 388 8728, Models TF5100, TF3528, TF5206 or approved equal
- B. Material: Concrete: TF5100 (650 lbs), TF3528 (250 lbs), TF5206 (350 lbs).
- C. Color: See plans.
- D. Installation Method: Per manufacturer, threaded inserts.
- E. Dimensions:
1. TF5100 Half Moon: 48" x 24 x 14"
 2. TF3528 Circle: 25" Dia x 15"
 3. TF5206 Circle: 19" x 17" x 18"

2.2 BICYCLE RACKS

- A. Products:
1. Bike Garden Rack by Forms+Surfaces or approved equal. (800) 451 0141
 2. Frame: Cast stainless steel and stainless steel tubing
 3. Hardware: Stainless steel
- B. Style: Configuration A-CIP
- C. Security: Designed to lock wheel and frame.
- D. Installation Method: Per manufacturer, surface mount to concrete sidewalk.

- E. Finish: Polyester Powdercoat, RAL color.
 - 1. Color: Submit standard color options to Owner for selection.

2.3 BASKETBALL GOALS - ADJUSTABLE

- A. Products:
 - 1. Porter Athletic Company, 7'-6" - 10'-0" adjustable height outdoor in-ground basketball system with clear backboard and lockable height adjustment, Big Shot Pro System #09572 or approved equal. Pole Pad #095758, Poly net. 1-888-277-7778
- B. Installation Method: In-ground. Per manufacturer.
- C. Goal: Heavy-duty, double solid rim with 3/16" steel side and center support gussets, powder-coated orange finish. Poly net.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Complete field assembly of site and street furnishings, where required.
- B. Unless otherwise indicated, install site and street furnishings after landscaping and paving have been completed.
- C. Install site and street furnishings level, plumb, true, and securely positioned at locations indicated on Drawings in accordance with manufacturer's printed instructions.
- D. Pipe Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with non-shrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.
- E. Install flagpoles per manufacturer's instructions.

3.2 BASKETBALL GOAL INSTALLATION

- A. Install goal posts at least 36" into 48" deep x 30" dia concrete footing. Finish footing below finish court surface or finish grade. Install posts, extensions, backstops, goals and nets in accordance with the drawings, the manufacturer's written instructions and NFSHSA specifications.
- B. Provide two (2) basketball goal assemblies for each new basketball court.

END OF SECTION 32 40 00

SECTION 32 90 00 PLANTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:

- 1. Trees.
- 2. Shrubs.
- 3. Seeded lawns, sod and “no-mow” areas.
- 4. Topsoil and soil amendments.
- 5. Fertilizers and mulches.
- 6. Stakes and guys.
- 7. Landscape edging.
- 8. Maintenance, guarantees and warranties.

- B. Related Sections: The following Sections contain requirements that relate to this Section:

- 1. Division 31, Section "Site Clearing" for protection of existing trees and planting, topsoil stripping and stockpiling, and site clearing.
- 2. Division 31, Section "Earth Moving" for excavation, filling, rough grading, and subsurface aggregate drainage and drainage backfill.
- 3. Division 31 Section "Erosion Controls" soil erosion and sedimentation control.

1.3 INDUSTRY STANDARDS

- A. References: Some products and execution are specified in this Section by reference to published specifications or standards of the following:

The American Society for Testing and Materials (ASTM)
American Association of Nurserymen (AAN)
US Department of Agriculture (USDA)
NC Department of Agriculture (NCDA)
NC Composting Council (NCCC)

- B. Landscape Contractor shall mean a registered “Landscape Contractor” as defined by the NC General Statute 89D (www.nclclb.com). Unless proper credentials and evidence of experience can be supplied to prove equal capabilities, only a Landscape Contractor licensed in the State of NC shall be permitted to perform the work.

- 1. The Landscape Contractor’s performance shall conform to the requirements in the most current edition of the NC Landscape Contractors Manual (NCLCM) as approved by the NC Board of Landscape Contractors. In the event the Landscape Contractor feels there is discrepancy between the NCLCM and the requirements of this Contract that could affect the quality of work; it is the Contractor’s responsibility to apprise the Owner and Landscape Architect of the issue.

1.4 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.

- B. Product certificates signed by manufacturers certifying that their products comply with specified requirements.

- 1. Manufacturer's certified analysis for standard products.

2. Label data substantiating that plants, trees, shrubs, and planting materials comply with specified requirements.
- C. Certification of grass seed from seed vendor for each grass-seed mixture stating the botanical and common name and percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
- D. Samples of each of the following:
 - 1 Sample of imported mulch (1) 1-gal. sized bag.
 - 2 Topsoil (1) 1-gal sized bag.
- E. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, at least fifteen names and address of architects and owners, total years of experience and landscape contractor's license number. If the landscape contractor hires a sub-contractor for seeding operations, the same references shall be required from them also.
- F. Material test reports from qualified independent testing agency indicating and interpreting test results relative to compliance of the following materials with requirements indicated.
 1. Analysis of existing topsoil and suitability as a medium for growing specified lawn. Include recommendations of amendments required to make existing topsoil suitable as a growing medium for specified lawn, if required.
 2. Analysis of imported topsoil, if required due to unacceptability of existing topsoil to meet acceptable growing medium requirements for lawn.
- G. Planting schedule indicating anticipated dates and locations for each type of planting.
- H. Maintenance instructions recommending procedures to be established by Owner for maintenance of landscaping during an entire year. Submit before expiration of required maintenance periods.
- I. Landscape plant schedule, per Article 1.4, A, C, indicating quantity, botanical name, common name, specified size and vendor source for each individual plant species; including any substitutions. Include all cultivars and varieties for substitutions. Provide vendor source contact information as attachment to schedule.

CLH Design and the Owner reserve the right to reject any substitution requests and may request that the landscape contractor provide additional vendor search information and/or complete documentation to prove a hardship, to confirm reason(s) for substitution or to prove that the material is not available from local and national nurseries.

Refer to section 1.6, C for information regarding the appropriate time to dig trees. It is the Contractor's responsibility to plan ahead of time rather than waiting and checking availability at the time of installation.
- J. All sod shall be from a certified sod producer and be blue tag certified in accordance with NCCIA and AOSCA.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed landscaping work similar in material, design, and extent to that indicated for this Project and with a record of successful landscape establishment.
 1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on the Project site during times that landscaping is in progress.
- B. Testing Agency Qualifications: To qualify for acceptance, an independent testing agency must demonstrate to Architect's satisfaction, based on evaluation of agency-submitted criteria conforming to ASTM E 699, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.

- C. Provide quality, size, genus, species, and variety of trees and shrubs indicated, complying with applicable requirements of ANSI Z60.1 "American Standard for Nursery Stock."
 - 1. Contractor shall show proof of cultivar authenticity to Landscape Architect. When cultivars are specified, standard species will not be acceptable.
- D. Topsoil Analysis: Furnish a soil analysis made by a qualified independent soil-testing agency stating percentages of organic matter, inorganic matter (silt, clay, and sand), deleterious material, pH, and mineral and plant-nutrient content of topsoil.
 - 1. Report suitability of on-site topsoil for growth of applicable planting material. State recommended quantities of nitrogen, phosphorus, and potash nutrients and any limestone, aluminum sulfate, or other soil amendments to be added to produce a satisfactory topsoil at no additional cost to owner.
- E. Measurements: Measure trees and shrubs according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches (150 mm) above ground for trees up to 4-inch (100-mm) caliper size, and 12 inches (300 mm) above ground for larger sizes. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip-to-tip.

When size ranges are given, 50 % of plant material shall be at the larger size.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 01 Section "Project Meetings."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery and while stored at site.
- B. Seed: Deliver seed in original sealed, labeled, and undamaged containers.
- C. Trees and Shrubs: Deliver freshly dug trees and shrubs. Do not prune before delivery, except as approved by Landscape Architect. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy natural shape. Provide protective covering during delivery. Do not drop trees and shrubs during delivery. For trees which cannot be dug in the summer, Contractor shall have trees pre-dug and heeled-in at the nursery where they are grown until planting. Contractor shall be responsible for ensuring that the trees have been adequately watered and cared for at the nursery prior to delivery. No substitutions will be allowed for trees which cannot be "summer-dug".
- D. Handle balled and burlap stock by the root ball.
- E. Deliver trees, shrubs, and ground covers after preparations for planting have been completed and install immediately. If planting is delayed more than 6 hours after delivery, set planting materials in shade, protect from weather and mechanical damage, and keep roots moist.

PLANT MATERIAL SHALL NOT BE DELIVERED TO THE SITE MORE THAN 72 HOURS BEFORE PLANTING TAKES PLACE. THE LANDSCAPE ARCHITECT RESERVES THE RIGHT TO REJECT ALL MATERIAL NOT PLANTED WITHIN THAT TIME PERIOD UNLESS THE LANDSCAPE CONTRACTOR MAKES HEELING-IN AND IRRIGATION PROVISIONS WITHIN 24 HOURS OF PLANT DELIVERY.

- 1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
- 2. Do not remove container-grown stock from containers before time of planting.
- 3. Water root systems of trees and shrubs stored on site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.

1.7 PROJECT CONDITIONS

- A. Utilities: Determine location of above grade and underground utilities and perform work in a manner which will avoid damage. Hand excavate, as required. Maintain grade stakes until removal is mutually agreed upon by parties concerned.
- B. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Landscape Architect before planting.

1.8 COORDINATION AND SCHEDULING

- A. Coordinate installation of planting materials during normal planting seasons for each type of plant material required.

Planting Season: The normal season for planting balled and burlap material is November 15 through March 15. The normal season for planting container grown material is September 15 through April 15. After notification to proceed, planting operations shall be conducted under favorable weather conditions during the normal planting season. The Landscape Contractor shall make provisions for watering the material on an as-needed basis and as frequently as is required to ensure that plant material thrives.

The General Contractor shall coordinate the planting schedule with the Landscape Contractor to avoid any summer digging and planting.

The Landscape Architect shall be notified and must approve of any schedule changes which may require summer planting. THE CONTRACTOR SHALL NOT BE COMPENSATED FOR ADDITIONAL WATERING COSTS FOR PLANTINGS WHICH ARE INSTALLED IN THE SUMMER.

- B. Temporary Seeding: In accordance with the schedule as detailed on the drawings.
 - 1. In the event the Landscape Contractor is required to establish a temporary seeding cover due to the construction schedule, the Landscape Contractor is not relieved from providing the specified permanent seed mixture.
 - 2. The Landscape Contractor is responsible for eradicating any temporary seed cover by means of mowing, thatching and using an herbicide approved by the Owner's representative at the manufacturer's recommended rate.

1.9 GRASS ESTABLISHMENT SCHEDULE

- A. Refer to the Supplementary Conditions for Final Completion dates of grassed areas of the site.
- B. Definitions:
 - 1. Final Complete seeded or sprigged grass: A healthy, dense, weed free stand of the specified species of grass with 95% grass coverage as evaluated on a per square yard sample basis. Required topdressing for play fields may be applied following Final completion.
 - 2. Final Complete sodded grass: An installed and rolled healthy sod, free of weeds and dead spots. Required topdressing for play fields may be applied following Final completion.
- C. Complete Site: A complete installation of grass sod and/or stand of grass, germinated from seed or sprigs, on the complete site shall be established by the following date:
 - 1. Complete Site (Seed, Sprig or Sod) Final Completion: *See Final Completion Date noted in contract documents.* Due to seasonal restrictions the specified date shall not be extended. Extension to the Contract Time will not change this date.

1.10 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

- B. Special Warranty: Contractor is responsible for general maintenance and care during warranty period. Contractor agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Death and unsatisfactory growth; except for defects resulting from abuse or incidents that are beyond Contractor's control.
 - b. Structural failures including plantings falling or blowing over.
 2. Warranty Periods from Date of Final Completion:
 - a. Trees, Shrubs, Ornamental Grasses, and 12 months.
 - b. Lawn, grass and sod (herbicide and fertilizer): 12 months
 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.
 4. Areas seeded or sodded that are bare and not established at the end of the warranty period shall be re-seeded or re-sodded at no additional cost to the Owner.
 5. Contractor is responsible for applying weed control herbicide and fertilizers during warranty period.

1.11 TREE AND SHRUB MAINTENANCE

- A. Maintain trees and shrubs by pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, tightening and repairing stakes and guy supports, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray as required to keep trees and shrubs free of insects and disease. The presence of significant insects or disease at the end of warranty period shall be grounds for rejection of material. Restore or replace damaged tree wrappings. Maintain trees and shrubs until end of warranty period.

1.12 LAWN/GRASS MAINTENANCE

- A. Begin maintenance of lawns and other grassed areas immediately after each area is planted and continue until acceptable lawn is established and accepted by the Owner, but for not less than the following periods:
1. Seeded Lawns/Grass and Naturalized Seed Areas: **Final Completion.**
 - a. When full maintenance period has not elapsed before end of planting/growing season, or if lawn is not fully established at that time (95% coverage as established on a per square yard sample basis), continue maintenance during next planting season until 95% coverage is established.
 2. Sodded Lawns/Grass: **Final Completion.**
 - a. Sodded areas will be accepted at final inspection if –
 1. Sodded areas are properly established.
 2. Sod is free of bare and dead spots and without weeds.
 3. Sodded areas have been mowed a minimum of twice.

- B. Maintain and establish lawns by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and re-mulch to produce a uniformly smooth lawn.
- C. Watering: Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources and to keep lawns uniformly moist to a depth of 4 inches (100 mm). Following the date of project Final Completion, water from irrigation may be obtained from the site water system.
 - 1. Supplement natural precipitation to provide a net rate of one inch of water per week or as required to maintain lawn in a thriving condition.
 - 2. Watering shall conform to the time, volume and frequency recommendations of applicable governmental water conservation regulations.
 - 3. Irrigate at minimum rate of once per day for two full weeks following date of seeding or sod installation.
 - 4. Irrigate at minimum of once per week for remainder of maintenance period.
- D. Mow lawns as soon as there is enough top growth to cut with mower set at specified height for principal species planted. Repeat mowing as required to maintain specified height without cutting more than 40 percent of the grass height at any mowing. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet.
- E. Postfertilization: Apply fertilizer to lawn after first mowing and when grass is dry. Apply only from August through October.
 - 1. Use fertilizer that will provide actual nitrogen of at least 1 lb per 1000 sq. ft. (0.5 kg per 100 sq. m) of lawn area or as required to maintain lawn in a thriving condition. A minimum of 50% of the nitrogen shall be in a slow release form.

1.13 STORMWATER CONTROL MEASURE, WETLAND AND DETENTION POND MAINTENANCE

- A. Begin maintenance of stormwater control measures (stormwater wetlands, detention ponds and bioretention cells) immediately after each area is planted and continue until completion of the 12-month warranty period.
- B. The area to be maintained shall include the wet and dry surfaces of the facility and perimeter areas within 15-ft of the water quality pool elevation, along with the inlet and outlet structures, embankments, emergency spillway, turf and plants.
 - 1. Maintenance shall include all items listed in the Operation & Maintenance Plan listed on the drawings. Maintenance shall include, but not limited to, the following:
 - a. Keep dry and wet areas clean of trash and debris.
 - b. Repair of erosion. Re-seed any bare areas including top and slopes of embankments.
 - c. Keep inlet and outlet pipes, weirs, orifices, under-drains, and swales clear of blockages.
 - d. Remove accumulated sediment from riprap aprons.
 - e. Remove accumulated sediment forebay of wetlands and ponds if greater than 12-in of accumulation.
 - f. Prune shelf plants.
 - g. Remove invasive plants and algae.
 - h. Replace dead plants.
 - i. Replace/replenish mulch.
 - j. Other requirements of the Operation and Maintenance Plan on the drawings.
 - 2. Perform inspections at least every two months and after every storm of greater than 1.5-in of rainfall. Perform maintenance as needed.
 - 3. Final maintenance shall be performed immediately prior to the 11-month inspection.
 - 4. Perform additional maintenance and repair resulting from the 11-month inspection.
 - 5. Records of inspections and maintenance performed shall documented and supplied to the Owner at the completion of the warranty and maintenance period.

PART 2 - PRODUCTS

2.1 TREE AND SHRUB MATERIAL

- A. General: Furnish nursery-grown trees and shrubs conforming to ANSI Z60.1, with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement, including trunks which are not straight on single stem trees.
- B. The natural stem/root collar of balled and burlap materials shall be found within two inches of the nursery maintained soil line. Trees shall not be accepted which have been grown too deeply or too high in the soil profile.
- C. Grade: Provide trees and shrubs of sizes and grades conforming to ANSI Z60.1 for type of trees and shrubs required. Trees and shrubs of a larger size may be used if acceptable to Landscape Architect, with a proportionate increase in size of roots or balls.
- D. Label one tree and shrub in each plant grouping with securely attached, waterproof tag bearing legible designation of botanical and common name. Proof of cultivar shall be required on all species for which a cultivar is designated.
- E. Label at least 1 tree and 1 shrub of each variety and caliper with a securely attached, waterproof tag bearing legible designation of botanical and common name.
- F. Imported Fire Ant Control: All plants shall be accompanied by a certificate stating: “certified under all applicable state and federal quarantine.” Contact Landscape Architect for inspection of all plant materials for the presence of imported fire ants. The presence of fire ants shall be cause for rejection of plant material.

