

S P E C I F I C A T I O N S

EMMA B. TRASK MIDDLE SCHOOL ADDITIONS & RENOVATIONS

2900 N. College Road
Wilmington, NC 28405

PROJECT NUMBER: 900-9009

MARCH 27, 2019



Sawyer Sherwood & Associate, P.C.
124 Market Street
Wilmington, NC 28401

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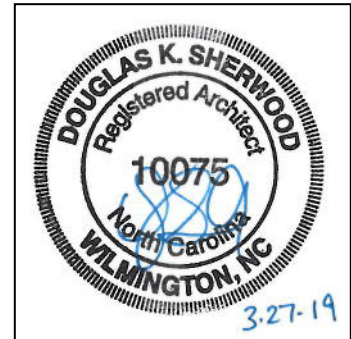
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33 3200 SEWER PUMP STATION
33 4000 STORM DRAINAGE UTILITIES

ARCHITECTURAL

Sawyer Sherwood & Associate Architecture

124 Market Street
Wilmington, NC 28401
Tel: 910-762-0892



Douglas K. Sherwood, AIA
(Email: doug@s2a3.com)

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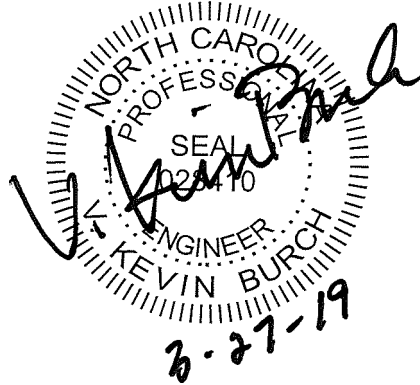
END OF ARCHITECTURAL SPECIFICATIONS

SECTION 00 01 07

SPEIFCIFACTION SEALS PAGE

PROFESSIONAL ENGINEER

V. KEVIN BURCH, PE



SECTION NUMBER

SECTION NAME

06 10 00

ROUGH CARPENTRY

07 01 50

PREPARATION FOR ROOFING

07 22 16

ROOF INSULATION

07 54 00

THERMOPLASTIC SINGLE PLY ROOFING

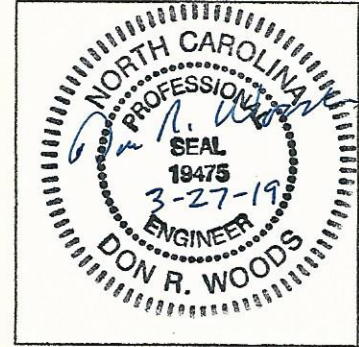
07 62 00

SHEET METAL FLASHING & TRIM

END OF SECTION 00 01 07

STRUCTURAL

Woods Engineering, P.A.
254 North Front Street, Suite 201
Wilmington, NC 28401
Tel: 910-343-8007



Don R. Woods
(Email: donwoods@woodseng.com)

DIVISION 01 GENERAL REQUIREMENTS
01 4533 Special Inspections

DIVISION 03 CONCRETE
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DIVISION 05 METALS
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END OF STRUCTURAL SPECIFICATIONS

**TRASK MIDDLE SCHOOL RENOVATIONS
NEW HANOVER COUNTY SCHOOLS
WILMINGTON, NORTH CAROLINA
NHCS #900-9009
Construction Documents**

Division 22 – Plumbing
220000 Plumbing



Cheatham and Associates, P.A.
Mechanical | Electrical | Plumbing | Fire Protection
Consulting Engineers
3412 Enterprise Drive
Wilmington, NC 28405
910-452-4210 | Fax 910-452-4211
www.cheathampa.com
NC License No. C-1073

**TRASK MIDDLE SCHOOL RENOVATIONS
NEW HANOVER COUNTY SCHOOLS
WILMINGTON, NORTH CAROLINA
NHCS #900-9009
Construction Documents**

Division 23 – Heating, Ventilating and Air Conditioning

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- 230500 Heating and Air Conditioning
- 230913 Instrumentation and Control Devices for HVAC
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- 230993 Sequences of Operation



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**TRASK MIDDLE SCHOOL RENOVATIONS
NEW HANOVER COUNTY SCHOOLS
WILMINGTON, NORTH CAROLINA
NHCS #900-9009
Construction Documents**

Division 26 – Electrical

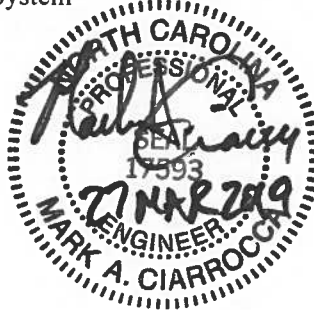
260000 Electrical, Basics
260500 Basic Materials and Methods
260519 Conductors and Cables
260526 Grounding & Bonding
260533 Raceways and Boxes
260548 Seismic Controls for Electrical Systems
260553 Electrical Identification
260923 Lighting Control Devices
262200 Dry-Type Transformers (600V & less)
262413 Switchboards
262416 Panelboards
262726 Wiring Devices
264313 Surge Protective Devices
265119 LED Interior Lighting

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NHCS Design Guidelines for Division 270000
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271500 Communications Horizontal Cabling
275116 Intercom-Public Address Systems
275123 Educational Intercommunications & Program Systems
275123.50 Educational Intercommunications & Program Systems (NHCS Design Guidelines)

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281300 Video Intercom & Access Control System
281600 Intrusion Detection
282300 Electronic Video Surveillance
282300A Video Surveillance
283111 Digital, Addressable Fire-Alarm System



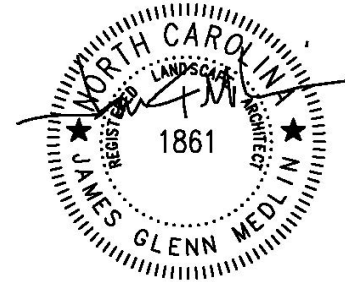
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DOCUMENT - SEALS PAGE

1.1 DESIGN PROFESSIONALS OF RECORD

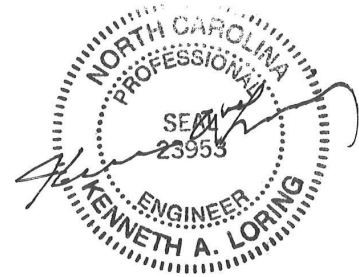
A. Landscape Architect:

1. Glenn Medlin, PLA
2. License #1861
3. Responsible for Divisions
 - a. 31 10 00
 - b. 31 20 00
 - c. 32 12 16
 - d. 32 13 13
 - e. 32 14 00
 - f. 32 90 00
 - g. 33 40 00



B. Civil Engineer:

1. Kenneth A Loring, PE
2. License #23953
3. Responsible for Divisions
 - a. 31 25 00
 - b. 33 10 00
 - c. 33 30 00
 - d. 33 32 00



SECTION 01 1000

SUMMARY

PART 1 GENERAL

1.1 PROJECT

- A. Project Name: NHCS Trask Middle School Renovation
- B. Owner's Name: New Hanover County Schools.
- C. Architect's Name: Sawyer Sherwood & Assoicate, P.C.
- D. The Project consists of the selective demolition, renovation and construction of building elements as indicated on the drawings.

1.2 DESCRIPTION OF WORK

- A. Scope of work is indicated on drawings.
- B. Owner will remove the following items before start of work:
 - 1. Display cabinets.
 - 2. Furniture.
- C. Contractor shall coordinate removal and delivery to Owner of the following:
 - 1. Air handling units identified on Mechanical drawings.
 - 2. Hardware cores.
 - 3. Fire alarm panel.
- D. Contractor shall salvage and store the following as work progresses, for later reinstallation by Contractor:
 - 1. Brick masonry: Where drawings indicate brick will be removed, carefully remove, clean and store brick for reinstallation at areas indicated on drawings.
 - 2. Knox box.
 - 3. Plumbing fixtures.
 - 4. Appliances.
 - 5. Casework to extents indicated on drawings.
 - 6. Lockers to extents indicated on drawings.
 - 7. Marker boards, tack boards and projectors.

1.3 WORK BY OWNER

- A. Owner will supply the following for installation by Contractor:
 - 1. Restroom accessories to extent indicated on drawings and in Section 10 2800 Toilet, Bath and Laundry Accessories..
 - 2. Interactive touch panel (Recordex) monitors.

1.4 OWNER OCCUPANCY

- A. Owner intends to continue to occupy portions of the existing building during the entire construction period.

- B. Owner intends to occupy the Project by the date stated in the Agreement as the contract completion date.
- C. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- D. Schedule the Work to accommodate Owner occupancy.

1.5 CONTRACTOR USE OF SITE AND PREMISES

- A. Provide access to and from site as required by law and by Owner:
 - 1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
 - 2. Do not obstruct roadways, sidewalks, or other public ways without permit.
- B. Utility Outages and Shutdown:
 - 1. Limit disruption of utility services to hours the building is unoccupied.
 - 2. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7 days notice to Owner and authorities having jurisdiction.
 - 3. Prevent accidental disruption of utility services to other facilities.

END OF SECTION

SECTION 01 2300

ALTERNATES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Description of Alternates.

1.2 ACCEPTANCE OF Alternates

- A. Coordinate related work and modify surrounding work to integrate the Work of each Alternate.

1.3 SCHEDULE OF Alternates

- A. Alternate No. G-1 - Preferred Hardware:

- 1. Base Bid Item: Any manufacturer listed in Specification 08 7100 Door Hardware.
- 2. Alternate Item: Hinges (Ives), Cylinders (Yale), Mortise Locks (Yale), Closers (LCN), Exit Devices (Von Duprin), Key Keeper (Knox Vault), Electronic locksets (Schlage),

- B. Alternate No. G-2 - All work associated with renovations to the athletic support spaces:

- 1. Base Bid Item: Existing conditions remain
- 2. Alternate Item: Area to be renovated per plans and specifications

- C. Alternate No. C-1 - Traffic Circle :

- 1. Base Bid Item: Existing conditions remain
- 2. Alternate Item: Install traffic circle as shown on Civil plans and specifications

- D. Alternate No. C-2 - Asphalt Coating & Striping:

- 1. Base Bid Item: Existing conditions remain
- 2. Alternate Item: Recoat all asphalt parking areas and restripe per plans and specifications

- E. Alternate No. M-1 - Preferred DDC Controls

- 1. Base Bid Item: Any manufacturer listed in the Specifications
- 2. Alternate Item: DDC system by Johnson Controls, Inc.