2.2 SHADE AND FLOWERING TREES

- A. Shade Trees: Single-stem trees with straight trunk, free of basal sprouts, well-balanced crown, and intact leader, of height and caliper indicated, conforming to ANSI Z60.1 for type of trees required. Grounds for rejection may include, but not limited to: improper branch density or distribution, “v” crotches, including bark, undesirable multiple leaders, leaders that have been topped or headed back, prevalent suckering or epicormic sprouting. Trees which have evidence of unevenly distributed, girdling or suckering roots may be rejected.
 - 1. Branching Height: 1/2 of tree height.
- B. Small Trees: Small upright or spreading type, branched or pruned naturally according to species and type, and with relationship of caliper, height, and branching recommended by ANSI Z60.1, and stem form as specified in the Plant List on the drawings. Good structure shall be especially critical for trees. Grounds for rejection may include, but not limited to: improper branch density or distribution, “v” crotches, including bark, undesirable multiple leaders, leaders that have been topped or headed back, prevalent suckering or epicormic sprouting. Trees which have evidence of unevenly distributed, girdling or suckering roots may be rejected.
- C. Provide balled and burlap trees unless noted otherwise on the drawings. Plants designated “B&B” in the plant list shall be balled and burlap. They shall be nursery grown and freshly dug. They shall be dug with firm, natural balls of earth of sufficient diameter and depth to encompass the fibrous and feeding root system necessary for full recovery of the plant. Balls shall be firmly wrapped with untreated biodegradable burlap and bound with twine, cord, or wire mesh basket. Plants shall not be accepted if the ball is dry, deformed or broken before or during the planting operations.

2.3 DECIDUOUS SHRUBS

- A. Form and Size: Deciduous shrubs with not less than the minimum number of canes required by and measured according to ANSI Z60.1 for type, shape, and height of shrub.
- B. Provide container grown shrubs unless noted otherwise on the drawings.

2.4 CONIFEROUS EVERGREENS

- A. Form and Size: Specimen-quality, exceptionally heavy, tightly knit, symmetrically shaped coniferous evergreens.
- B. Provide balled and burlap coniferous evergreens.
 - 1. Container-grown coniferous evergreens will be acceptable in lieu of balled and burlap coniferous evergreens subject to meeting ANSI Z60.1 limitations for container stock and provided they are equal in quality and size to balled and burlap material.

2.5 BROADLEAF EVERGREENS

- A. Form and Size: Normal-quality, well-balanced, broadleaf evergreens, of type, height, spread, and shape required, conforming to ANSI Z60.1.
- B. Provide balled and burlap broadleaf evergreens.
 - 1. Container-grown broadleaf evergreens will be acceptable in lieu of balled and burlap broadleaf evergreens subject to meeting ANSI Z60.1 limitations for container stock and provided they are equal in quality and size to balled and burlap material.

2.6 GRASS/LAWN MATERIALS

- A. Grass Seed: Fresh, clean, dry, new-crop seed complying with the Association of Official Seed Analysts' "Rules for Testing Seeds" for purity and germination tolerances.
 - 1. Seed Mixture: Provide seed of grass species and varieties as specified in the plans and/or specifications.
 - 2. Sod shall be as indicated on the plans and detail drawings. Provide machine cut, strongly rooted, certified turf grass sod, not less than two years old, free from weeds and undesirable native grasses and stripped not more than 24 hours before laying. Sod pad size shall be uniform thickness of 5/8", plus or minus 1/4", measured at the time of cutting and excluding top growth and thatch.

2.7 TOPSOIL

- A. Topsoil: ASTM D 5268, pH range of 5.5 to 7, 4 percent organic material minimum, free of stones 1 inch (25 mm) or larger in any dimension, and other extraneous materials harmful to plant growth. Sticks, roots, and clay clumps shall be removed from topsoil prior to spreading.
 - 1. Topsoil Source: Reuse surface soil stripped and stockpiled on the site if adequate quantities exist. Verify suitability of surface soil to produce topsoil meeting requirements and amend when necessary. Screen topsoil of roots, plants, sods, stones greater than 1/2" diameter in general lawn areas and planting beds, clay lumps, and other extraneous materials harmful to plant growth. Screen topsoil prior to planting. If inadequate quantities of topsoil exist on-site contractor will be required to import pre-screened topsoil. A minimum depth of 3 inches shall be required.

2.8 SOIL AMENDMENTS

- A. Lime: ASTM C 602, Class T, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent, with a minimum 99 percent passing a No. 8 (2.36 mm) sieve and a minimum 75 percent passing a No. 60 (250 micrometer) sieve.
 - 1. Provide lime in the form of dolomitic limestone.
- B. Organic Compost: Organic compost of neutral character, decomposed, stable and weed-free meeting the US Composting Council standards.
- C. Perlite: Horticultural perlite, soil amendment grade.
- D. Peat Humus: Finely divided or granular texture, with a pH range of 6 to 7.5, composed of partially decomposed moss peat (other than sphagnum), peat humus, or reed-sedge peat.

- E. Peat Humus: For acid-tolerant trees and shrubs, provide moss peat, with a pH range of 3.2 to 4.5, coarse fibrous texture, medium-divided sphagnum moss peat or reed-sedge peat.
- F. Sawdust or Ground-Bark Humus: Decomposed, nitrogen-treated, of uniform texture, free of chips, stones, sticks, soil, or toxic materials.
 - 1. When site treated, mix with at least 0.15 lb (2.4 kg) of ammonium nitrate or 0.25 lb (4 kg) of ammonium sulfate per cu. ft. (cu. m) of loose sawdust or ground bark.
- G. Manure: Well-rotted, un-leached stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.
- H. Herbicides: EPA registered and approved, of type recommended by manufacturer.
- I. Water: Potable.
- J. Mycorrhizae: Applied to planting hole backfill or planting bed solid. Product shall be formulated for the moisture regime of the particular planting location (low, medium, high) contain a broad spectrum of mycorrhizae species, an organic bi-stimulant (2-2-2 preferred) and a water holding gel (low moisture locations only). Apply per manufacturer's recommendations.

2.9 FERTILIZER

- A. Bonemeal: Commercial, raw, finely ground; minimum of 4 percent nitrogen and 20 percent phosphoric acid.
- B. Superphosphate: Commercial, phosphate mixture, soluble; minimum of 20 percent available phosphoric acid.
- C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea-form, phosphorous, and potassium in the following composition:
 - 1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency and as needed to maintain plant material and lawns in a thriving condition.
- D. Slow-Release Fertilizer: Granular fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency and as needed to maintain plant material and lawns in thriving condition.

2.10 MULCHES

- A. Organic Mulch: Organic mulch, free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of the following:
 - 1. Triple Shredded Hardwood Mulch: At least 80% hardwoods with moisture content of 30% or less, that can pass through a maximum screen size of 1 5/8". Raw material shall contain no yard waste, construction debris, or any other extraneous material.
 - a. Depth: 3" (after compaction)
 - b. Refer to plans for location.

2.11 EROSION-CONTROL MATERIALS

- A. Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches (150 mm) long.

- B. Fiber Mesh: Biodegradable twisted jute or spun-coir mesh, 0.92 lb per sq. yd. (0.5 kg per sq. m) minimum, with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches (150 mm) long.

2.12 STAKES AND GUYS

- A. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, redwood, or pressure-preservative-treated softwood, free of knots, holes, cross grain, and other defects, 2 by 2 inches (50 by 50 mm) by length indicated, pointed at one end.
- B. Use flexible Arbor tape or equivalent ¾" woven belt synthetic fabric strap installed per manufacturer's specifications. Color: Green.
- C. Flags: Standard surveyor's plastic flagging tape, pink, 6 inches (150 mm) long.
NOTE: Clearly mark all guy wires with flagging for visibility, especially near recreation and pedestrian areas.

2.13 LANDSCAPE EDGINGS

- A. "V" Ditch: A 4-inch deep trench by 6 inches width around all planting beds. Except where beds are adjacent to naturally wooded areas due to the possible damage to existing tree roots. Use care around existing tree roots in and around all planting beds. Do not cut existing tree roots to form the "V" ditch, work around them wherever possible.

2.14 MISCELLANEOUS MATERIALS

- A. Anti-desiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's instructions. Apply as per nursery's recommendations. It should be applied prior to plant transport from the nursery where it is dug, if in full leaf.

2.15 TACKIFIER

- A. Non-asphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive landscaping for compliance with requirements and for conditions affecting performance of work of this Section. Do not proceed with installation until unsatisfactory conditions have been corrected. Do not seed the site until the Landscape Architect has reviewed the final grades.

3.2 PREPARATION

- A. Lay out individual tree and shrub locations and areas for multiple plantings. Entire areas for multiple plantings shall be chiseled to a depth of 12 inches and tilled and amended to a depth of 8 inches with the same soil mixture as is required for planting backfill material. Stake locations, outline areas, and secure Landscape Architect's acceptance before the start of planting work. Make minor adjustments as may be required.

3.3 PLANTING SOIL PREPARATION

- A. Before mixing, clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to plant growth.
- B. Mix soil amendments and fertilizers with topsoil at rates indicated. Delay mixing fertilizer if planting does not follow placing of planting soil within a few days.
- C. For tree pit or trench backfill, mix planting soil before backfilling and stockpile at site.

- D. For planting beds, mix planting soil prior to planting.
 - 1. Mix lime with dry soil prior to mixing fertilizer. Prevent lime for lawn plantings from contacting roots of acid-tolerant plants.
- E. Do not attempt soil preparation of plant installation when soils are frozen, wet, in poor tilth or otherwise unsuitable for planting.

3.4 LAWN PLANTING PREPARATION

- A. Limit subgrade preparation to areas that will be planted in the immediate future.
- B. Loosen subgrade to a minimum depth of 8 inches. Remove stones larger than 1/2 inch (19 mm) in any dimension and sticks, roots, rubbish, and other extraneous materials. Remove excess gravel which will inhibit lawn establishment and survival.
- C. Spread topsoil to depth required to meet thickness, grades, and elevations shown, after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen.
 - 1. Place approximately 1/2 the thickness of topsoil required. Work into top of loosened subgrade to create a transition layer and then place remainder of the topsoil.
- D. Preparation of Unchanged Grades: Where lawns are to be planted in areas unaltered or undisturbed by excavating, grading, or surface soil stripping operations, prepare soil as follows:
 - 1. Remove and dispose of existing grass, vegetation, and turf. Do not turn over into soil being prepared for lawns.
 - 2. Till surface soil to a depth indicated on soil test report, but at a minimum of 6 inches (150 mm). Apply required soil amendments and initial fertilizers and mix thoroughly into top 4 inches (100 mm) of soil. Trim high areas and fill in depressions. Till soil to a homogenous mixture of fine texture.
 - 3. Clean surface soil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to plant growth.
 - 4. Remove waste material, including grass, vegetation, and turf, and legally dispose of it off the Owner's property.
- E. Grade lawn and grass areas to a smooth, even surface with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future. Remove trash, debris, stones larger than 1 inch in any dimension (1/2 inch in playing fields), and other objects that may interfere with planting or maintenance operations. Remove all glass, wire or other objects of any size which may cause injury.
- F. Moisten prepared lawn areas before planting when soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- G. Restore prepared areas if eroded or otherwise disturbed after fine grading and before planting.
- H. Contact Owner and Landscape Architect for review and approval of seedbed preparation and seeding methods prior to and during seeding operations.

3.5 EXCAVATION FOR TREES AND SHRUBS

- A. Pits and Trenches: Excavate with vertical sides and with bottom of excavation slightly raised at center to assist drainage. Loosen hard subsoil in bottom of excavation. Refer to planting details.
 - 1. Place tree in pit by lifting and carrying the tree by its ball (never lift by branches or trunk) and then lowering it into the pit. Set the tree straight, plumb and in the center of the pit with the most desirable side of the tree facing the prominent view (sidewalk, building, street, etc.).
 - 2. Determine the elevation of the root flare and ensure that it is planted at or slightly above finished grade. This may require that the tree be set higher than the grade in the nursery. If the root flare is less than 2-inches below the soil level of the root ball, plant the tree at the appropriate level above the grade, so the flare is even with the grade. If the flare is more than 2-inches at the center of the root ball above the grade, the tree shall be rejected.

- B. Obstructions: Notify Landscape Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
- C. Drainage: Notify Landscape Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub pits.
- D. Fill excavations with water and allow to percolate out, before placing setting layer and positioning trees and shrubs.

3.6 PLANTING TREES AND SHRUBS

- A. Set balled and burlap stock plumb and in center of pit or trench with top of ball raised above adjacent finish grades as indicated.
 - 1. Place stock on setting layer of compacted planting soil.
 - 2. Remove burlap from tops of balls and partially from sides, but do not remove from under balls. Remove the top 2/3's of the wire baskets. Remove pallets, if any, before setting. Do not use planting stock if ball is cracked or broken before or during planting operation.
 - 3. Place backfill around ball in layers, tamping to settle backfill and eliminate voids and air pockets. When pit is approximately 1/2 backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing and tamping final layer of backfill.
- B. Set container-grown stock plumb and in center of pit or trench with top of ball raised above adjacent finish grades as indicated.
 - 1. Carefully remove containers so as not to damage root balls.
 - 2. The root ball shall be loosened to alleviate matted or encircling roots. Roots shall be spread out evenly in an outward, radial fashion.
 - 3. Place stock on setting layer of compacted planting soil.
 - 4. Place backfill around ball in layers, tamping to settle backfill and eliminate voids and air pockets. When pit is approximately 1/2 backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing and tamping final layer of backfill.
- C. Dish and tamp top of backfill to form a 3-inch- (75-mm-) high mound around the rim of the pit. Do not cover top of root ball with backfill.
- D. Wrap trees of 2-inch (50-mm) caliper and larger with trunk-wrap tape if the species is susceptible to sun or wind scorch. Start at base of trunk and spiral cover trunk to height of first branches. Overlap wrap, exposing half the width, and securely attach without causing girdling. Inspect tree trunks for injury, improper pruning, and insect infestation and take corrective measures required before wrapping. Do not wrap the trees at the base to discourage insect infestation.

3.7 TREE AND SHRUB PRUNING

- A. Prune, thin, and shape trees and shrubs as directed by Landscape Architect.
- B. Only minimal pruning should be necessary at time of planting since plant material shall conform to the specified standards for quality. All pruning performed by the Contractor shall conform to the standards of the current ANSI A300, American National Standard for tree care operations. Under no circumstances shall the Contractor cut or prune leaders or remove more than 1/3 of the top without permission of the Landscape Architect. Prune to remove dead wood, crossovers, split or broken branches. Do not shorten, trim or clip branches solely for appearance purposes unless directed to by the Landscape Architect.

3.8 TREE AND SHRUB GUYING AND STAKING

- A. Upright Staking and Tying: Stake trees of 2- through 5-inch (50- through 125-mm) caliper. Stake trees of less than 2-inch (50-mm) caliper only as required to prevent wind tip-out. Use a minimum of 2 stakes of length required to penetrate at least 18 inches (450 mm) below bottom of backfilled excavation and to extend at least 72 inches (1800 mm) above grade. Set vertical stakes and space to avoid penetrating

balls or root masses. Support trees with 2 strands of flexible Arbor tape or equivalent ¾" woven belt synthetic fabric strap at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree. Flag heavily in recreation areas or any places where children are likely to be.

Note: Only upright staking of trees will be allowed around child play areas to avoid tripping hazards. Refer to the staking detail on the drawings.

3.9 MULCHING

- A. Mulch backfilled surfaces of pits, trenches, planted areas, and other areas indicated.
- B. Organic Mulch: Apply the following average thickness of organic mulch and finish level with adjacent finish grades. Do not place mulch against trunks or stems. Refer to section 2.10 for additional information.
 - 1. Thickness: 4 inches (mulch depth shall be 3" after compaction and settling).

NOTE: Mulch shall NOT be from on-site chipping operations (unless specifically indicated in plans and specifications).