- F. Alternate No. M-2 - Mechanical Equipment Replacement in the Gymnasium

- 1. Base Bid Item: Existing conditions remain
- 2. Alternate Item: Replace equipment and ductwork as shown on plans and specifications

- G. Alternate No. E-1 - Preferred Intercom System

- 1. Base Bid Item: Any manufacturer listed in the Specifications
- 2. Alternate Item: Intercom system by Aiphone Corporation

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 3000

ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Preconstruction meeting.
- B. Progress photographs.
- C. Coordination drawings.
- D. Submittals for review, information, and project closeout.
- E. Submittal procedures.

1.2 PROJECT COORDINATOR

- A. Project Coordinator: Construction Manager.
- B. Cooperate with the Project Coordinator in allocation of mobilization areas of site; for field offices and sheds, for work access, traffic, and parking facilities.
- C. During construction, coordinate use of site and facilities through the Project Coordinator.
- D. Comply with Project Coordinator's procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.
- E. Comply with instructions of the Project Coordinator for use of temporary utilities and construction facilities. Responsibility for providing temporary utilities and construction facilities is identified in Section 01 1000 - Summary.
- F. Coordinate field engineering and layout work under instructions of the Project Coordinator.
- G. Make the following types of submittals to Architect through the Project Coordinator:

PART 3 EXECUTION

2.1 PRECONSTRUCTION MEETING

- A. Project Coordinator will schedule a meeting after Notice of Award.
- B. Attendance Required:
 - 1. Owner.
 - 2. Architect.
 - 3. Contractor.
- C. Agenda:
 - 1. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
 - 2. Designation of personnel representing the parties to Contract, Contractor and Architect.
 - 3. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
 - 4. Scheduling.
- D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

2.2 PROGRESS PHOTOGRAPHS

- A. Submit photographs with each application for payment, taken not more than 3 days prior to submission of application for payment.
- B. Photography Type: Digital; electronic files.
- C. Provide photographs of site and construction throughout progress of Work produced by an experienced photographer, acceptable to Architect.
- D. In addition to periodic, recurring views, take photographs of each of the following events:
 - 1. Completion of site clearing.
 - 2. Excavations in progress.
 - 3. Foundations in progress and upon completion.
 - 4. Structural framing in progress and upon completion.
 - 5. Enclosure of building, upon completion.
 - 6. Final completion, minimum of ten (10) photos.
- E. Views:
 - 1. Provide non-aerial photographs from four cardinal views at each specified time, until date of Substantial Completion.
 - 2. Provide factual presentation.
 - 3. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.
- F. Digital Photographs: 24 bit color, minimum resolution of 1024 by 768, in JPG format; provide files unaltered by photo editing software.
 - 1. Delivery Medium: Via email.
 - 2. File Naming: Include project identification, date and time of view, and view identification.
 - 3. PDF File: Assemble all photos into printable pages in PDF format, with 2 to 3 photos per page, each photo labeled with file name; one PDF file per submittal.
 - 4. Hard Copy: Printed hardcopy (grayscale) of PDF file and point of view sketch.

2.3 COORDINATION DRAWINGS

- A. Provide information required by Project Coordinator for preparation of coordination drawings.
- B. Review drawings prior to submission to Architect.

2.4 SUBMITTALS FOR REVIEW

- A. When the following are specified in individual sections, submit them for review:
 - 1. Product data.
 - 2. Shop drawings.
 - 3. Samples for selection.
 - 4. Samples for verification.
- B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in the contract documents.
- C. Samples will be reviewed for aesthetic, color, or finish selection.

-
- D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 7800 - Closeout Submittals.

2.5 SUBMITTALS FOR INFORMATION

- A. When the following are specified in individual sections, submit them for information:
1. Design data.
 2. Certificates.
 3. Test reports.
 4. Inspection reports.
 5. Manufacturer's instructions.
 6. Manufacturer's field reports.
 7. Other types indicated.
- B. Submit for Architect's knowledge as contract administrator or for Owner.

2.6 SUBMITTALS FOR PROJECT CLOSEOUT

- A. Submit Correction Punch List for Substantial Completion.
- B. Submit Final Correction Punch List for Substantial Completion.
- C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 7800 - Closeout Submittals:
1. Project record documents.
 2. Operation and maintenance data.
 3. Warranties.
 4. Bonds.
 5. Other types as indicated.
- D. Submit for Owner's benefit during and after project completion.

END OF SECTION

SECTION 01 4000

QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Submittals.
- B. Testing and inspection agencies and services.
- C. Control of installation.
- D. Mock-ups.
- E. Tolerances.
- F. Manufacturers' field services.
- G. Defect Assessment.

1.2 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the contract documents, or for Owner's information.
- C. Test Reports: After each test/inspection, promptly submit one copies of report to Architect and to Contractor.
 - 1. Include:
 - a. Date issued.
 - b. Project title and number.
 - c. Name of inspector.
 - d. Date and time of sampling or inspection.
 - e. Identification of product and specifications section.
 - f. Location in the Project.
 - g. Type of test/inspection.
 - h. Date of test/inspection.
 - i. Results of test/inspection.
 - j. Compliance with Contract Documents.
 - k. When requested by Architect, provide interpretation of results.
 - 2. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the contract documents, or for Owner's information.
- D. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
 - 1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

- 2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.
 - E. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- 1.3 Testing and Inspection Agencies and Services
- A. Owner will employ and pay for services of an independent testing agency to perform specified testing and inspection required by Special Inspections as required by the contract documents.
 - B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

PART 3 EXECUTION

2.1 CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.
- D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have work performed by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

2.2 MOCK-UPS

- A. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.
- B. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work.
- C. Notify Architect fifteen (15) working days in advance of dates and times when mock-ups will be constructed.
- D. Provide supervisory personnel who will oversee mock-up construction. Provide workers that will be employed during the construction at Project.
- E. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.
- F. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- G. Obtain Architect's approval of mock-ups before starting work, fabrication, or construction.

1. Make corrections as necessary until Architect's approval is issued.
- H. Accepted mock-ups shall be a comparison standard for the remaining Work.
- I. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

2.3 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

2.4 TESTING AND INSPECTION

- A. Testing Agency Duties:
 1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
 2. Perform specified sampling and testing of products in accordance with specified standards.
 3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
 5. Perform additional tests and inspections required by Architect.
 6. Submit reports of all tests/inspections specified.
- B. Limits on Testing/Inspection Agency Authority:
 1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 2. Agency may not approve or accept any portion of the Work.
 3. Agency may not assume any duties of Contractor.
 4. Agency has no authority to stop the Work.
- C. Contractor Responsibilities:
 1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
 2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
 3. Provide incidental labor and facilities:
 - a. To provide access to Work to be tested/inspected.
 - b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
 - c. To facilitate tests/inspections.
 - d. To provide storage and curing of test samples.

4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
 5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
 6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
- D. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.
 - E. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

2.5 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment as applicable, and to initiate instructions when necessary.
- B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

2.6 DEFECT ASSESSMENT

- A. Replace Work or portions of the Work not complying with specified requirements.
- B. If, in the opinion of Architect, it is not practical to remove and replace the work, Architect will direct an appropriate remedy or adjust payment.

END OF SECTION

Quality Assurance Plan

Quality Assurance for Seismic Resistance

Seismic Design Category	"C"
Quality Assurance Plan Required (Y/N)	No

Per the 2015 International Existing Building Code, Section 403.4 Alterations to existing buildings; Alterations are permitted to be made to any structure without requiring the structure to comply with Section 1613 provided the alteration complies with requirements for new structures and the following conditions are met:

1. The alteration does not increase the seismic force in any element by more than 10% or decrease the strength of any member by more than 10%.
2. The alteration does not decrease the design strength of any existing structural element to resist seismic forces by more than 10%.

The alteration does not increase the forces or decrease strength, therefore the existing structure is not required to comply with Section 1613.

The project will brace the top of all masonry partitions as part of voluntary seismic improvements.

Quality Assurance for Wind Requirements

Basic Wind Speed (3 second gust)	154mph
Wind Exposure Category	"B"
Quality Assurance Plan Required (Y/N)	Yes

Description of wind force resisting system and designated wind resisting components:

1. The structure alterations have increased the building wind loading. New CMU shear walls have been added and existing masonry walls have been strengthened to resist the additional wind loads.
2. Wall cladding and exterior wall framing connections to structure are part of the systems.
3. Shear wall connections to roof diaphragms.
4. Roof diaphragm systems, including roof deck connections to the supporting steel and number of deck sidelaps.
5. Shear wall connections to foundations.
6. Lateral footing reinforcement.
7. Lateral footing soil bearing capacity.
8. Roofing attachment to metal decks.

Statement of Responsibility

Each contractor responsible for the construction or fabrication of a system or component designated above must submit a Statement of Responsibility.

SECTION 01 5813

TEMPORARY PROJECT SIGNAGE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Project identification sign.

1.2 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Shop Drawing: Show content, layout, lettering, color, foundation, structure, sizes and grades of members.

PART 2 PRODUCTS

2.1 SIGN MATERIALS

- A. Structure and Framing: New, wood, structurally adequate.
- B. Sign Surfaces: Exterior grade plywood with medium density overlay, minimum 3/4 inch (19 mm) thick, standard large sizes to minimize joints.
- C. Rough Hardware: Galvanized.
- D. Paint and Primers: Exterior quality, two coats; sign background of color as selected by Architect.

2.2 PROJECT IDENTIFICATION SIGN

- A. One painted or printed sign of construction, design, and content indicated on drawings, location as designated.
- B. Content:
 - 1. Project number, title, logo and name of Owner as indicated on Contract Documents.
 - 2. Names and titles of Architect and Consultants.
 - 3. Name of Prime Contractor .
- C. Graphic Design, Colors, Style of Lettering: Designated by Architect.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install project identification sign within 30 days after date fixed by Notice to Proceed.
- B. Erect at designated location.
- C. Erect supports and framing on secure foundation, rigidly braced and framed to resist wind loadings.
- D. Install sign surface plumb and level, with butt joints. Anchor securely.
- E. Paint exposed surfaces of sign, supports, and framing.

3.2 MAINTENANCE

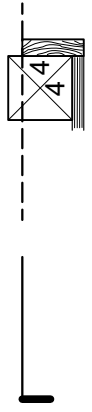
- A. Maintain signs and supports clean, repair deterioration and damage.