3.10 SEEDING NEW LAWNS

- A. Sow seed with a spreader or a seeding machine. Do not broadcast or drop seed when wind exceeds 5 mph (8 km/h). Evenly distribute seed by sowing equal quantities in 2 directions at right angles to each other.
 - 1. Do not use wet seed or seed that is moldy or otherwise damaged in transit or storage.
- B. Sow seed at the rates required to achieve 95% coverage prior to Final completion as determined on a per square yard basis.
- C. Rake seed lightly into top 1/8 inch (3 mm) of topsoil, roll lightly, and water with fine spray. Remove surface rocks of greater than 1" diameter.
- D. Protect seeded slopes 6:1 (H:V) and steeper against erosion with erosion-control blankets installed and stapled according to manufacturer's recommendations.
- E. Protect seeded areas with slopes flatter than 6:1 against erosion by spreading straw mulch after completion of seeding operations. Spread uniformly at a minimum rate of 2 tons per acre (45 kg per 100 sq. m) to form a continuous blanket 1-1/2 inches (38 mm) loose depth over seeded areas. Spread by hand, blower, or other suitable equipment. Tack with liquid asphalt tack (9 gals/1,000 SF) or non-asphaltic tackifier.
- F. If seeding occurs in summer months, protect seeded areas against hot, dry weather or drying winds by applying peat mulch within 24 hours after completion of seeding operations. Soak and scatter uniformly to a depth of 3/16 inch (4.8 mm) thick and roll to a smooth surface.

3.11 HYDROSEEDING NEW LAWNS

- A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogenous slurry suitable for hydraulic application.
 - 1. Mix slurry with non-asphaltic tackifier.
 - 2. Apply slurry uniformly to all areas to be seeded in a 2-step process. Apply first slurry application at the minimum rate of 500 lb per acre (5.5 kg per 100 sq. m) dry weight but not less than the rate required to obtain specified seed-sowing rate. Apply slurry cover coat of fiber mulch at a rate of 1000 lb per acre (11 kg per 100 sq. m).

3.12 RECONDITIONING LAWNS

- A. Recondition existing lawn areas damaged by Contractor's operations, including storage of materials or equipment and movement of vehicles. Also recondition lawn areas where settlement or washouts occur or where minor regrading is required.
- B. Remove sod and vegetation from diseased or unsatisfactory lawn areas; do not bury into soil. Remove topsoil containing foreign materials resulting from Contractor's operations, including oil drippings, fuel spills, stone, gravel, and other construction materials, and replace with new topsoil.
- C. Where repairable lawn remains, as determined by the Owner, mow, dethatch, core aerate, and rake heavily and deeply. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.
- D. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of it off the Owner's property.
- E. Till stripped, bare, compacted or otherwise unrepairable areas thoroughly to a depth of 8 inches.
- F. Apply required soil amendments and initial fertilizers and mix thoroughly into top 4 inches (100 mm) of soil. Provide new planting soil as required to fill low spots and meet new finish grades.
- G. Apply seed and protect with straw mulch as required for new lawns.
- H. Water newly planted areas and keep moist until new grass is established.

3.13 SODDING NEW LAWNS

- A. Lay sod to form solid, uniform mass with tightly fitted joints. "Butt" ends and sides of sod strips. Do not overlap sod strips. Stagger strips to offset joints in adjacent courses. Lay sod strips across slopes and perpendicular to drainage flow. Tamp or roll lightly to ensure contact with subgrade.
- B. Secure with pegs or staples at spacing recommended by the sod grower and supplier and as approved by the Landscape Architect and Owner. If pegs or staples are used for athletic fields, they shall be removed upon full establishment prior to final acceptance.
- C. Water sod with fine spray immediately after planting. Water daily during first two weeks of establishment to maintain soil to depth of 4".
- D. At no time shall sodded turf be allowed to grow over 3 inches in height. Throughout this period, the target mowing height shall be 1.5 inches. At no time shall more than 50% of the turf height be removed in any three-day period by mowing or other maintenance activity.
- E. Sodded turf shall be fertilized according to the monthly application rates recommended in Carolina Lawns for the utilized grass or at reduced rate if instructed by the Landscape Architect.
- F. Weed control shall be provided as necessary to prevent the establishment or proliferation of a weed species and to achieve acceptable turf at time of initial Acceptance.
- G. Remove all poly mesh netting prior to placement and dispose of off-site.

3.14 INSTALLATION OF EDGINGS

- A. "V" Ditches: Clearly delineate planting beds, play areas and sign locations with a 4-inch deep by 6-inch wide ditch. Lines shall be smooth. A minimum five-foot wide lawn strip shall be provided between planting beds and paved surfaces where shown on the drawings.

3.15 INSTALLATION OF MISCELLANEOUS MATERIALS

- A. Apply anti-desiccant using power spray to provide an adequate film over trunks, branches, stems, twigs, and foliage.

1. When deciduous trees or shrubs are moved in full-leaf, spray with anti-desiccant at nursery before moving and again 2 weeks after planting.

3.16 INSPECTION AND ACCEPTANCE

- A. When landscape work is completed, including maintenance, Architect will, upon written request, make a final inspection to determine acceptability.
- B. At time of inspection for initial Acceptance, turf shall have been freshly mowed within the last 48 hours. Turf shall be healthy, of uniform color and exhibiting signs of good growth. A minimum of 95% of the specified seeding area shall be covered in established turf possessing both stolens (i.e. runners) and rhizomes. There shall be no bare areas greater than 4 sq. ft. or 1.5 ft. in any dimension. Seedling plants not having reached tiller stage (i.e. runner producing) shall be considered bare area. Turf shall be 100% free of noxious and perennial weeds and relatively free of annual weeds.
- C. At time of inspection for initial Acceptance, sodded and sprigged turf shall have been freshly mowed within the last 48 hours. Turf shall be healthy, of uniform color and exhibiting good growth. A minimum of 100% of the specified turf area shall be covered in sod that has been installed for a minimum six weeks. Turf shall be 100% free of all weeds.
- D. Should the athletic field turf not be accepted on the date listed on the drawings the Owner will require the Landscape Contractor to place the field on a program of intensive cultural management in order to bring the fields to acceptance specification as quickly as possible. Actions may include sodding (minimum laid piece size – 1.5 ft. by 2 ft.) and any cultural activity which is suggested by the North Carolina Cooperative Extension Service as being of value in an intensive Bermuda grass management program. The Owner shall not be responsible for any additional costs associated with these actions.
- E. When inspected landscape work does not comply with requirements, replace rejected work and continue specified maintenance until re-inspected by Architect and found to be acceptable. Remove rejected plants and materials promptly from project site.

3.17 CLEANUP AND PROTECTION

- A. During landscaping, keep pavements clean and work area in an orderly condition.
- B. Protect landscaping from damage due to landscape operations, operations by other contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of it off the Owner's property unless an agreement is made with the Owner otherwise.

END OF SECTION 32 90 00

**DIVISION 33
UTILITIES**

SECTION 33 10 00 – SITE WATER UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes water systems piping for potable water service and fire protection service outside the building.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 15 Sections for fire protection systems inside building.
 - 2. Division 15 Sections for water distribution systems inside building.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure Ratings: Except where otherwise indicated, the following are minimum pressure requirements for water system piping.
 - 1. Underground Piping: 150 psig.
 - 2. Underground Piping, Downstream of Fire Department Connections: 200 psig.

1.4 SUBMITTALS

- A. General: Submit the following according to Conditions of the Contract and Division 1 Specification Sections.
- B. Product data, including pressure rating, rated capacity, and settings of selected models for the following:
 - 1. Water meters.
 - 2. Valves.
 - 3. Fire hydrants.
 - 4. Identification materials and devices.
 - 5. Pipe and Fittings.
- C. Shop drawings for precast concrete pits. Include frames and covers. Include drains when indicated.
- D. Shop drawings for cast-in-place concrete valve and meter pits. Include frames and covers. Include drains when indicated.
- E. Record drawings at Project closeout of installed water system piping and products according to Division 1 Section "Project Closeout."
- F. As-Built survey of installed water system. Perform and submit as-built survey as soon as possible following installation of water main piping and appurtenances. Survey shall be submitted at least 60-days prior to needed use of water main.
- G. Test reports specified in "Field Quality Control" Article in Part 3. Submit test reports at least 60-days prior to needed use of water main.

1.5 QUALITY ASSURANCE

- A. All materials, construction methods and testing shall comply with the requirements of the Town of Clayton Manual of Specifications, Standards, and Design.
- B. Provide listing/approval stamp, label, or other marking on equipment made to specified standards.
- C. Listing and Labeling: Provide equipment and accessories that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in "National Electrical Code," Article 100.

2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

D. Product Options: Water systems specialties and accessories are based on specific types, manufacturers, and models indicated. Components by other manufacturers but having equal performance characteristics may be considered, provided deviations in dimensions, operation, and other characteristics do not change design concept or intended performance as judged by Architect. The burden of proof of equality of products is on Contractor. Refer to Division 1 Section "Product Substitutions."

E. All work within any NCDOT right-of-way shall conform to the requirements of the current version of the NCDOT's Policies and Procedures for Accommodating Utilities on Highway Rights of Way, the provisions and conditions of the encroachment agreement(s), and other applicable NCDOT standards and policies. The encroachment agreement(s) are considered part of the project specifications by reference. Copies of the agreement(s) will be provided upon request from the Architect.

F. As-Built Survey: As-built survey shall be signed and seal by a NC Professional Land Surveyor and shall include the following:

1. All fire hydrant water valve sizes and locations with no less than two primary reference dimensions from permanent above grade features.
2. Locations of bacteriological sampling points.
3. Pipe materials and sizes.
4. Other water system components such as meters, backflow preventers, etc.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, for shipping as follows:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends, flange faces, and weld ends.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. Storage: Use the following precautions for valves, including fire hydrants, during storage:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect valves from weather. Store valves indoors and maintain temperature higher than ambient dew point temperature. Support valves off ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants whose size requires handling by crane or lift. Rig valves to avoid damage to exposed valve parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver pipes and tubes with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and piping specialties from moisture and dirt.

G. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

B. Verify that water system piping may be installed in compliance with original design and referenced standards.

C. Site Information: Reports on subsurface condition investigations made during the design of the Project are available for informational purposes only; data in reports are not intended as representations or warranties of accuracy or continuity of conditions (between soil borings). Owner assumes no responsibility for interpretations or conclusions drawn from this information.

1.8 SEQUENCING AND SCHEDULING

- A. Coordinate connection to water main with utility company.
- B. Coordinate with pipe materials, sizes, entry locations, and pressure requirements of building fire protection and building water distribution systems piping.
- C. Coordinate with other utility work.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All piping, valves, fittings, fire hydrants, meters, meter vaults, appurtenances and other products shall conform to the requirements of the latest editions of the Town of Clayton Manual of Specifications, Standards, and Design.
- B. Products shown herein, shall be approved in writing by the Town of Clayton, prior to ordering or installation.

2.2 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work shall be as approved by the Town of Clayton.

2.3 PIPES AND FITTINGS

- A. Ductile-Iron Pipe: ANSI/AWWA C150/21.50 and C151/A21.51, Pressure Class 350 with ductile iron fittings.
 - 1. Lining: ANSI/AWWA C104/A21.4, cement mortar, seal coated.
 - 2. Gaskets, Glands, and Bolts and Nuts: AWWA C111.
 - 3. Push-On-Joint-Type Pipe: AWWA C111/ANSI A21.51, rubber gaskets.
 - 4. Mechanical-Joint-Type Pipe: AWWA C111, rubber gaskets, ductile- or cast-iron glands, and steel bolts and nuts.
 - 5. Mechanical-Joint Restraint: Restrained Joint Pipe shall be TR Flex or Lok Tyte as manufactured by United States Pipe and Foundry Company, Lok-Fast or Lok-Ring as manufactured by American Cast Iron Pipe Company, Snap-lok as manufactured by Griffin Pipe Products Company.
 - 6. Coating: AWWA C151, bituminous coating.
 - 7. Markings: Net weight, pressure class, nominal thickness, sampling period and manufacturer, "DUCTILE".
 - 8. Fittings: ANSI/AWWA C153/A21.53, ductile-iron compact fittings, 350-psig pressure rating.
 - a. Lining: ANSI/AWWA C104/A21.4, cement mortar.
 - b. Gaskets: AWWA C111, rubber.
 - c. Joints: AWWA C111, mechanical joint, all bell.
 - d. Coating: AWWA C151, bituminous coating.
 - 9. Manufacturers: American Cast Iron Pipe Company, Griffin Pipe Products Company, or United States Pipe and Foundry Company.
- B. Copper Tube: ASTM B 88, Types K, seamless water tube, annealed temper soft drawn for use with compression type (brass) fittings for ¾-inch through 2-inch below ground services.

2.4 MECHANICAL JOINT RESTRAINTS

- A. Mechanical joint restraint systems shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWA C110/A21.10. Mechanical joint restraint systems (gland body, wedges and wedge actuating components) shall be constructed of grade 65-45-12 ductile iron material in accordance with ASTM 536. For applications requiring restraint 30 inches and greater, an alternate grade of iron meeting the material requirements of ASTM A536 is acceptable provided the device meets all the end product performance requirements. An identification number consisting of the year, day, plant and shift, shall be cast into each gland body.
 - 1. Sizes 3-inch through 16-inch shall be rated at 350-psi minimum working pressure and sizes 18 inches and larger rated at 250-psi minimum working pressure. Ratings are for water pressure and must include a minimum safety factor of 2 to 1 in all sizes.

2. Bolt heads are to be “auto-torque” twist off. Mechanical joint restraint systems shall accommodate all classes of ductile iron pipe (pressure class 350 through pressure class 150 and class 56 through 50) and appurtenances such as valves and hydrants without damage to the fitting, pipe or cement linings.
3. All components shall be manufactured and assembled in the United States. Acceptable manufacturers and models are: Mega-Lug Series 1100 by EBAA Iron, Star Grip by Star Pipe Products or Wedge Action Uniflange Series 1400 by Ford Meter Box Co.

2.5 VALVES

- A. Nonrising Stem Gate Valves 3 Inches and Larger: AWWA C509, UL Listed and FM Approved, resilient seated, bronze stem, cast-iron or ductile-iron body and bonnet, stem nut, 200-psig working pressure, mechanical joint ends. Valves shall be Mueller, American Flow Control, Clow (M&H) or Kennedy.
- B. Post Indicator Valves: NRS, UL 262, FM approved, iron body and bonnet with flange for indicator post, bronze seating material, inside screw, 175-psig working pressure, mechanical joint ends.
- C. Rising Stem Gate Valves 3 Inches and Larger for installation in vaults or other enclosure: AWWA C509, resilient seated; OS&Y, bronze stem, cast-iron or ductile-iron body and bonnet, stem nut, 200-psig working pressure, flanged ends.
- D. Nonrising Stem Gate Valves, 2 Inches and Smaller: Resilient seat, solid wedge, inside screw, non-rising stem, bolted bonnet, stainless steel bolts, and threaded ends. All valves shall be furnished with a 2-inch operator nut and open left. Valves shall be Mueller H-2360-8, American Flow Control 2502SS Series or Clow (M&H) F-6103.
- E. Valve Boxes: Cast-iron box having top section and cover with lettering "WATER," bottom section with base of size to fit over valve and barrel and adjustable cast-iron extension of length required for depth of bury of valve.
 1. Provide a steel tee-handle operating wrench with each valve box. Wrench shall have tee handle with one pointed end, stem of length to operate valve, and socket-fitting valve-operating nut.
- F. Indicator Posts: UL 789, FM-approved, vertical type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of bury of valve. Post indicator valves (PIVs) on fire protection systems shall be equipped with a supervisory switch.
- G. Curb Stops: Bronze body, ground key plug or ball, and wide tee head, with inlet and outlet to match service piping material.
- H. Service Boxes for Curb Stops: Cast-iron box with telescoping top section of length required for depth of bury of valve. Include cover having lettering "WATER," and bottom section with base of size to fit over curb stop and barrel approximately 3 inches in diameter.
 1. Provide steel tee-handle shutoff rod with each service box. Shutoff rod shall have tee handle with 1 pointed end, stem of length to operate curb stop, and slotted end fitting curb stop head.
- I. Tapping Sleeve and Tapping Valve: Complete assembly, including tapping sleeve, tapping valve, and bolts and nuts. Use sleeve and valve compatible with tapping machine.
 1. Stainless Steel Tapping Sleeve: Sleeve body, flange, bolts, nuts, test plug, and any other structural components shall be constructed of Grade 18-8 Type 304 stainless steel. The sleeve and gasket shall provide full wrap-around (360 degree) pipe coverage. Sleeve to be provided with a full gasket of gridded virgin SBR compounded for water service per ASTM D2000. Outlet gasket to be gridded virgin Buna-N compounded for water service per ASTM D2000. Tapping Sleeves shall be Romac SST with Stainless Steel Flange; Mueller H-304SS; or Smith-Blair 665.
 2. Tapping Valves: Resilient seat tapping valves shall be epoxy coated (minimum 10-mil thickness) and otherwise meet the requirements of Nonrising Stem Gate Valves 3 Inches and Larger specification above, except that the seat openings shall be larger than nominal size with a raised alignment ring on the flange. Valve ends shall be mechanical joint by flange. Valves shall open counter-clockwise (left) and shall have a 2-inch operator nut. All bolts and nuts are to be stainless steel. Tapping valves shall be "O" ring type a mechanical joint end conforming to AWWA non-rising stem construction. Inlet flange end shall be Class 125 (ANSI B16.1). Tapping valves shall be American Flow Control 2500-TM, Clow F-6114, Mueller T-2360 or Kennedy Kenseal II.