3.3 REMOVAL

- A. Remove signs, framing, supports, and foundations at completion of Project and restore the area.

END OF SECTION

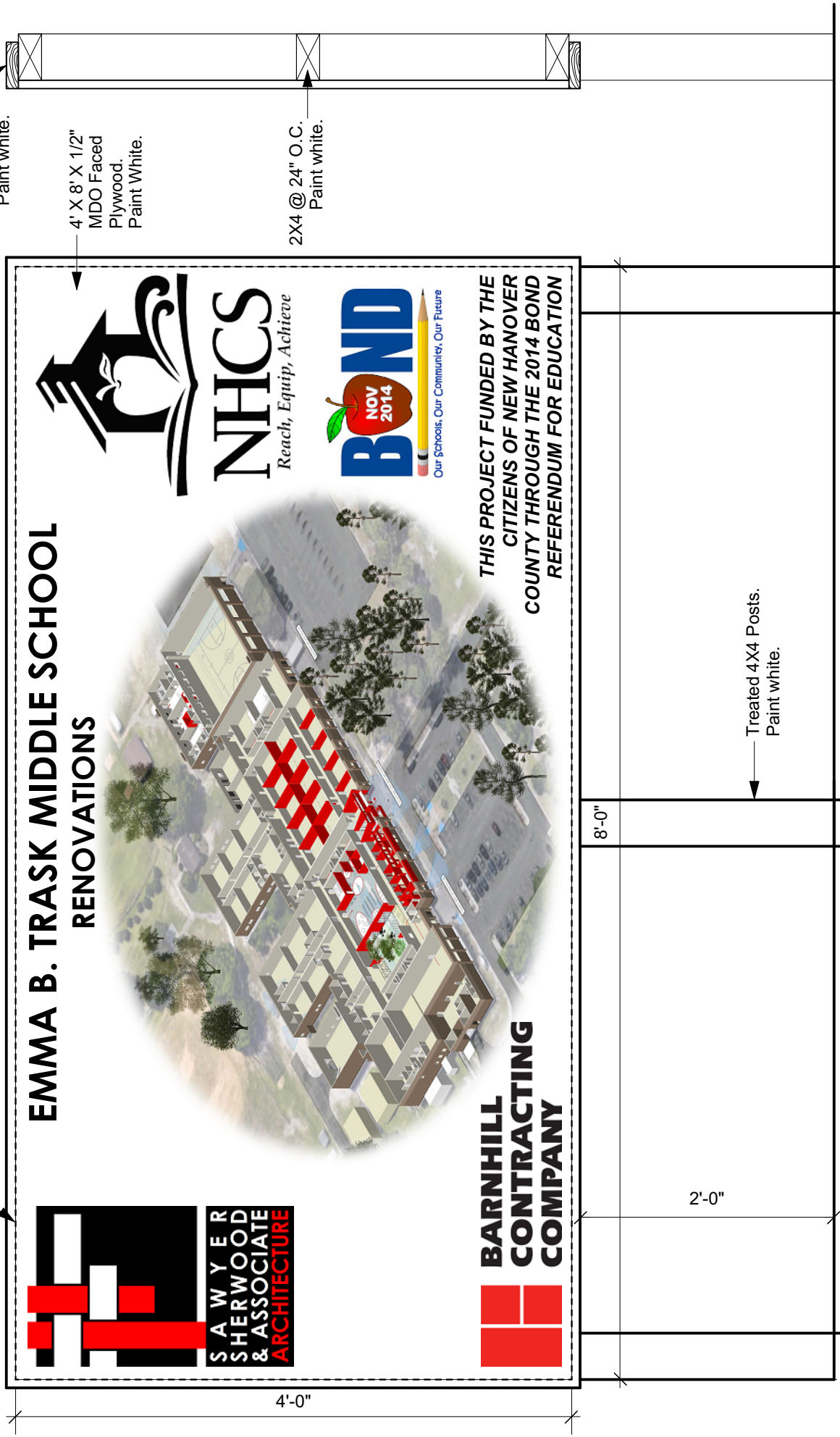
Print image & text on weather resistant material