2.6 2-IN WATER SERVICES

- A. Type K Copper, soft drawn; comply with ASTM B-88, Standard Specification for Seamless Copper Water Tube, FS WW-T-799. Water service pipe for 2-inch connections shall be type "K" soft drawn copper with compression type joints with brass fittings and shall be one continuous run from main to meter with no joints or couplings in between. On these water services, the fittings shall be compression type brass fittings.
- B. The service line for a 2-inch meter shall consist of a 2-inch tap, 2-inch type K soft drawn copper service line, a threaded x compression adapter, a 2-inch threaded Iron Body Gate Valve and a 2-inch x 4-inch long threaded (iron pipe thread) brass nipple.
- C. Service saddles shall be 2-inch all bronze saddle with double bronze straps and with a grade 60 neoprene "O" ring gasket attached to the body. The saddle casting, straps, and nuts shall be water works bronze 85-5-5-5. The saddle shall have 2-inch iron pipe threads. Service saddle shall be Ford 202B Series, Mueller BR2B or Smith Blair 325-000 Series.
- D. 2-inch Meter Setters shall be constructed from 85-5-5-5 Brass (AWWA C800) and copper tubing, and factory tested for water-tightness before shipping. 2-inch meter setter/yoke shall be comprised of all brass and copper padlock wing inlet ball valve (lockable cut-off), angled double check valve, 1 ¼-inch by-pass line with a 1 ¼-inch stop ball valve, in-line double check valve, stabilizer bars, and brace pipe eyelets for 1-inch pipe. Outlet connections are to be compression. Meter setter/yoke shall be Ford VBHH77-18BHC-11-77 or Mueller H-1423-2.
- E. Meter boxes shall be cast iron boxes having the same approximate weight as, and lids interchangeable with, the MBX-5A as manufactured by Capitol Foundry for 2 inch meters. Meter boxes shall be supported by standard concrete bricks, which shall in turn be supported by a minimum of 4 inches of #57 or #67 washed stone.

2.7 WATER METERS

- A. Compound meters shall comply with AWWA C702. Meters shall be provided with strainers and shall be Itron AMR ERT module equipped. Meters shall be manufactured by Badger. Contractor shall furnish and install meters 2 inches and larger.
- B. Detector-Type Water Meter: Refer to backflow preventer specification.

2.8 VAULTS

- A. Concrete: Portland cement mix, 3000 psi .
 1. Cement: ASTM C 150, Type I.
 2. Fine Aggregate: ASTM C 33, sand.
 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 4. Water: Potable.
- B. Reinforcement: Steel conforming to the following:
 1. Fabric: ASTM A 185, welded wire fabric, plain.
 2. Reinforcement Bars: ASTM A 615, Grade 60, deformed.
- C. Ladder: ASTM A 36, steel or polyethylene-encased steel steps.
- D. Manhole: ASTM A 48, Class 35, gray-iron, 24-inch minimum diameter traffic frame and cover, of size and weight indicated.
- E. Drain: ASME A112.21.1M, cast-iron area drain, 4-in. Include body anchor flange, light-duty cast-iron grate, bottom outlet, and integral or field-installed bronze ball or clapper-type backwater valve.

2.9 FIRE HYDRANTS

- A. General: Fire hydrants shall comply with ANSI/AWWA C502 Dry-Barrel Fire Hydrants, latest revision, UL 246 and FM1510. Hydrants shall be hub end, triple nozzle, improved AWWA type. Interior coating to be in accordance with AWWA C550. Minimum working pressure shall be 150-psi. Hydrants shall be Clow F-254 Medallion, Mueller A-423 Super Centurion 250, American Darling B62B-1, American Flow Control B-84-B, or Kennedy Guardian.
 1. Two 2½-inch fire nozzles and one 4½-inch steamer nozzle, National Standard hose threads.

2. The steamer nozzle shall be provided with an auxiliary straight pattern Storz Fire Department connection. Storz unit to be hard coated aluminum construction Guardian 6600 series Storz Fire Department Connection, Female NPT x Locking Storz Inlet with Storz blind Cap. Storz cap to include securing chain.
3. All nozzles shall be provided with caps and chains.
4. The hydrant foot valve opening shall be 5¼ inches.
5. Hydrant to be dry top with lubrication reservoir.
6. Bronze to bronze threads shall be provided between the hydrant seat or seat ring and the seating attaching assembly. Seat ring to shoe shall be bronze to bronze.
7. All hydrants must include cast or ductile epoxy lined shoe (minimum 4 mils), rubber drain seals and positive protective valve stop device.
8. Hydrants shall open left and shall have a National Standard pentagon-type operating nut (1 ½” point to flat). The operating nut shall be of one-piece bronze construction. A thrust washer shall be supplied between the operating nut and stem lock nut. The valve stem shall have a safety flange and a safety coupling.
9. Hydrants shall have a 6-inch hub-end or mechanical joint elbow.
10. The hydrant barrel shall be of sufficient length to provide a minimum bury of 3 feet.
11. Hydrants shall be of the compression type closing with line pressure and shall be of the traffic model breakaway type.
12. Hydrant cap and stuffing box shall be of unitized, one-piece design creating a watertight cavity without the use of gaskets. The combination of O-Rings to a crimped brass ferrule around the stem shall seal the cavity from contact with water. Hydrant caps shall have a means for providing periodic lubrication of the operating threads.
13. The main valve shall be of synthetic rubber reinforced with steel. The seat shall be of a bronze ring threaded to a bronze insert in the hydrant shoe, with O-Rings to seal the drain way and barrel from leakage of water in the shoe.
14. The hydrant drain hole shall momentarily force flush with each operation.
15. All hydrant extension kits, flange kits, stems, couplings or other repair parts must be of the original hydrant manufacturer. Only one 24-inch extension kit is allowed.
16. Hydrants are to be painted with 2 coats of Sherwin Williams or approved equal paint. Barrels are to be painted federal safety red with the caps and bonnet. Storz nozzle shall not be painted.
17. If line is to be pressurized within 7 days of setting hydrant, then 4000-psi high early strength concrete shall be used.

2.10 FIRE DEPARTMENT CONNECTIONS

- A. Exposed, Sidewalk Fire Department Connections: 5-in x 4-in with 30-deg turndown, 5-in Storz connection inlet, 4-in female NPS outlet. Include cap and chain; fixed (no swivel) connection. Connect to galvanized steel elbow and FDC pipe; and round sidewalk escutcheon plate marked “AUTO SPRKLR”. Provide 1-in, ¼ (quarter) turn valve tapped into FDC pipe at 12-in above finish grade.
- B. Wafer Check Valve: UL Listed/FM Approved, ductile iron body, bronze clapper and seat ring, ‘O’ ring seals, stainless spring closure, with ½” ball drip valve below seat to allow valve to drain water from FDC.
- C. Signage: Approx. 18"x10", steel, white background with min. 6" red lettering, marked FDC, mounted on a galvanized steel pole with concrete footing. Mounting height to bottom of sign: 5-ft. min.

2.11 BACKFLOW PREVENTERS

- A. General: As listed as approved by the Public Utilities Handbook of the City of Raleigh Public Utilities Department.
- B. Reduced Pressure (RP or RPZ) Backflow Preventers – ¾” thru 2”: ASSE 1013, AWWA C511, CSA B64 Certified and USC Foundation for Cross Connection Control and Hydraulic Research approved, lead-free, with full port, resilient seated ball valve shut-off valves and ball valve test cocks. Include 2 spring loaded, center stem guided check valves and one hydraulically dependent differential relief valve.
- C. Reduced Pressure (RP or RPZ) Backflow Preventers – 2-1/2” thru 10”: ASSE 1013, AWWA C511, CSA B64 Certified and USC Foundation for Cross Connection Control and Hydraulic Research approved, FM approved or UL listed, lead-free, with OS&Y gate valves on inlet and outlet, and strainer on inlet. Include test cocks and pressure-differential relief valve with ASME A112.1.2 air gap fitting located between 2 positive-seating check valves for continuous-pressure application. Assembly shall be of a compact design utilizing a flow orientation of inlet flow vertical up, outlet flow vertical down at the direct outlet of the gate valves.
- D. Reduced Pressure Detector Assembly (RPDA) Backflow Preventers – 2-1/2” thru 10”: ASSE 1047, USC Foundation for Cross Connection Control and Hydraulic Research approved, FM approved and UL listed, lead-free, with OS&Y gate valves on inlet and outlet, and strainer on inlet. Include test cocks and pressure-differential relief

valve with ASME A112.1.2 air gap fitting located between 2 positive-seating check valves and test cocks, and bypass with displacement-type water meter, valves, and reduced pressure backflow preventer, for continuous-pressure application. Assembly shall be of a compact design utilizing a flow orientation of inlet flow vertical up, outlet flow vertical down at the direct outlet of the gate valves. Gate valves on backflow preventers on fire protection systems shall be equipped with supervisory switches.

2.12 PROTECTIVE ENCLOSURES

- A. General: Manufactured, ASSE 1060 certified, weather-resistant enclosure designed to protect aboveground water piping equipment or specialties. Enclosures shall be sized as required for access and service of protected unit. Enclosures for compact design backflow preventers shall be no larger than 64”(L)x60”(W)x60”(H). Enclosures shall be as manufactured by Hot Box or approved equal.
1. Housing: Reinforced-aluminum or reinforced-fiberglass construction with factory applied paint. Paint color to be selected by Designer from manufacturer’s standard color choices. Unpainted aluminum exterior will not be allowed.
 2. Drain opening: Sized to alleviate a full release by the backflow preventer.
 3. Access doors with locking device.
 4. Insulation inside housing.
 5. Thermostatically controlled electric heater (for 2-1/2” or larger backflow preventers) or plug-connected self-limiting temperature control pipe heating cable (for 2” and smaller backflow preventers) and connection to power supply. Heating equipment shall be designed and furnished by the enclosure manufacturer.
 6. Concrete base slab: 4 inch thick of dimensions required to extend at least 6 inches beyond edges of housing. Provide PVC sleeves at pipe penetrations of slab.
 7. Anchoring devices to attach housing to base with stainless steel mounting hardware.
 8. Coordination: Coordinate with other trades for installation of electrical services, GFI, tamper switches, temperature sensors, and connections to fire alarm systems as applicable. Locate GFI and other electrical components away from water discharge from backflow devices.

2.13 ANCHORAGES

- A. Clamps, Straps, and Washers: ASTM A 506, steel.
- B. Rods: ASTM A 575, steel.
- C. Rod Couplings: ASTM A 197, malleable iron.
- D. Bolts: ASTM A 307, steel.
- E. Cast-Iron Washers: ASTM A 126, gray iron.
- F. Concrete Reaction Backing: Portland cement concrete mix, 3000 psi.
1. Cement: ASTM C 150, Type I.
 2. Fine Aggregate: ASTM C 33, sand.
 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 4. Water: Potable.

2.14 IDENTIFICATION

- A. Metallic-Lined Plastic Underground Warning Tapes: Solid aluminum foil core, 35 gauge minimum, encased on each side with plastic (minimum overall thickness 5 mils) and be 3 inches wide with black lettering imprinted on a color coded background that conforms to APWA uniform color code specification (BLUE) and silver with black ink letters. Minimum tensile strength shall be 22 lbs/inch. Soil tolerance range to be pH 2.5 to pH 11.0. On one side of the tape, the text shall include the wording “WATER LINE BELOW” repeated along the length of the tape. A detectable warning tape shall be used with all water mains. Underground warning tape is to be placed directly over the pipe 12 to 18 inches below the finished grade
- B. Locator Wire: #12 AWG blue insulated solid copper wire shall be installed above all water mains. Electrical conductivity along the pipe shall be continuous and uninterrupted between valve boxes. A sufficient excess length of wire shall be left in each valve box to provide at least a 6 to 12 inches length of wire above finished grade.

2.15 ALARM DEVICES

- A. Supervisory Switches: Single pole, double throw; designed to signal valve in other than fully open position. UL 753, FM approved, of type and sizes to mate and match piping and equipment.

PART 3 - EXECUTION

3.1 GENERAL

- A. All construction shall conform to the requirements of the Town of Clayton and the NCDOT as applicable in addition to the requirements state herein.

3.2 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.3 SERVICE ENTRANCE PIPING

- A. Extend water system piping and connect to water supply source and building water distribution and fire protection systems in locations and pipe sizes indicated.
 - 1. Terminate domestic water system piping at 5-feet outside building wall until building water systems are installed. Terminate piping with caps, plugs, or other fittings as required for piping material. Make connections to building water system when those systems are installed.
 - 2. Terminate fire protection water system 12-in above finish floor elevation within building with caps, plugs, or flanges as required for piping material. Coordinate exact locaiton with fire protection contractor. Install restrained joints for buried piping within 60 inches of building. Use restrained-joint pipe and fittings, thrust blocks, anchors, tie-rods and clamps, and other supports at vertical and horizontal offsets.

3.4 JOINT CONSTRUCTION

- A. Ductile-Iron Piping Gasketed Joints: Construct joints according to AWWA C600.
- B. Flanged Joints: Align flanges and install gaskets. Assemble joints by sequencing bolt tightening. Use lubricant on bolt threads.

3.5 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. General Locations and Arrangements: Drawings indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated except where deviations to layout are approved on coordination drawings.
- B. Install piping at indicated slope.
- C. Install components having pressure rating equal to or greater than system operating pressure.
- D. Install piping free of sags and bends.
- E. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- F. Install fittings for changes in direction and branch connections.
- G. Piping Connections: Except as otherwise indicated, make piping connections as specified below.
 - 1. Install unions, in piping 2 inches and smaller, adjacent to each valve and at final connection to each piece of equipment having 2-inch or smaller threaded pipe connection.
 - 2. Install flanges, in piping 2-1/2 inches and larger, adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.
 - 3. Install dielectric fittings to connect piping of dissimilar metals.

3.6 PIPING INSTALLATION

- A. Water Main Connection: Tap water main with size and in location as indicated according to requirements of water utility. Obtain all required tap, right-of-way, pavement cut, and/or other permits prior to beginning construction.

1. Install tapping sleeve and tapping valve according to manufacturer's installation instructions.
2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
3. Install gate valve onto tapping sleeve. Comply with AWWA C600. Install valve with stem pointing up and with cast-iron valve box.
4. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water service piping.
5. Install service clamps and corporation stops in size, quantity, and arrangement required by utility company standards and according to manufacturer's installation instructions.
6. Install service clamps on pipe to be tapped. Position outlet for corporation stop.
7. Install corporation stops into service clamps. Install valve with stem pointing up and with cast-iron valve box.
8. Install curb stop in service piping with head pointing up and with cast-iron service box.
9. Install manifold for multiple taps in water main.
10. Use drilling machine compatible with service clamp and corporate stop. Drill hole in main. Remove drilling machine and connect water service piping.

- B. Comply with requirements of NFPA 24 for materials and installation.
- C. Install ductile-iron pipe and ductile-iron and cast-iron fittings according to AWWA C600.
- D. Install copper tube and wrought-copper fittings according to CDA No. 404/0 "Copper Tube Handbook."
- E. Bury piping at minimum depth of 48 inches below finished grade and not less than 18 inches below average local frost depth.
- F. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.
- G. Shoring or bracing of pits, trenches and other excavations shall be in accordance with the requirements of NCDOT and OSHA.
- H. The subgrade at the bottom of the trench shall be shaped to secure uniform support throughout the length of the pipe. A space shall be excavated under the bell of each pipe to provide space to relieve bearing pressure on the bell and provide room to adequately make the joint.
- I. Open ends of pipe shall be plugged with a standard plug or cap at all times when pipe laying is not in progress. Trench water shall not be permitted to enter pipe.
- J. Backfill material shall be free from stones greater than 4-inches in diameter, construction material debris, frozen material, organic matter, or unstable material. Backfill materials shall be placed in loose lifts of 8-inches or less in depth. All backfill shall be compacted to not less than 95% of the standard Proctor maximum dry density except the final foot beneath pavement or slab areas where this requirement shall be increased to 98% of the standard Proctor maximum dry density.
- K. Install and test fire protection piping and appurtenances in accordance with the specific requirements of the Town of Clayton and applicable NFPA requirements.

3.7 ANCHORAGE INSTALLATION

- A. Anchorages: Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
 1. Gasketed-Joint, Ductile-Iron Piping: According to AWWA C600.
 2. Fire Service Piping: According to NFPA 24.
- B. Apply full coat of asphalt or other acceptable corrosion-retarding material to surfaces of installed ferrous anchorage devices.

3.8 FIRE HYDRANT INSTALLATION

- A. Install fire hydrants as indicated on the Drawings.

3.9 ROUGHING-IN FOR WATER METERS

- A. Install rough-in piping and specialties for water meter installation as indicated on the Drawings and according to the Town of Clayton's requirements. Meter to be installed by City personnel.

3.10 PIT CONSTRUCTION AND INSTALLATION

- A. Construct pits of poured-in-place concrete or provide precast concrete pits of dimensions indicated, with access frame and cover, ladder, and drain. Include sleeves with waterproof mechanical sleeve seals for pipe entry and exit.
- B. Connect area drain outlet to storm drain

3.11 FIRE DEPARTMENT CONNECTION INSTALLATION

- A. Install fire department connections in locations indicated in accordance with NFPA 14 and 24.
- B. Install wafer check valve with ball drip valve at each fire department connection. Install concrete or cast iron vault set on #57 washed stone at wafer check valve.
- C. Orient nozzles of FDC toward vehicle travelway.
- C. Install signage out of pedestrian and vehicle travelways near FDC. Front of sign to face primary vehicle travelway.

3.12 BACKFLOW PREVENTER INSTALLATION

- A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to plumbing and health department authorities having jurisdiction.
- B. Do not install bypass around backflow preventer.
- C. Do not install reduced-pressure-principle-type in pit.
- D. Support backflow preventers, valves, and piping on 3000-psi minimum, portland-cement-mix concrete piers.
- E. Contractor shall contract with qualified personnel to perform and provide certification of installed backflow prevention devices.

3.13 IDENTIFICATION INSTALLATION

- A. Install continuous plastic underground warning tape during back-filling of trench for all underground water piping. Locate 12 inches to 18 inches below finished grade, directly over piping.
- B. Install copper locator wire directly above all underground water piping. Electrical conductivity along the pipe shall be continuous and uninterrupted between valve boxes. A sufficient excess length of wire shall be left in each valve box to provide at least a 6 to 12 inches length of wire above finished grade.

3.14 ALARM DEVICE INSTALLATION

- A. Comply with NFPA 24 for devices and methods of valve supervision.
- B. Supervisory Switches: Supervise valves in open position.
 - 1. Valves: Grind away portion of exposed valve stem. Bolt switch, with plunger in stem depression, to OS&Y gate-valve yoke.
 - 2. Indicator Posts: Drill and thread hole in upper-barrel section at target plate. Install switch, with toggle against target plate, on barrel of indicator post.
- C. Connect alarm devices to building fire alarm system. Wiring and fire-alarm devices are specified in Division 13.

3.15 FIELD QUALITY CONTROL

- A. General: Pipelines shall be tested, in sections between valves, as soon as the installation is completed. Using this method, errors in workmanship can be identified immediately and leaks can be fixed quickly and with minimum expense. Prerequisite Conditions for Testing and Disinfection shall be as follows:

1. Pipelines and appurtenances have been laid and the trench backfilled.
2. Hydrants shall be properly located, operable and plumb and at correct elevation.
3. Valves shall be properly located, operable and at correct elevation. Valve boxes or manhole shall be centered over operating nuts and the top of the box or manhole shall be at proper elevation.
4. All services shall be installed complete with setters (Contractor shall provide a meter, approved by Town, for pressure testing). There shall be no bypass around the meter used for pressure testing.
5. All reaction anchors have had sufficient set of 7 days or high early strength concrete may be used to reduce the curing time to 3 days. For high early concrete mix, use 4,500-psi or greater concrete. Temporary bracing shall not be allowed.
6. Lines shall be properly vented where entrapped air is a consideration.
7. All visible leaks, broken or cracked pipe, valves, hydrants, etc. shall be repaired.
8. Air release valves shall be installed complete and in place after pressure test.
9. All construction activities on the project, that requires trenching or excavation within the limits of the water location shall be completed. Pavement base course and curb and gutter shall be in place before sampling. Pressure testing is to be performed before pavement is put down.
10. Approval from Town's Inspector on section of line to be tested.

B. Order of Operations

1. **Fill Line:** After all prerequisites are met, fill the system slowly with water, at a velocity of approximately 1 foot per second, while necessary measures are taken to eliminate all air at the highest points of the system where air may collect in pockets. After filling, shut off system in order to prevent contaminated water from flowing back in the line supplying the water.
2. **Pressure Test:** A pressure test shall be scheduled with a Town representative performing the test 48 hours in advance. If an existing gate valve is known to be leaking, chlorination must be performed prior to pressure testing.
3. **Flushing:** Allow filled system to set undisturbed for a minimum of 24 hours, then begin flushing operations. The section of main to be disinfected shall be flushed through blowoff assemblies. Flushing shall be a velocity of not less than 2.5 feet per second to remove sediment and other foreign matter until the water runs clear. The contractor shall be responsible for making adequate provisions for drainage of large volume of flushing water, including proper dechlorination/disposal of chlorinated water. Any damages that may occur from this operation shall be the sole responsibility of the contractor. In conjunction with beginning flushing, a Town representative will perform a high range chlorine concentration test. Chlorine concentration of 50 mg/l minimum must be provided. Allow chlorinated water to set in the test section for 24 hours. The chlorine concentration shall not drop below 20 ppm within a minimum period of 24 hours.
4. **Sampling:** Check chlorine and turbidity. After allowing the system to flush so that at least two volumes of water pass through the main, the bacteria sample shall be collected at regular intervals not exceeding 1,200 feet, and tested for bacteriological quality. The contractor shall be responsible for making adequate provisions for drainage of large volume of flushing water, including proper dechlorination/disposal of heavily chlorinated water.
 - a. Pipe subjected to contaminating materials shall be treated as directed by Town Engineer. Should such treatment fail to cleanse the pipe, replacement shall be required. The Town shall bear no portion of any cost sustained by the contractor in meeting this specification.
 - b. Services shall be included in the main line disinfection process. The contractor shall have the same responsibility for laterals as for the mains in regard to bearing full cost of any corrective measures needed to comply with either the bacteriological test or other such requirements.
5. **Final:** After final flushing, flow all hydrants to confirm the valves are open.

C. Pressure Tests and Leakage

1. The contractor shall test and disinfect completed sections of water line, including service lines, fire hydrants, and fittings with water. Town reserves the right to test all lines. This testing, however, does not relieve the contractor of his responsibility to repair or replace any cracked or defective pipe within the 12-month warranty period. All work necessary to secure a tight line shall be done at the contractor's expense. Testing shall be performed in the presence of Town Engineer.
2. All additions or replacements to water system, including fire lines and backflow prevention devices, shall be tested and chlorinated before being placed in service. Such work must take place under the supervision of Town Engineer.
3. The newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for two hours to a leakage test with a constant test pressure of 150% of design working pressure, but no less than 150 psi. The test pressure shall be allowed to build up slowly using a hand pump or power pump to the test pressure. Only Town personnel shall operate water valves on Town's existing water system. Extreme care

shall be used to prevent backflow into the potable water supply. The lines should be allowed to stand under pressure for a period of 24 hours prior to the test. Air should be vented from all high points just prior to the test. Only clean water, free of dirt and other debris, from a clean container shall be used for testing. The contractor shall notify Town's inspector 48 hours in advance of any expected test. The contractor shall pretest all mains for a period of 2 hours before notifying Town for a final pressure test. No final pressure test will begin after 2:00 PM. The maximum allowable leakage shall be no greater than allowances determined by formulas presented in AWWA C-600 and C-605. No leakage shall be allowed for services.

4. Tapping sleeve and valve shall be pneumatically tested in place prior to tapping of the existing line in accordance with the manufacturer's recommendations.
5. The Town's inspector will verify 1 pressure test – the final observation of the test section. A fee will be charged if the Town inspector is required to make more than 1 trip to verify a pressure test or conduct purity sampling on the same section of main being tested.
6. Acceptance Tests:
 - a. Pressure Test: Subject the pipe system to a hydrostatic pressure test. Raise the pressure by pump to 150-psi, 150% of design working pressure, or test pressure as shown on the drawings, whichever is greater. Measure pressure at the low point on the system compensating for gauge elevation. Maintain this pressure (+ or – 5 psi) for 2 hours. If pressure cannot be maintained using reasonable pumping rate, determine cause, repair, and repeat the test until successful. Contractor shall be responsible for all labor, materials, and equipment to perform the testing.
 - b. Leakage Test: Leakage shall be defined as the quantity of water that must be supplied into the pipe to maintain the test pressure, after all air in the pipeline has been expelled and the pipe has been tested for a duration of 2 hours. Leakage shall not exceed the quantity determined by formulas presented in AWWA C-600 or C605, for ductile and PVC respectively. Updated leakage tables may be available from the Public Water Supply Division of North Carolina Department of Natural Resources.
 - c. If leakage exceeds allowances, the contractor shall be responsible for locating and repairing leaks, and retesting of line until successful.
 - d. No leakage will be allowed for all welded steel pipe. If leaks are revealed by test, repair by rewelding. Peening of leaks will not be allowed. A certified welder must perform all welding.

D. Disinfection and Bacteriological Testing

1. Pipe Disinfection and Bacteriologic Testing: comply with ANSI/AWWA C651, *Disinfecting Water Mains*. The contractor shall disinfect water mains and accessories in accordance with the procedures listed below and meet the requirements of Town. Bacteriological testing shall comply with Section 5 of AWWA C651. All samples shall be tested for bacteriological (chemical and physical) quality in accordance the *Standard Methods for the Examination of Water and Wastewater*; and shall show the absence of coliform organisms and the presence of chlorine residual. The lines shall not be placed in service or pressure tested until a negative bacteriological report has been received.
 - a. Samples cannot be collected if any type of precipitation is falling.
 - b. All sampling pipe shall be copper, brass, or PVC.
 - c. The contractor is responsible for furnishing all material and construction sampling points and for taking the samples. Temporary pipes used for sampling shall be composed of sections of vertical pipe terminating into a 90-degree horizontal bend and nipple at least 18 inches above ground level. Copper tubing used for sampling shall terminate horizontally with the ground, at least 18 inches above ground level. It may be difficult to obtain passing samples from outlets other than those listed above. Samples will not be taken from a hose.
 - d. The Contractor will prepare a Sampling Log, including a sketch of the sampling points, as specified by the Town. The samples shall be taken in standard sterilized bacteria sample bottles marked with the sample location. The Contractor is responsible for collecting samples and doing so in the presence of a Town representative. Samples can only be taken Monday through Thursday no later than 1:00 PM. Chlorine injected on Friday yielding a 48-hour contact time will be reviewed and approved on a case by case basis.
 - e. Samples shall be delivered to a State certified testing laboratory for analysis. Results of the analyses shall be furnished to the Town directly from the testing laboratory with the project name and the testing location(s) referenced on each result. In the event that two successive bacteriological tests fail for any given section(s), that section(s) of the main shall be re-chlorinated, re-sampled, and re-analyzed.
 - f. Contractor is responsible for all testing costs.
2. Forms of chlorine for disinfecting:

- a. Calcium hypochlorite – Two forms are available – granular and tablets (both with 65% available chlorine). It will normally require 6.5 lbs. of Calcium Hypochlorite to produce a concentration of 50mg/L of available chlorine in 10,000 gallons of water. (*Warning Note: This chemical must not be used on solvent-welded or on screwed-joint steel pipe because of the danger of fire or explosion from the reaction of the joint compounds with the calcium hypochlorite.*)
 - b. Sodium hypochlorite – is supplied in strengths of 5.25% to 16% available chlorine. The required amount of sodium hypochlorite to produce a 50mg/L concentration of available chlorine in 10,000 gallons of water can be calculated from the following formula: Gallons of Sodium Hypochlorite needed = $50 \div \% \text{ of available chlorine}$
3. Methods of Chlorine Application:
- a. The contractor will inject a chlorine solution as specified in AWWA Standard C651, latest revision, into the water main. Chlorination shall be in accordance with the following guidelines for calcium hypochlorite granules to provide 50-ppm:
 - 6-in diameter pipe: 0.93-lbs per 1,000-ft of pipe.
 - 8-in diameter pipe: 1.68-lbs per 1,000-ft of pipe.
 - 12-in diameter pipe: 3.77-lbs per 1,000-ft of pipe.
 - b. The chlorine solution shall be injected in the section of the main nearest an existing main. The chlorine solution shall result in a chlorination concentration of 50 ppm or greater. Chlorine injected on Friday yielding a 48 contact time will be reviewed and approved on a case by case basis. Manually operated pumps shall not be used to inject the solution into the main.
4. Bacteriologic Test: Before the water main is placed in service, all samples shall be collected at regular intervals not exceeding 1,200 feet and tested for bacteriologic quality and shall show the absence of both background growth (gram positives) and coliform organisms.
- a. Samples for bacteriological analysis shall be collected in sterile bottles treated with sodium thiosulfate. A chain of custody shall accompany the samples delivered to the plant. Test results cannot be read until 24 hours after sample has been run by lab. If laboratory results indicate the presence of coliform bacteria, the samples are unsatisfactory. If laboratory results indicate background growth masking the detection of coliform bacteria, the sample will be considered unsatisfactory. If the line fails second sampling, the main shall be re-chlorinated by the contractor and new tests performed prior to moving to the next section of main. The tablet method cannot be used in repeated disinfecting.
 - b. Cleaning and disinfecting will be the responsibility of the contractor. Town will furnish water and operate all necessary valves for these operations. The contractor shall be responsible for loading, hauling, discharging of water, and dechlorinating device.
 - c. Samples for bacteriological analysis shall be collected for each section of pipe between main line valves after flushing is completed.
 - d. Primary sampling points are blow-offs, 2-inch setters and all fire lines. Sampling will be allowed at hydrants if available to flush and sample the entire section of newly laid pipe. Otherwise, the contractor shall install a flushing and sampling tap consisting of a corportaion cock installed in the pipe with a temporary copper pipe. Such additional work required for this shall be at the contractor's expense and is to be properly abandoned after acceptance.
5. New Water Mains Disinfection.
- a. The contractor is responsible for furnishing all taps and materials required to satisfactorily disinfect the water system. The following steps will be completed by Town and the Contractor cooperatively.
 - b. The Town's inspector will witness the flushing of the section of main to be disinfected until the water appears clear. The contractor is responsible for adequate disposal of the large volumes of water generated from flushing and dechlorinating device.
 - c. The contractor will inject a chlorine solution as specified in Section 4 of the AWWA Standard C651, latest revision, into the water main.
 - i. Do not use manually operated pumps to inject the solution into the main.
 - ii. The chlorine solution shall result in a chlorine concentration of 50 ppm or greater.
 - iii. The chlorine solution should be injected in the section of main nearest an existing water main.

- d. The Town's Inspector will draw water from the following areas until at least 50 ppm chlorine concentration has been measured at all points of discharge at which time each point will be closed:
 - end of the main
 - hydrants
 - lateral lines
 - other connections
 - i. The Town's Inspector will close all control valves feeding water into the main.
 - ii. The chlorine concentration shall not drop below 20 ppm within a minimum period of 24 hours.
 - iii. Sometime after the 24-hour period expires, the Town's inspector will check the chlorine concentration to confirm that it has not dropped below 20 ppm.
6. New Water Mains Purity Testing.
- a. The contractor is responsible for furnishing all material and constructing sample points.
 - b. The Contractor is responsible for preparing a Sampling Log that includes a sketch of sampling points.
 - c. The contractor must ensure that each sample point terminates horizontally at least 18" above ground level.
 - d. SAMPLES WILL NOT BE TAKEN FROM A HOSE.
 - e. Samples are to be taken on Monday through Thursday, no later than 1:00 PM.
 - f. The Contractor is responsible for collecting and submitting samples to a State certified testing laboratory. Samples cannot be collected if any type of precipitation is falling.
 - g. Before chlorinating is performed, the Contractor will first flush the new water main. The main must be flushed so that two volumes of water pass through the main.
 - h. The Town's inspector will check both chlorine concentrations.
 - i. The chlorine concentration must be less than 4ppm for consumption purposes but greater than or equal to 2 ppm for testing purposes.
 - ii. If the chlorine concentration is not within these limits, the Contractor must flush and rechlorinate the water line and resample at a later date.
 - i. If the chlorine concentration is within limits, the Contractor will collect samples from the new main and from an approved/control water main in the distribution system.
 - j. On the day of collection, the Contractor will deliver the collected sample to a State certified laboratory. Samples may be delivered only Monday through Thursday no later than 1:00 PM.
 - k. The laboratory personnel will conduct a total coliform test using the membrane filter method. This test required 24 hours of incubation before the result is obtained.
 - l. The test results must be negative for coliform and E. Coli bacteria.
 - i. If the samples from the water main are positive, the main must be disinfected again which means Step 1 must be repeated in its entirety. This will prolong testing.
 - ii. In the rare event that the samples from the control main are positive, the control main must be flushed and resampled at a later date. This will prolong testing.
7. Dechlorination: No discharge of heavily chlorinated water into a storm sewer or a stream will be permitted unless the discharge is first treated by a neutralizing chemical applied to the water to be wasted to neutralize thoroughly the residual chlorine. A dechlorinating device is required. Disposal of heavily chlorinated water shall meet the applicable sections of AWWA C651, latest revision.
- E. Final Acceptance
- 1. Upon completion of water main installations and prior to acceptance, the Contractor shall provide adequate and competent personnel to conduct, in conjunction with Town, an inspection of each valve and hydrant on the newly completed main. The purpose of this inspection shall be to ensure the operability and location of each valve and to further ensure that all valves are left in the open position.
 - 2. Fire hydrants shall be greased and painted.
 - 3. Flow tests are to be performed on each hydrant to verify both that flows are in line with the design flows and that all line and leg valves are open.
 - 4. Upon receipt of State Certification, the main valve serving the new section of main(s) shall be turned on and placed into service..
- F. Private Fire Service System Flushing & Testing: Perform flushing and all tests as required by NFPA 14 and NFPA 24. Contractor is responsible for performing and coordinating fire system installation and testing in accordance with the requirements of the Town of Clayton.