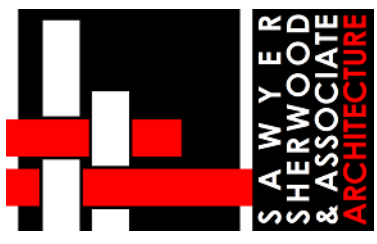
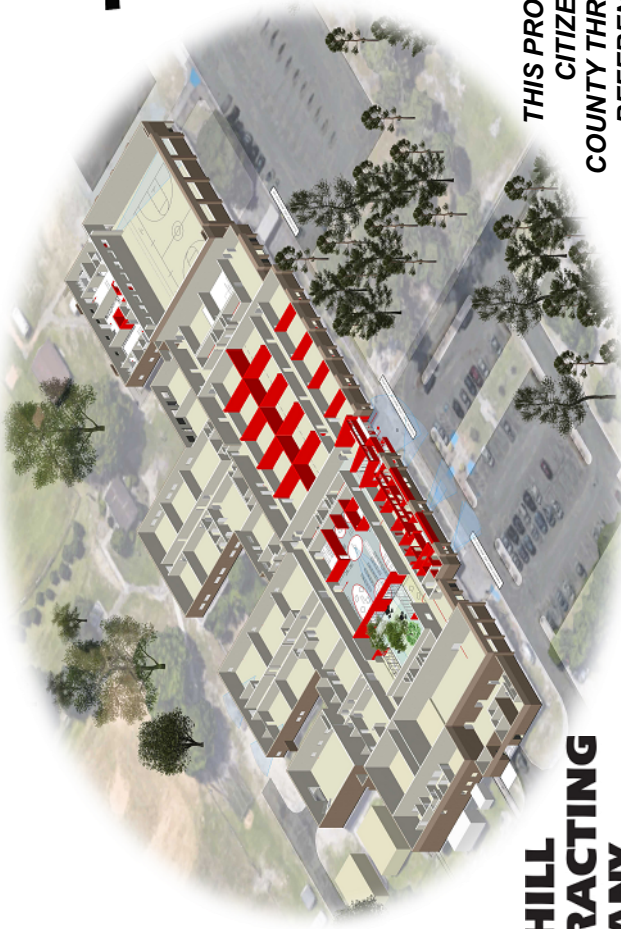
1X4 Trim.
Paint white.

4' X 8' X 1/2"
MDO Faced
Plywood.
Paint White.

2X4 @ 24" O.C.
Paint white.



EMMA B. TRASK MIDDLE SCHOOL RENOVATIONS



THIS PROJECT FUNDED BY THE
CITIZENS OF NEW HANOVER
COUNTY THROUGH THE 2014 BOND
REFERENDUM FOR EDUCATION

8'-0"

2'-0"

Treated 4X4 Posts.
Paint white.

Posts set 4' in ground

Posts set 4' in ground

Project Sign
Emma B. Trask Middle School Renovations

SECTION 01 6000

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General product requirements.
- B. Re-use of existing products.
- C. Transportation, handling, storage and protection.
- D. Product option requirements.
- E. Substitution limitations.
- F. Procedures for Owner-supplied products.
- G. Maintenance materials, including extra materials, spare parts, tools, and software.

1.2 SUBMITTALS

- A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
 - 1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS

2.1 EXISTING PRODUCTS

- A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by the Contract Documents.
- B. Specific Products to be Reused: The reuse of certain materials and equipment already existing on the project site is required.
 - 1. See Section 01 1000 for list of items required to be salvaged for reuse and relocation.

2.2 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by the Contract Documents.
- B. Use of products having any of the following characteristics is not permitted:
 - 1. Containing lead, cadmium, or asbestos.

2.3 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.

- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.4 MAINTENANCE MATERIALS

- A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
- B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.1 SUBSTITUTION LIMITATIONS

- A. Article 4 of the CM at Risk Bid Manual specified time restrictions for submitting request for substitutions during the bidding period and the documents required.

3.2 OWNER-SUPPLIED PRODUCTS

- A. Owner's Responsibilities:
 - 1. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
 - 2. Arrange and pay for product delivery to site.
 - 3. On delivery, inspect products jointly with Contractor.
 - 4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
 - 5. Arrange for manufacturers' warranties, inspections, and service.
- B. Contractor's Responsibilities:
 - 1. Review Owner reviewed shop drawings, product data, and samples.
 - 2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
 - 3. Handle, store, install and finish products.
 - 4. Repair or replace items damaged after receipt.

3.3 TRANSPORTATION AND HANDLING

- A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
- B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.
- C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- D. Transport and handle products in accordance with manufacturer's instructions.
- E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.
- H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.4 STORAGE AND PROTECTION

- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels intact and legible.
- D. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- G. Comply with manufacturer's warranty conditions, if any.
- H. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- I. Prevent contact with material that may cause corrosion, discoloration, or staining.
- J. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- K. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

SECTION 01 7000

EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.1 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
 - 1. On request, submit documentation verifying accuracy of survey work.
 - 2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in compliance with Contract Documents.
 - 3. Submit surveys and survey logs for the project record.
- C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
 - 1. Structural integrity of any element of Project.
 - 2. Integrity of weather exposed or moisture resistant element.
 - 3. Efficiency, maintenance, or safety of any operational element.
 - 4. Visual qualities of sight exposed elements.
 - 5. Work of Owner or separate Contractor.

1.2 QUALIFICATIONS

- A. For surveying work, employ a land surveyor registered in North Carolina and acceptable to Architect. Submit evidence of surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate. Employ only individual(s) trained and experienced in collecting and recording accurate data relevant to ongoing construction activities,

1.3 PROJECT CONDITIONS

- A. Use of explosives is not permitted.
- B. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- C. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.
- D. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- E. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
 - 1. Provide dust-proof barriers between construction areas and areas continuing to be occupied by Owner.

1.4 COORDINATION

- A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

- B. Notify affected utility companies and comply with their requirements.
- C. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- D. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- F. Coordinate completion and clean-up of work of separate sections.
- G. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

2.1 PATCHING MATERIALS

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.2 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.3 PREINSTALLATION MEETINGS

- A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify Architect four days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
 - 1. Review conditions of examination, preparation and installation procedures.
 - 2. Review coordination with related work.
- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.4 LAYING OUT THE WORK

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of any discrepancies discovered.
- C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
- F. Utilize recognized engineering survey practices.
- G. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
 - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
 - 2. Grid or axis for structures.
 - 3. Building foundation, column locations, ground floor elevations.
- H. Periodically verify layouts by same means.
- I. Maintain a complete and accurate log of control and survey work as it progresses.