1. Complete and submit “Contractor’s Material and Test Certificate for Underground Piping” (NFPA 14) upon satisfactory completion of system flushing and all tests.
- G. Backflow Prevention Device Certification
1. All new backflow prevention devices shall be tested and certified by an inspector approved by the City of Raleigh prior to operation of the water system. Performance, coordination and submittal of documentation of the testing and certification shall be the responsibility of the Contractor.
- H. Contractor shall be responsible for ensuring all waterlines are fully flushed and free of all deleterious matter prior to connecting to the building plumbing system.

END OF SECTION 33 10 00

SECTION 33 30 0 – SITE SANITARY SEWERAGE UTILITIES

PART 1: GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including the General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes sewerage systems outside the building.
- B. Related Sections: The following Sections contain requirements that relate to this Section.
 - 1. Division 3 Section "Cast-in-Place Concrete" for cast-in-place concrete structures.

1.3 DEFINITIONS

- A. Sewerage Piping: System of sewer pipe, fittings, and appurtenances for gravity flow of sanitary sewage.

1.4 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Nonpressure-Piping Pressure Ratings: At least equal to system test pressure.
- B. Force Main Minimum Working Pressure Ratings: Except where otherwise indicated, the following are minimum pressure requirements for force main system piping:
 - 1. Underground Force Main Piping: 150 psi.

1.5 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for the following:
 - 1. Cleanouts.
 - 2. Pipe and fittings.
 - 3. Couplings.
 - 4. Manhole Apurtenances.
 - 5. Valves.
- C. Shop drawings for precast concrete manholes and other structures. Include frames, covers, and grates.
- D. Shop drawings for cast-in-place concrete or field-erected masonry manholes and other structures. Include frames, covers, and grates.
- E. Record drawings at Project closeout of installed sanitary sewer system piping and products according to Division 1.
- F. As-Built survey of installed sanitary sewer mains and manholes. Perform and submit as-built survey as soon as possible following installation of manholes and sewer main piping. Survey shall be submitted at least 60-days prior to needed use of sewer main.
- G. Inspection and test reports specified in the "Field Quality Control" Article.

1.6 QUALITY ASSURANCE

- A. All materials, construction methods and testing shall comply with the requirements of the Town of Clayton Manual of Specifications, Standards, and Design.
- B. All work within any NCDOT right-of-way shall conform to the requirements of the current version of the NCDOT's Policies and Procedures for Accommodating Utilities on Highway Rights of Way, the provisions and conditions of the encroachment agreement(s), and other applicable NCDOT standards and policies. The encroachment

agreement(s) are considered part of the project specifications by reference. Copies of the agreement(s) will be provided upon request from the Architect.

- C. Environmental Agency Compliance: Comply with regulations pertaining to sanitary sewerage systems.
- D. Product Options: Drawings indicate sizes, profiles, connections, and dimensional requirements of system components and are based on specific manufacturer types indicated. Other manufacturers' products with equal performance characteristics may be considered. Refer to Division 1 Section "Product Substitutions."
- E. As-Built Survey / Record drawings at Project closeout of installed sewer system piping and products. As-built survey shall be signed and seal by a NC Professional Land Surveyor and shall include the following:
 - 1. All manhole invert and rim elevations and horizontal locations with no less than two primary reference dimensions from permanent above grade features.
 - 2. All cleanout locations with no less than two primary reference dimensions from permanent above grade features.
 - 3. Pipe materials, sizes, lengths, and slopes.
 - 4. Other sewer system components such as grease traps, etc.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic structures in direct sunlight.
- B. Do not store plastic pipe or fittings in direct sunlight.
- C. Protect pipe, pipe fittings, and seals from dirt and damage.
- D. Handle precast concrete manholes and other structures according to manufacturer's rigging instructions.

1.8 PROJECT CONDITIONS

- A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.
- B. Locate existing structures and piping to be closed and abandoned.
- C. Existing Utilities: Do not interrupt existing utilities serving facilities occupied by the Owner or others except when permitted under the following conditions and then only after arranging to provide acceptable temporary utility services.
 - 1. Notify Architect not less than 48 hours in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without receiving Architect's written permission.

1.9 SEQUENCING AND SCHEDULING

- A. Coordinate sanitary sewerage system connections to municipality's sanitary sewer. Obtain all necessary permits for pavement cuts, line taps, etc. from the authorities having jurisdiction.
- B. Coordinate with interior building drainage systems.
- C. Coordinate with other utility work.

PART 2: PRODUCTS

2.1 GENERAL

- A. All materials shall comply with the requirements of the latest editions of the Town of Clayton Manual of Specifications, Standards, and Design.

2.2 PIPES AND FITTINGS

- A. Ductile-Iron Pipe: AWWA C150 and C151, Class 50 minimum, for push-on joints per AWWA C111.
 - 1. Standard-Pattern, Ductile-Iron and Cast-Iron Fittings: AWWA C110, for push-on joints. Min. class 54.
 - 2. Compact-Pattern, Ductile-Iron Fittings: AWWA C153, for push-on joints. Min. class 54.

3. Pipe and Fitting Interior Coating: Min. 40-mil normal dry film thickness of Protecto 401.
4. Pipe and Fitting Exterior Coating: Min. 1-mil bituminous paint per ASTM C151.
5. Gaskets: AWWA C111, rubber.

B. Polyvinyl Chloride (PVC) Gravity Sewer Pipe and Fittings: ASTM D 3034, SDR 35, for elastomeric seal gasketed joints, ASTM D3212 and ASTM F477.

C. Polyvinyl Chloride (PVC) Gravity Sewer Service Pipe and Fittings: ASTM D 2665, SCH 40, for solvent-cemented or gasketed joints.

1. Primer: ASTM F 656.
2. Solvent Cement: ASTM D 2564.
3. Gaskets: ASTM F 477, elastomeric seal.

D. 2-in Polyvinyl Chloride (PVC) Sewer Force Main Pipe and Fittings: Pipe shall be SDR 21 (PR200) PVC. Pipe and fittings shall be manufactured from virgin rigid PVC (polyvinyl chloride) vinyl compounds with a Cell Class of 12454 as identified in ASTM D 1784. PVC pipe shall be Iron Pipe Size (IPS) conforming to ASTM D 2241 for plain-end pipe and ASTM D 2672 for belled-end pipe. PVC. Pipe and fittings shall be manufactured as a system and be the product of one manufacturer.

1. Fittings: Schedule 40 (IPS) conforming to ASTM D 2466.
2. Solvent Cement: ASTM D2564 and ASTM F656.

2.3 SPECIAL PIPE COUPLINGS AND FITTINGS

A. Sleeve-Type Pipe Couplings: Rubber or elastomeric sleeve and band assembly fabricated to match outside diameters of pipes to be joined, for nonpressure joints.

1. Sleeves for Cast-Iron Soil Pipe: ASTM C 564, rubber.
3. Sleeves for Plastic Pipe: ASTM F 477, elastomeric seal.
4. Sleeves for Dissimilar Pipes: Compatible with pipe materials being joined.
5. Bands: Stainless steel, at least one at each pipe insert.

2.4 CLEANOUTS

A. Description: ASME A112.36.2M, round, cast-iron housing with clamping device and round, secured, scoriated, cast-iron cover. Include cast-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug. Cleanout box shall be per Town details and shall be Russco model MBX 348 Valve Box or approved equal.

B. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, service class, cast-iron soil pipe and fittings.

2.5 MANHOLES

A. Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for rubber gasket joints.

1. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent floatation.
2. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having a separate base slab or base section with integral floor.
3. Riser Sections: 4-inch minimum thickness, 48-inch diameter, and lengths to provide depth indicated.
4. Top Section: Eccentric cone type, unless concentric cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
5. Joints: 'O'-ring meeting ASTM C443, or "ram neck".
6. Exterior Joint Seal: 60-mil EPDM bands. Infi-Shield external sealing system or approved equal.
7. Grade Rings: Include 2 or 3 reinforced-concrete rings, of 6- to 9-inch total thickness, that match a 24-inch-diameter frame and cover.
8. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.
9. Steps: Manufactured form deformed, ½" steel reinforcement rod complying with ASTM A 615 and encased in polypropylene complying with ASTM D4101. Include pattern designed to prevent lateral slippage off step. Cast or anchor into sidewalls with steps at 12 to 16 inch intervals.
10. Special Interior Coating for Force Main Receiving Manholes: Polyurea coating system comprised of a 20% solids, dual-component primer coat (150-sf/gal) and intermediate coat (150-sf/gal) and a 65% solids, two-

part top coat (125-sf/gal). Polyurea coatings shall be Duramer 1030 as manufactured by SewerKote or approved equal.

- B. Manhole Frames and Covers: ASTM A48, Class 35, gray iron. Include 22-inch inside diameter by 8-inch riser with 4-inch minimum width flange, and 23-1/2-inch- diameter cover.

2.5 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318, ACI 350R, and the following:
 - 1. Cement: ASTM C 150, Type II.
 - 2. Fine Aggregate: ASTM C 33, sand.
 - 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 - 4. Water: Potable.
- B. Structures: Portland-cement design mix, 4000 psi minimum, with 0.45 maximum water-cement ratio.
 - 1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
 - 2. Reinforcement Bars: ASTM A 615, Grade 60, deformed steel.
- C. Structure Channels and Benches: Factory or field formed from concrete. Portland-cement design mix, 4000 psi minimum, with 0.45 maximum water-cement ratio.

2.6 IDENTIFICATION

- A. Metallic-Lined Plastic Underground Warning Tapes: Polyethylene plastic tape with detectable metallic core, 4 inches wide (min) by 4 mils thick, solid green in color with continuously printed caption in black letters "CAUTION - SEWER LINE BURIED BELOW."
- B. Copper Tracer Wire: #12 gauge solid (bare) copper and continuous to the greatest extent possible. The tracer wire shall be securely bonded together at all wire joints with an approved industrial crimp connector to provide electrical continuity.

PART 3: EXECUTION

3.1 GENERAL

- A. All construction shall conform to the requirements of Town of Clayton and the NCDOT as applicable in addition to the requirements state herein.

3.2 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Division 2 Section "Earthwork."

3.3 IDENTIFICATION

- A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tapes directly over piping and at outside edges of underground structures.
 - 1. Use detectable warning tape over nonferrous piping and over edges of underground structures.
- B. Install copper tracer wire during back-filling of trench for all PVC sewer lines and forcemains. Perform continuity tests on all installed tracer wire. Repair or replace any failed segments.

3.4 SEWERAGE PIPING APPLICATIONS

- A. General: Include watertight joints.
- B. Refer to Part 2 of this Section for detailed specifications for pipe and fitting products. Refer to the drawings type of pipe to be installed.

3.5 INSTALLATION, GENERAL

- A. General Locations and Arrangements: Drawings (plans and details) indicate the general location and arrangement of underground sewerage piping. Location and arrangement of piping layout take into account many design considerations. Install piping as indicated, to extent practical.
- B. Install piping beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's recommendations for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.
- C. Use manholes for changes in direction, except where fittings are indicated. Use fittings for branch connections, except where direct tap into existing sewer is indicated.
- D. Use proper size increasers, reducers, and couplings, where different sizes or materials of pipes and fittings are connected. Reduction of the size of piping in the direction of flow is prohibited.
- E. Install gravity-flow-systems piping at constant slope between points and elevations indicated. Install straight piping runs at constant slope, not less than that specified, where slope is not indicated.
- F. Extend sewerage piping and connect to building's sanitary drains, of sizes and in locations indicated. Terminate piping as indicated.
- G. Install sewerage piping pitched down in direction of flow, at minimum and cover as indicated.
- H. Tunneling: Install pipe under streets or other obstructions, that cannot be disturbed, by tunneling, jacking, or a combination of both.

3.6 PIPE JOINT CONSTRUCTION AND INSTALLATION

- A. General: Join and install pipe and fittings according to the following.
- B. Hub-and-Spigot, Cast-Iron Soil Pipe and Fittings: With rubber compression gaskets according to CISPI "Cast Iron Soil Pipe and Fittings Handbook," Volume I. Use gaskets that match class of pipe and fittings.
- C. Ductile-Iron Pipe with Ductile-Iron or Cast-Iron Fittings: With push-on-joint, rubber gaskets according to AWWA C600.
- D. Polyvinyl Chloride (PVC) Plastic Pipe and Fittings: As follows:
 - 1. Join solvent-cement-joint pipe and fittings with solvent cement according to ASTM D 2855 and ASTM F 402.
 - 2. Join pipe and gasketed fittings with elastomeric seals according to ASTM D 2321.
 - 3. Join profile sewer pipe and ribbed drain pipe and gasketed fittings with elastomeric seals according to ASTM D 2321 and manufacturer's written instruction.
 - 4. Install according to ASTM D 2321.

3.7 MANHOLE INSTALLATION

- A. General: Install manholes, complete with accessories, as indicated.
- B. Form continuous concrete channels and benches between inlets and outlet, where indicated.
- C. Set tops of frames and covers flush with finished surface where manholes occur in pavements. Set tops 3 inches above finished surface elsewhere, except where otherwise indicated.
- D. Place precast concrete manhole sections as indicated, and install according to ASTM C 891.
 - 1. Provide joint gasket at joints of sections.
 - 2. Apply bituminous mastic coating at joints of sections.

3.8 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318, ACI 350R, and as indicated.

3.9 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
- B. Set cleanout frames and covers in earth in a cast-in-place concrete block, 18 by 18 by 12 inches deep. Set tops flush with surrounding earth grade.
- C. Set cleanout frames and covers in concrete paving with tops flush with surface of paving.

3.10 FIELD QUALITY CONTROL – GRAVITY SEWER

- A. Refer to Town of Clayton – Manual of Specifications, Standards, and Design for additional testing requirements and details.
- B. Clear interior of piping and structures of dirt and superfluous material as the work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.
 - 1. In large, accessible piping, brushes and brooms may be used for cleaning.
 - 2. Place plug in end of incomplete piping at end of day and whenever work stops.
 - 3. Flush piping between manholes and other structures, if required by authorities having jurisdiction, to remove collected debris.
- B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of the Project. Schedule inspections by Town/Engineer with at least 24 hours advance notice.
 - 1. Submit separate reports for each system inspection.
 - 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visual between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of a ball or cylinder of a size not less than 92.5 percent of piping diameter.
 - c. Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 - 3. Replace defective piping using new materials and repeat inspections until defects are within allowances specified.
 - 4. Reinspect and repeat procedure until results are satisfactory.
- C. Test new piping systems and parts of existing systems that have been altered, extended, or repaired for leaks and defects. Furnish all labor and equipment necessary to perform leakage tests. Leakage tests shall be observed by Town/Architect.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to authorities having jurisdiction.
 - 3. Schedule tests, and their inspections by Town/Architect, with at least 24 hours advance notice.
 - 4. Submit separate reports for each test.
 - 5. Perform hydrostatic test or low pressure air test as required by the Town of Clayton.
 - a. Hydrostatic test: Allowable leakage is a maximum of 50 gallons per inch nominal pipe size per mile of pipe per 24-hours.
 - b. Air test: Perform air test according to ASTM C828.
 - 6. Manholes: Perform vacuum test in presence of the Town of Clayton/Architect. Plug and brace all pipes entering manhole. A vacuum of 10 inches of mercury shall be drawn and the vacuum pump shut off. The time for the vacuum to drop to 9 inches of mercury shall not be less than the following:

Manhole Depth	Diameter of Manhole		
	48" Dia.	60" Dia.	72" Dia.
6	15 sec.		
8	20 sec.	26 sec.	33 sec.
10	25 sec.	33 sec.	41 sec.
12	30 sec.	39 sec.	49 sec.
14	40 sec.	46 sec.	57 sec.
16	45 sec.	52 sec.	67 sec.

6. Leaks and loss in test pressure constitute defects that must be repaired.
7. Replace leaking piping using new materials and repeat testing until leakage is within allowances specified at no additional cost to the owner.

3.11 FIELD QUALITY CONTROL – FORCE MAIN SEWER SYSTEM

A. General: All materials shall be inspected by the engineer prior to installation. The Contractor shall furnish all materials, labor and equipment to perform all testing and inspections.

B. All tests shall be performed under the observation of the engineer.

C. Pressure Testing

1. A hydrostatic pressure test shall be performed on each segment of installed force main.
2. The test shall be performed after the force main has been backfilled and at least seven days following the pouring of the last thrust block.
3. The following procedures shall be followed in performing hydrostatic pressure tests on force mains:
 - a. The force main segment shall be carefully filled with water at a velocity of approximately one foot per second. Water may be introduced from either the pump station or a temporary connection made in the force main. Appropriate measures necessary to eliminate all air from the force main shall be taken during this process.
 - b. Once full of water, the force main segment shall be pressurized and allowed to stabilize at a minimum test pressure of 150-psi.
 - c. This pressure shall be maintained for at least two consecutive hours.
 - d. If the stated pressure cannot be maintained, the applicant is responsible for assuring that the cause of test failure is determined, all necessary repairs are made, and repeating the hydrostatic pressure test until the force main segment passes.
4. Pressure Testing may be performed concurrently or separately with the Leakage Testing specified below.

D. Leakage Testing.

1. A leakage test shall be performed on each segment of installed force main at the hydrostatic pressure test stipulated above.
2. Leakage shall be defined as the quantity of water required to maintain a pressure within five pounds per square inch of the specified test pressure after the pipe has been filled with water and all air has been expelled.
3. Leakage shall be measured with a calibrated test meter and shall not exceed the amount given by the following formula:

$$L = (N \times D \times \sqrt{P}) / 7400$$

L = Allowable leakage (gallons per hour)
 N = Number of joints in length of pipe segment tested
 D = Nominal diameter of pipe segment tested (inches)
 P = Test pressure (pounds per square inch)

4. All visible leaks shall be repaired regardless of the amount of leakage. If leakage exceeds this rate, the applicant is responsible for assuring that the cause of test failure is determined, all necessary repairs are made, and repeating the test until the force main segment passes.

END OF SECTION 33 30 00

SECTION 33 32 00 – SEWER PUMP STATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including the General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Submersible grinder wastewater pumps.
 - 2. Fiberglass wet well and appurtenances.
 - 3. Pump controls.
 - 4. Auto-dialer.

1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
 - 1. Product data for the following:
 - a. Pumps (including performance curves).
 - b. Lift-out rail system.
 - c. Discharge pipe and fittings.
 - d. Control panel and alarm.
 - e. Wet well, tanks and vaults.
 - f. Hatches and castings.
 - g. Float switches.
 - h. Valves.
 - i. Other appurtenances.
 - j. Control panel.
 - k. Alarms.
 - l. Elapsed time meter.

- C. Inspection and test reports specified in the “Field Quality Control” Article.
- D. Two complete manufacturer’s operations and maintenance manuals with schematics, warranties, etc. for all operating systems.

1.6 QUALITY ASSURANCE

- A. Pumps and Motors: Pumps and motors are to be engineered, manufactured and assembled under a written quality assurance program. The written quality assurance program shall have been in effect for at least five years, and shall include a written record of periodic internal and external audits to confirm compliance with UL Quality Assurance specifications.
- B. Warranty: All components shall be warranted by the installer against defects in material and workmanship for a period of two years after final acceptance. Such warranty shall include replacement of defective items and service costs of qualified labor to make repairs.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect all materials. Do not store plastic structures in direct sunlight.
- B. Protect pumps and all appurtenances from dirt and damage.

1.8 PROJECT CONDITIONS

- A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.

PART 2 – PRODUCTS

2.1 PUMPS

- A. Submersible Grinder Pumps: Pumps shall be capable of handling residential and commercial sewage and grinding it to a fine slurry, enabling it to be pumped over long distances in pipelines as small as 1.25" in diameter. Pump and motor assembly shall be UL listed for Class 1, Group D explosion-proof service. Each pump shall provide the hydraulic conditions as indicated on the drawings.
- B. The pumps shall be manufactured in the United States utilizing domestic parts and components in its construction. The castings shall be constructed of class 25 cast iron. The motor housing shall be oil filled to dissipate heat. Air filled motors shall not be considered equal since they do not properly dissipate heat from the motor. All mating parts shall be machined and sealed with a Buna-N o-ring. All fasteners exposed to the liquid shall be stainless steel.
- C. The motor shall be protected on the top side with sealed cord entry plate with molded pins to conduct electricity eliminating the ability of water to enter internally through the cord. The motor shall be protected on the lower side with a dual seal arrangement. The first seal is a double lip seal molded in FKM fluoroelastomer or Buna N. The second / main seal shall be a unitized hard face silicon carbide seal with stainless steel housings and spring.
- D. The upper and lower bearing shall be capable of handling all radial thrust loads. The lower bearing shall have the additional ability to handle the downward axial thrust produced by the impeller and cutters by design of angular contact roller races. The pump housing shall be of the concentric design thereby equalizing the pressure forces inside the housing which will extend the service life of the seals and bearings. Additionally, there shall be no cutwater in the housing volute in order to discourage the entrapment of flowing debris.
- E. The pump shall be furnished with stainless steel handle having a nitrile grip

2.2 GRINDER

- A. The cutter and plate shall consist of 440 stainless steel with a Rockwell C hardness of 55-60. The stationary cutter plate shall have specially designed orifices through it, which enable the slurry to flow through the pump housing at an equalized pressure and velocity. The stationary cutter shall consist of V shapes to maximize cutting action and arc shape exclusion slots to outwardly eject debris from under the rotary cutter. The rotary cutter shall have (4) blades and be designed with a recessed area behind the cutting edge to prevent the accumulation and binding of any material between rotary cutter and the stationary cutter.
- B. The cutting system must incorporate close tolerances for optimum performance. Ring or radial cutters, or those that grind on the outside circumference of shall not be considered equal.

2.3 POWER CORDS

- A. The submersible pump shall be supplied with 25 feet of multi-conductor power cord. It shall be cord type SEOOW (3-phase), capable of continued exposure to the pumped liquid. The power cord shall be sized for the rated full load amps of the pump in accordance with the National Electric Code. The power cable shall not enter the motor housing directly but will conduct electricity to the motor by means of a water-tight compression fitting cord plate assembly, with molded pins to conduct electricity. This will eliminate the ability of water to enter internally through the cord, by means of a damaged or wicking cord.
- B. Three phase motors shall be used with an appropriate controller with integral overload protection.

2.4 MECHANICAL SEALS

- A. The pump shall have a dual seal arrangement consisting of a lower and upper seal to protect the motor from the pumping liquid. The lower seal shall be a FKM fluoroelastomer OR Buna N molded double lip seal, designed to exclude foreign material away from the main upper seal. The upper seal shall be a unitized silicon carbide hard face seal with stainless steel housings and spring equal to Crane Type T-6a. The motor plate / housing interface shall be sealed with a Buna-N o-ring.

2.5 BEARINGS AND SHAFT

- A. An upper radial and lower thrust bearing shall be required. The upper bearing shall be a single ball / race type bearing. The lower bearing shall be an angular contact heavy duty ball / race type bearing, designed to handle axial grinder pump thrust loads. Both bearings shall be permanently lubricated by the oil, which fills the motor housing.

The bearing system shall be designed to enable proper cutter alignment from shut off head to maximum load at 10' of TDH. The motor shaft shall be made of 300 or 400 series stainless steel and have a minimum diameter of .670".

2.6 IMPELLER

- A. The impeller shall be an investment cast stainless steel impeller, with pump out vanes on the back shroud to keep debris away from the seal area. It shall be keyed and bolted to the motor shaft.

2.7 CONTROLS

- A. The pumps shall be controlled with an IP Series NEMA 4X outdoor duplex control panel with level sensor transducer, adjustable set-points, data logging, and a high-water alarm.

- B. Marking: All control panels shall be labeled as follows:

1. Mfgs name, address, and contact phone numbers.
2. Panel ratings in horsepower, voltage and amperage.
3. Field wiring guide for installers.
4. Individual component identification.
5. Internal wiring numbers.

- C. The panel shall include:

1. 6 digit LED display showing system information including level in inches, mode, pump's elapsed time, events (cycles), alarm counter.
2. Pump circuit breakers.
3. Control circuit breakers.
4. Alarm circuit fuse.
5. Control circuit fuse.
6. I.E.C. rated motor starters with 3-pole ambient compensated bimetal overload relays.
7. Pump hand-off-auto switches.
8. Alarm test switches.
9. Pump run lights.
10. Alternator relay (solid state).
11. Override relay.
12. Control transformer with primary fusing.
13. Intrinsically safe relays for float switch connections.
14. Terminal blocks,
15. Two (2) ground lugs.
16. All necessary wiring and brackets.
17. Separate Manual Disconnect for each pump.
18. Level sensor control system for duplex pumps and alarm system.
19. Elapsed time meter for each pump.
20. High level alarm light and horn and contact closure for automatic dialer.
21. Test and silence switches for alarm.
22. Seal failure light for each pump and contact closure for automatic dialer.
23. Control disconnect.
24. Surge protection.
25. 115 volt GFI duplex convenience outlet.
26. Manual transfer switch (See Electrical Plans).

- D. The control panel shall be fitted with a red alarm light mounted on top of the enclosure and audio alarm horn (83-85-db).

- E. The alarm shall have a bright glow and flash during high water conditions. The alarm light and horn shall go out and stop sounding when the water level drops.

- F. All internal wiring shall be neat and color coded. Each wire shall be a different color or stripe (except for ground), and all incoming wires shall terminate into a box clamp type terminal block. All wires shall be 14 GA. Type TEW rated for 105 degrees Celsius.

- G. A schematic diagram (showing wire color) shall be permanently fastened to the inside of the enclosure. An installation and service manual shall also be included with each control panel.

- H. The control panel shall be U.L. listed and labeled to UL 698A as an assembly.
- I. A cycle counter shall be provided for each pump to show the number of cycles (starts) of the pump. The counter shall be energized by an auxiliary contact from the motor starter or contactor and be wired in parallel with the pump run light. The counter shall have a maximum reading of 999,999 cycles (starts). The counter shall be non-resettable.
- J. The control panel shall contain a full inner door. The inner door shall be hinged and contain all lights, switches and overload resets. All circuit breakers shall also be mounted through the inner door.
- K. A delay timer shall be supplied in the control panel. The timer shall delay the starting of the pump when called for. The delay timer shall be adjustable from 0-60 seconds.
- L. The control panel shall contain a phase monitor/relay. The monitor/relay shall protect pump motor(s) against phase loss, under voltage, and phase reversal conditions. When incorrect phase sequence or phase loss occurs or if the three phase voltages fall below the drop out voltages (field adjustable), the monitor/relay shall drop out the pump(s) and signal the panel alarm. The pump(s) and alarm shall return to normal after the condition(s) are corrected.
- M. An E.T.M. shall be provided for each pump to record the actual running time of the motor. The E.T.M. shall be energized by an auxiliary contact from the motor starter or contactor and be wired in parallel with the pump run light. The E.T.M. shall have a maximum reading of 99,999.99 hours. The E.T.M. shall be non-resettable.
- N. A set of dry contacts shall be provided for the remote monitoring of a panel function. Functions shall include high water, low water, seal failure, overtemperature, overload, and pump running conditions. The dry contacts shall close upon the detection of said condition. Contacts shall be rated for 3 amps.
- O. A 115 volt, 15 amp duplex ground fault interrupting receptacle shall be mounted in or adjacent to the control panel. The receptacle shall be protected by a 15 amp circuit breaker. The receptacle shall have a NEMA 5-15R configuration and be powered from the control circuit transformer.
- P. A lightning arrestor (1 PH) shall be supplied in the control panel. The arrestor shall protect the equipment from overvoltages caused by lightning discharges. The arrestor shall be rated at 650 volts RMS L-G.

2.8 AUTOMATIC ALARM MONITOR DIALER

- A. Alarm Monitor: Provide automatic alarm dialer and necessary switches, contacts, relays, etc. and associated wiring required to monitor and report the alarm conditions as noted herein. Monitor shall be capable of reporting at least 6 different alarm conditions and shall be equipped with a battery back-up. Monitor shall be connected to a Category 6 cable extended from the building by the Electrical Contractor. Monitor/Dialer shall be Networx NX-6 or most recent equivalent version by same manufacturer.
 - 1. High water alarm (Fault #1).
 - 2. Loss of primary power (Fault #2).

2.9 CONTROL SEQUENCE

- A. General: Level sensor shall be set at the elevations as indicated on the drawings.
- B. Normal Operation: On rising liquid level in the wet well, a level sensor (lead pump on) shall initiate operation of the lead pump. The pump shall continue to operate until the liquid level falls to the elevation where a level sensor setting (pump off) shall stop the pump.
- C. Lag Pump: Should the liquid level in the wet well continue to rise with the lead pump operating, a third level sensor setting (lag pump on) shall initiate operation of the lag pump.
- D. Alarm: Should the liquid level in the wet well continue to rise with the lead and lag pumps operating, a third level sensor setting (high water alarm) shall activate the alarm light and horn and automatic alarm dialer. A redundant float switch shall be provided for the Alarm level.
- E. Generator Failure: Should the generator fail the automatic alarm dialer shall be activated.

2.10 WET WELL

- A. Pump station shall be provided as a package unit within a 48" diameter fiberglass basin. The wetwell shall be include the following:
1. Concrete ballast ring poured around integral anti-floatation collar.
 2. Factory pre-assembled schedule 80 PVC discharge piping with ball valves.
 3. 4-in inlet hub with rubber pipe seal.
 4. Factory pre-assembled galvanized guide rail system.
 5. Stainless steel pump lift-out chain.
 6. Aluminum cover with ¼" aluminum diamond plate access hatch and galvanized steel vent pipe.
 7. Pre-mounted level sensor system for pump control and redundant float switch for alarm.
 8. All stainless steel pre-mounted supports brackets.
 9. Pre-mounted, NEMA 4X junction box for electrical connections.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be performed in accordance with the manufacturer's written instructions and other applicable Division 2 specification sections.

3.2 FIELD QUALITY CONTROL

- A. Pump Operational Test: A representative from the pump manufacturer shall be present at the operational test to review proper operation of the equipment. The Contractor shall provide all materials, labor and equipment needed to verify the entire pump station is operating as designed and intended.

- B. Wet Well Test: Wet well shall be tested for leakage once set in place. Perform either vacuum, air pressure, or hydrostatic tests. Contractor shall furnish all required equipment, water, and labor required for testing. All testing shall be performed in the presence of the Architect.

1. Vacuum Test: A vacuum of 10-in of mercury (Hg) shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to 9-in Hg. If pressure drops in less than 120-sec the wet well will have failed the test and necessary repairs shall be made. Re-testing shall proceed until a satisfactory test is obtained.
2. Air Pressure Test: The wet well shall be pressurized to 5-psi and allowed to stabilize. After stabilization, the pressure shall be decreased to 4-psi and the time for the pressure to drop to 3-psi shall be measured. If the pressure drops in less than 120-sec the wet well will have failed the test. Necessary repairs shall be made and re-testing shall proceed until a satisfactory test is obtained. Smoke may be utilized to assist in locating leaks.
3. Hydrostatic Test: The wet well shall be filled to within 12-in of the top and allowed to soak for 24-hrs. The wet well shall be re-filled and the water level recorded. The water shall remain in the wet well for 24-hrs. and the water level recorded. If the water level falls ½-in or more in 24-hrs. the wet well will have failed the test. Necessary repairs shall be made and re-testing shall proceed until a satisfactory test is obtained.