3.5 GENERAL INSTALLATION REQUIREMENTS

- A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.6 ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 - 1. Verify that construction and utility arrangements are as indicated.
 - 2. Report discrepancies to Architect before disturbing existing installation.
 - 3. Beginning of alterations work constitutes acceptance of existing conditions.
- B. Keep areas in which alterations are being conducted separated from other areas that are still occupied.
 - 1. Provide, erect, and maintain temporary dustproof partitions.
- C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
 - 1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.
 - 2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.
- D. Remove existing work as indicated and as required to accomplish new work.
 - 1. Remove items indicated on drawings.
 - 2. Relocate items indicated on drawings.
 - 3. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
 - 4. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.
- E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.
 - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
 - 2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
 - 3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
 - b. Provide temporary connections as required to maintain existing systems in service.
 - 4. Verify that abandoned services serve only abandoned facilities.
 - 5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub

and tag with identification; patch holes left by removal using materials specified for new construction.

- F. Protect existing work to remain.
 - 1. Prevent movement of structure; provide shoring and bracing if necessary.
 - 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 - 3. Repair adjacent construction and finishes damaged during removal work.
- G. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
 - 1. When existing finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Architect.
 - 2. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.
 - 3. Where a change of plane of 1/4 inch (6 mm) or more occurs in existing work, submit recommendation for providing a smooth transition for Architect review and request instructions.
- H. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.
- I. Refinish existing surfaces as indicated:
 - 1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
 - 2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.
- J. Clean existing systems and equipment.
- K. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.
- L. Do not begin new construction in alterations areas before demolition is complete.
- M. Comply with all other applicable requirements of this section.

3.7 CUTTING AND PATCHING

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. See Alterations article above for additional requirements.
- C. Perform whatever cutting and patching is necessary to:
 - 1. Complete the work.
 - 2. Fit products together to integrate with other work.
 - 3. Provide openings for penetration of mechanical, electrical, and other services.
 - 4. Match work that has been cut to adjacent work.
 - 5. Repair areas adjacent to cuts to required condition.
 - 6. Repair new work damaged by subsequent work.

7. Remove samples of installed work for testing when requested.
 8. Remove and replace defective and non-complying work.
- D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
 - E. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
 - F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
 - G. Restore work with new products in accordance with requirements of Contract Documents.
 - H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
 - I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 8400, to full thickness of the penetrated element.
 - J. Patching:
 1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
 2. Match color, texture, and appearance.
 3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.8 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.9 PROTECTION OF INSTALLED WORK

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

- G. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.10 SYSTEM STARTUP

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
- C. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- D. Verify that wiring and support components for equipment are complete and tested.
- E. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- F. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- G. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.11 DEMONSTRATION AND INSTRUCTION

- A. See Section 01 7900 - Demonstration and Training.

3.12 ADJUSTING

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.13 FINAL CLEANING

- A. Use cleaning materials that are nonhazardous.
- B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- C. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- D. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- E. Clean filters of operating equipment.
- F. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, and drainage systems.
- G. Clean site; sweep paved areas, rake clean landscaped surfaces.
- H. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.14 CLOSEOUT PROCEDURES

- A. Make submittals that are required by governing or other authorities.
 - 1. Provide copies to Architect and Owner.

- B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.
- C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.
- D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.
- E. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.
- F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
- G. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.
- H. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

3.15 MAINTENANCE

- A. Provide service and maintenance of components indicated in specification sections.
- B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.
- C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
- D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.
- E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

END OF SECTION

SECTION 01 7800

CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Project Record Documents.
- B. Operation and Maintenance Data.
- C. Warranties and bonds.

1.2 RELATED REQUIREMENTS

- A. Section 01 3000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- B. Section 01 7000 - Execution and Closeout Requirements: Contract closeout procedures.
- C. Individual Product Sections: Specific requirements for operation and maintenance data.
- D. Individual Product Sections: Warranties required for specific products or Work.

1.3 SUBMITTALS

- A. Project Record Documents:
 - 1. Submit documents to Architect with claim for final Application for Payment.
- B. Record Drawings:
 - 1. Certified, surveyed record drawings ("as-built" plans), sealed by a North Carolina licensed Professional Land Surveyor or Professional Engineer (engineer seal required for profiles), shall be furnished to the Town of Wrightsville Beach Public Works (TOWB) by the Engineer of Record (or Developer where applicable) upon completion and acceptance of the infrastructure by the Authority. The "as-built" plans shall conform to the As-Built Checklist, included at the end of this Section.
 - 2. For sewer projects, the "as-built" plans shall include accurate information regarding pipe size, pipe material, pipe length, manhole construction (size of manhole, invert, rim, alignment, and location), services, and pump stations along with any relevant rights-of-way, property boundaries and easements. Plans shall also include sewer profiles showing any utility crossings along with the aforementioned information.
 - 3. For pump station projects, the "as-built" plans shall include accurate information regarding interior and exterior pipe sizes, material, length, as well as all structural dimensions of the pump station, all electrical equipment (make and model), pump information (make, model, and impeller size), and site layout information. Both top view and side view drawings are required on the "as-built" plans.
 - 4. For water projects, the "as-built" plans shall include accurate information regarding pipe size, pipe material, pipe length, valve locations (and turn direction), hydrant locations, fitting locations, services, and blow-off locations along with any relevant rights-of-way, property boundaries and easements.
- C. Operation and Maintenance Data:
 - 1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return one copy with comments.