- C. Pump Station Testing:

1. Following installation, each pump in the pump station shall be subjected to a drawdown test or other similar testing procedure to confirm that the pump is operating at or near the required design operating points.
2. On-Site Testing shall consist of all manual and automatic operating functions under various operating conditions, including full load conditions. The equipment shall also be tested under adverse or emergency conditions. All alarms and remote signals shall also be tested. All defective equipment or malfunctioning systems shall be replaced or corrected, and the full system placed in a fully operational condition.
3. Field test of the pump station's electrical and instrumentation/control systems shall be performed. The basic functions which shall be tested for operation as intended by the pump station design shall include, but shall not be limited to, the following:
 - a. Pump operational functions
 - b. Level-sensing equipment.
 - c. Alarm system.
 - d. Auto-dialer system.
 - e. Stand-by or emergency power system.
4. Perform vacuum test of wetwell according to ASTM C 1244.
5. Results of all tests shall be documented and submitted to the Engineer.

END OF SECTION 33 32 00

SECTION 33 40 00 - SITE STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including the General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes site drainage systems outside the building. Systems include the following:
 - 1. Storm drainage.
 - 2. Foundation drainage connections outside of building.
 - 3. Roof drainage connections outside of building.
- B. Related Sections: The following Sections contain requirements that relate to this Section.
 - 1. Division 31 Section "Earth Moving."
 - 2. Division 31 Section "Sediment and Erosion Controls."
 - 3. Division 3 Section "Cast-In-Place Concrete."
 - 4. Division 15 Sections for storm drainage inside the building.

1.3 DEFINITIONS

- A. Drainage Piping: System of pipe, fittings, and appurtenances for gravity flow of storm drainage.

1.4 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. As-Built Survey / Record drawings of installed drainage system piping and basins and all stormwater management devices (ponds, wetlands, bio-retention areas). Survey shall be submitted at least 30-days prior to the project's substantial completion.

1.5 QUALITY ASSURANCE

- A. Environmental Agency Compliance: Comply with regulations pertaining to storm drainage systems.
- B. Utility Compliance: Comply with regulations pertaining to storm drainage systems.
- C. Product Options: Drawings indicate sizes, profiles, connections, and dimensional requirements of system components and are based on specific manufacturer types indicated. Other manufacturers' products with equal performance characteristics may be considered. Refer to Division 1 Section "Products."
- D. Perform As-Built Survey of installed drainage system piping and basins and all stormwater management devices (ponds, wetlands, bio-retention areas). As-built survey shall be signed and seal by a NC Professional Land Surveyor and shall include the following:
 - 1. All inlet, junction box and manhole locations with no less than two primary reference dimensions from permanent above grade features.
 - 2. As-built rims and inverts noted.
 - 3. Pipe materials and sizes, plus slopes and distances between structures.
 - 4. As-built dimensions for installed riprap dissipater pads.
 - 5. Topography of embankments and interiors of drained stormwater management ponds, wetlands and bio-retention cells. Topography shall include all survey point elevations.
 - 6. Detailed as-built dimensions and elevations of stormwater management device outlet structures, weirs, orifices, and outlet pipes.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic structures in direct sunlight.

- B. Do not store plastic pipe or fittings in direct sunlight.
- C. Protect pipe, pipe fittings, and seals from dirt and damage.

1.7 PROJECT CONDITIONS

- A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.
- B. Locate existing structures and piping to be closed and abandoned.
- C. Existing Utilities: Do not interrupt existing utilities serving facilities occupied by the Owner or others except when permitted under the following conditions and then only after arranging to provide acceptable temporary utility services.
 - 1. Notify Architect not less than 48 hours in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without receiving Architect's written permission.

1.8 SEQUENCING AND SCHEDULING

- A. Coordinate storm drainage system connections to utility company's storm sewer.
- B. Coordinate storm drainage system connections to existing on-site storm sewer.
- C. Coordinate with interior building drainage systems.
- D. Coordinate with other utility work.

PART 2 - PRODUCTS

2.1 PIPES AND FITTINGS

- A. General: Refer to plans for specific pipe material applications.
- B. Ductile-Iron Pipe: ANSI/AWWA C150/A21.50 and C151/A21.51, minimum pressure class 250.
 - 1. Lining: AWWA C104, cement mortar, coal tar epoxy lined.
 - 2. Gaskets, Glands, and Bolts and Nuts: AWWA C111.
 - 3. Push-On-Joint-Type Pipe: AWWA C111, rubber gaskets.
 - 4. Coating: AWWA C151, bituminous coating.
- C. Polyvinyl Chloride (PVC) Sewer Pipe and Fittings: ASTM D-1785, SCH 40 PVC for solvent-cemented or gasketed joints.
 - 1. Primer: ASTM F 656.
 - 2. Solvent Cement: ASTM D 2564.
 - 3. Gaskets: ASTM F 477, elastomeric seal.
- D. Reinforced-Concrete Sewer Pipe and Flared End Sections: ASTM C 76, Class III.
 - 1. Standard Joints: Plastic cement putty seal meeting ASTM C990 and Federal Specification SS-S-00210.
 - 2. Watertight Joints: O-ring rubber gasket meeting ASTM C-443 with external sealer wrap that is at least 12 inches wide and covers the full circumference of the joint.
 - a. External wrap shall be ConWrap CS-212 from Concrete Sealants, Inc., EZ-Wrap form Press-Seal Gasket Corp., Seal Wrap from Mar-Mac Manufacturing or approved equal. Cover external joint sealer with a 3 foot strip of filter fabric meeting NCDOT Type 4 Engineering Fabrics.
 - b. Watertight joints shall be provided at outlet pipes that penetrate pond embankments and other locations specified on the drawings.
- E. High Density Polyethylene (HDPE) Pipe and Fittings: AASHTO M252 or M294. Dual-wall with smooth interior and corrugated exterior. All sizes shall conform to the AASHTO classification Type S or D. N-12 by ADS or approved equal.

1. Watertight Joints: Watertight per ASTM D3212, AASHTO M294, bell and spigot, rubber gasket, ASTM F477.
2. Fittings: AASHTO M252, M294, MP6 or MP7, welded on the interior and exterior at all junctions. Only fittings supplied or recommended by the pipe manufacturer shall be used.

2.2 STORM SUB-DRAIN AND FOUNDATION DRAIN PIPING

- A. Storm Sub-Drain Pipe and Fittings: SCH 40 PVC or dual-wall, smooth interior HDPE as specified above, with ½-in drilled perforations. Minimum 4-inch diameter unless otherwise indicated on the drawings. Non perforated pipe shall be used outside of area to be drained to connect sub-drains to drainage inlets.
- B. Filter Fabric: Woven geotextile Drainage (Filter) Fabric as specified in Division 31 Section “Earth Moving.”

2.3 SPECIAL PIPE COUPLINGS AND FITTINGS

- A. Connection from roof downspout to underground storm pipe.
 1. Vertical stainless-steel downspout adapter with sch. 40 PVC pipe outlet sized to fit over downspout and underground piping. Adapter shall have a self-cleaning debris trap consisting of a hinged cover and removable debris screen. Powder-coat color to be selected by Architect from manufacturer’s full range of colors. As manufacture red by Piedmont Pipe Construction.
 2. Manufactured fitting of material similar to downspout sized to connect to standard round pipe shape of underground piping.

2.4 DRAINAGE INLETS

- A. Catch Basins and Drop Inlets: Brick and mortar, of depth, shape, and dimensions indicated. Precast concrete basins may be used in lieu of brick upon approval by the Architect. Precast basins shall include grade rings to allow adjustment to rim elevations. Knock-out waffle boxes shall not be used. All structures shall be designed to withstand AASHTO H-20 loads.
 1. Base, Channel, and Bench: Concrete.
 2. Wall: ASTM C 32, Grade MS, clay brick masonry units.
 - a. Option: ASTM C 55, Grade S-II, solid concrete brick masonry units may be used instead of clay brick.
 3. Mortar: ASTM C 270, Type S, using ASTM C 150, Type I, portland cement.
- B. Frames and Grates: ASTM A48, Class 35B, cast iron, H-20 loading. Include flat grate with small square or short-slotted drainage openings as indicated on the drawings. Provide grate with openings compliant with ADA standards when located within sidewalk or other pedestrian walking areas or where specifically indicated on drawings.
- C. Catch Basin Hood Casting: ASTM A48, Class 35B, cast iron, H-20 loading.
- D. Floor Drains: 12-inch diameter or 12-inch square top drain, Dura-Coated cast iron body with 6-inch bottom outlet, seepage pan, adjustable extension frame and medium duty slotted grate. Top shall be polished nickel bronze and secured with slotted screws.
- D. Area Drains or Planter Drains: 15-inch square top drain designed to be attached with a watertight connection to vertical HDPE or PVC pipe, ductile iron slotted surface grate, watertight pipe adapters. Grates shall be pedestrian-type where set in pavement or sidewalk. Grates shall be dome-type where set in mulched areas.
- E. Drain Basin: 15-inch or 18-inch diameter PVC body drain basin with ductile iron grates and integral pipe connection stubs formed to provide a watertight connection to HDPE pipe. Basins shall be as manufactured by Nyloplast or approved equal.

2.5 MANHOLES

- A. Precast Concrete Storm Drainage Manholes: ASTM C-478 precast reinforced concrete, eccentric cone. All structures shall be designed to withstand AASHTO H-20 loads.
 1. Base, Channel, and Bench: Concrete.
 2. Joint: Preformed flexible plastic gaskets complying with Fed. Spec. SS-S-210A.

3. Size: As required to accommodate proposed pipes indicated on the drawings, 4-ft diameter minimum.

B. Frames and Covers: ASTM A48, Class 35B, heavy-duty cast iron. Include flat, round grate with 1-1/2" wide slotted drainage openings with a minimum total open area of 150-sq.in.

2.6 STORMWATER CONTROL MEASURE OUTLET STRUCTURE

A. Concrete Outlet Structure: Pre-Cast, solid wall, 4,000-psi, reinforced concrete designed to meet H-20 loading of depth, shape, and dimensions indicated. Waffle boxes are not acceptable.

1. Base and ballast in-fill: Concrete.

2. Wall: Solid, reinforced concrete. Provide exterior brick veneer if indicated on drawings.

a. Brick: ASTM C 32, Grade MS, clay brick units.

b. Mortar: ASTM C 270, Type S, using ASTM C 150, Type I, portland cement.

3. Joints: Pre-Cast structures shall have no section joints below permanent pool elevation.

4. Grout: ASTM C1107, non-shrink, hydraulic cement grout.

5. Interior and Exterior Coating: Tintable, multi-purpose epoxy formulated for immersion in water meeting NSF/ANSI 61 for potable water. Sherwin Williams Dura-Plate 235 or approved equal. Color to be selected by designer.

B. Pipe Connectors: ASTM C 923, resilient, water-tight flexible connector, of size required, for each pipe connecting to outlet structure.

1. Following installation of pipe connector, grout voids between pipe, connector and outlets structure with non-shrink hydraulic cement grout on inside and outside of outlet structure. Finish grout flush with structure wall.

C. Frames and Grates: ASTM A48, Class 35B, cast iron, H-20 loading. Include flat grate with slotted drainage openings as indicated on the drawings.

D. Trash Rack: Aluminum with separate frame a grate with access hatch as detailed on the drawings. Trash racks shall be as manufactured by Trashracks.com or approved equal.

E. Trash Baffle: Fabricated from 7-gauge Type 316 aluminum sheet and fastened with all stainless steel fasteners.

2.7 CLEANOUTS

A. Description: ASME A112.36.2M, round, cast-iron housing with clamping device and round, secured, scoriated, cast-iron cover. Include cast-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug. Use units with top-loading classifications according to the following applications:

1. Heavy Duty: In earth, grass, pedestrian and vehicle-traffic service areas.

2. Extra Heavy Duty: In roads.

2.8 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350R, and the following:

1. Cement: ASTM C 150, Type I, 3,000-psi.

2. Fine Aggregate: ASTM C 33, sand.

3. Coarse Aggregate: ASTM C 33, crushed gravel.

4. Water: Potable.

B. Structures: Portland-cement design mix, 4000 psi minimum, with 0.45 maximum water-cement ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.

2. Reinforcement Bars: ASTM A 615, Grade 60, deformed steel.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 2 Section "Earthwork."

3.2 SPECIAL PIPE COUPLING AND FITTING APPLICATIONS

- A. Special Pipe Couplings: Use where indicated and where required to join piping and no other appropriate method is specified. Do not use instead of specified joining methods.

3.3 INSTALLATION, GENERAL

- A. General Locations and Arrangements: Drawings (plans and details) indicate the general location and arrangement of underground drainage systems piping. Location and arrangement of piping layout take into account many design considerations. Install piping as indicated, to extent practical. Refer to drawings for material and structure types for specific applications.

- 1. Orient grates of drainage structures in paved areas to align with general pattern of pavement joints and scoring.

- B. Install piping beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's recommendations for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.

- C. Use proper size increasers, reducers, and couplings, where different sizes or materials of pipes and fittings are connected. Reduction of the size of piping in the direction of flow is prohibited.

- D. Extend drainage piping and connect to building's storm drains, of sizes and in locations indicated. Terminate piping as indicated.

- E. Install drainage piping pitched down in direction of flow, at minimum slope of 1 percent and 36-inch minimum cover, except where otherwise indicated.

- F. Polyvinyl Chloride (PVC) Plastic Pipe and Fittings: As follows:

- 1. Join solvent-cement-joint pipe and fittings with solvent cement according to ASTM D 2855 and ASTM F 402.
 - 2. Join pipe and gasketed fittings with elastomeric seals according to ASTM D 2321.
 - 3. Join profile sewer pipe and ribbed drain pipe and gasketed fittings with elastomeric seals according to ASTM D 2321 and manufacturer's written instruction.
 - 4. Install according to ASTM D 2321.

- G. Install HDPE pipe in accordance with ASTM D2321 with the exception that minimum cover in trafficked areas shall be 12-inches.

- 1. Slightly scarify and grade the trench base to provide a uniform trench bottom. Before installing pipe, bring bedding material or trench bottom to grade along the entire length of the pipe. For 42" pipe and larger, shallow bell holes shall be provided.
 - 2. Trench width shall be wide enough to accommodate compaction equipment. Refer the manufacturer's recommendations. Pipe backfill to springline shall be compacted to 95% Standard Proctor density regardless of pipe location.
 - 3. Provide bedding, haunching and initial backfill of Class 1 or 2 granular materials per manufacturer's recommendation or as detailed on the drawings.
 - 4. Excessive groundwater necessitates dewatering. Pipe will float in standing water, requiring immediate haunching and initial backfill to hold line and grade.
 - 5. Join pipe per manufacturer's instructions.

- H. Join piping made of different materials or dimensions with couplings made for this application. Use couplings that are compatible with and fit both systems' materials and dimensions.

- I. Install stormwater control measure outlet pipes through embankments with concrete support cradle from the bottom of the pipe trench to the springline of the pipe.

3.4 CATCH BASIN AND DROP INLET INSTALLATION

- A. Construct inlets to sizes and shapes indicated.

- B. Set frames and grates to elevations indicated.

- C. Install prefabricated area drains per manufacturer's instructions.

3.5 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

- A. Abandoned Piping: Close open ends of abandoned underground piping that is indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either of the following procedures:
 - 1. Close open ends of piping with at least 8-inch-thick brick masonry bulkheads.
 - 2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
- B. Abandoned Structures: Excavate around structure as required and use either of the following procedures:
 - 1. Remove structure and close open ends of remaining piping.
 - 2. Backfill to grade according to Division 2 Section "Earthwork."

3.6 FIELD QUALITY CONTROL

- A. Clear interior of piping and structures of dirt and superfluous material as the work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.
 - 1. In large, accessible piping, brushes and brooms may be used for cleaning.
 - 2. Place plug in end of incomplete piping at end of day and whenever work stops.
 - 3. Flush piping between manholes and other structures, if required by authorities having jurisdiction, to remove collected debris.
- B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of the Project.
 - 1. Submit separate reports for each system inspection.
 - 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visual between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of a ball or cylinder of a size not less than 92.5 percent of piping diameter.
 - c. Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 - 3. Replace defective piping using new materials and repeat inspections until defects are within allowances specified.
 - 4. Reinspect and repeat procedure until results are satisfactory.
- C. All HDPE pipe and fittings 12-inch in diameter and greater shall be inspected by the pipe supplier/manufacturer following delivery to the construction site for damage caused during transit. Damaged or defective materials shall be removed from the site. A record of this inspection(s) shall be submitted to the Architect. Contractor shall supply documentation of experience in the installation of HDPE storm drainage pipe or shall provide for installation supervision by the supplier/manufacturer.
- D. Test new piping systems and parts of existing systems that have been altered, extended, or repaired for leaks and defects.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to authorities having jurisdiction.
 - 3. Schedule tests, and their inspections by authorities having jurisdiction, with at least 24 hours' advance notice.
 - 4. Submit separate reports for each test.

END OF SECTION 33 40 00