2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
 3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
 4. Submit two sets of revised final documents in final form within 10 days after final inspection.
- D. Warranties and Bonds:
1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
 2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 3 EXECUTION

2.1 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 1. Drawings.
 2. Addenda.
 3. Change Orders and other modifications to the Contract.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress.
- E. Record Drawings: Legibly mark each item to record actual construction including:
 1. Field changes of dimension and detail.
 2. Details not on original Contract drawings.
- F. Digital Information: Digital "as-built" information shall be provided by the Engineer of Record in AutoCAD format and shall include all information required on the "as-built" drawings. No other digital formats will be accepted.

2.2 OPERATION AND MAINTENANCE DATA

- A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

2.3 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

- A. For Each Product, Applied Material, and Finish:
- B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
- C. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

2.4 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

- A. For Each Item of Equipment and Each System:
 - 1. Description of unit or system, and component parts.
 - 2. Identify function, normal operating characteristics, and limiting conditions.
 - 3. Include performance curves, with engineering data and tests.
 - 4. Complete nomenclature and model number of replaceable parts.
- B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
- C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
- D. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- E. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- F. Provide servicing and lubrication schedule, and list of lubricants required.
- G. Include manufacturer's printed operation and maintenance instructions.
- H. Include sequence of operation by controls manufacturer.
- I. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- J. Include test and balancing reports.
- K. Additional Requirements: As specified in individual product specification sections.

2.5 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

- A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.
- B. Where systems involve more than one specification section, provide separate tabbed divider for each system.
- C. Binders: Commercial quality, 8-1/2 by 11 inch (216 by 280 mm) three D side ring binders with durable plastic covers; 2 inch (50 mm) maximum ring size. When multiple binders are used, correlate data into related consistent groupings.

- D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.
- F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.
- G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
- H. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.
- I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- J. Arrangement of Contents: Organize each volume in parts as follows:
 - 1. Project Directory.
 - 2. Table of Contents, of all volumes, and of this volume.
 - 3. Operation and Maintenance Data: Arranged by system, then by product category.
 - a. Source data.
 - b. Operation and maintenance data.
 - c. Field quality control data.
 - d. Photocopies of warranties and bonds.

2.6 WARRANTIES AND BONDS

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.
- E. Include originals of each in operation and maintenance manuals, indexed separately on Table of Contents.

END OF SECTION

SECTION 01 7900

DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.1 SUMMARY

- A. Demonstration of products and systems where indicated in specific specification sections.
- B. Training of Owner personnel in operation and maintenance is required for:
 - 1. HVAC systems and equipment.
 - 2. Electrical systems and equipment.
 - 3. Landscape irrigation.
 - 4. Items specified in individual product Sections.

1.2 RELATED REQUIREMENTS

- A. Section 01 7800 - Closeout Submittals: Operation and maintenance manuals.

1.3 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Training Plan: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
 - 1. Submit to Architect for transmittal to Owner.
 - 2. Submit not less than four weeks prior to start of training.
 - 3. Revise and resubmit until acceptable.
 - 4. Provide an overall schedule showing all training sessions.
 - 5. Include at least the following for each training session:
 - a. Identification, date, time, and duration.
 - b. Description of products and/or systems to be covered.
 - c. Name of firm and person conducting training; include qualifications.
 - d. Intended audience, such as job description.
 - e. Objectives of training and suggested methods of ensuring adequate training.
 - f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
 - g. Media to be used, such as slides, hand-outs, etc.
 - h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.
- C. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.
 - 1. Include applicable portion of O&M manuals.
 - 2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
 - 3. Provide one extra copy of each training manual to be included with operation and maintenance data.

- D. Training Reports:
 - 1. Identification of each training session, date, time, and duration.
 - 2. Sign-in sheet showing names and job titles of attendees.
 - 3. List of attendee questions and written answers given, including copies of and references to supporting documentation required for clarification; include answers to questions that could not be answered in original training session.
- E. Video Recordings: Submit digital video recording of each demonstration and training session for Owner's subsequent use.
 - 1. Format: DVD Disc or USB Drive.
 - 2. Label each disc or drive and container with session identification and date.

1.4 QUALITY ASSURANCE

- A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
 - 1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
 - 2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 DEMONSTRATION - GENERAL

- A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.
- B. Demonstration may be combined with Owner personnel training if applicable.
- C. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
 - 1. Perform demonstrations not less than two weeks prior to Substantial Completion.
 - 2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- D. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
 - 1. Perform demonstrations not less than two weeks prior to Substantial Completion.

3.2 TRAINING - GENERAL

- A. Conduct training on-site unless otherwise indicated.
- B. Owner will provide classroom and seating at no cost to Contractor.
- C. Provide training in minimum two hour segments.
- D. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.
- E. Review of Facility Policy on Operation and Maintenance Data: During training discuss:

1. The location of the O&M manuals and procedures for use and preservation; backup copies.
 2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
 3. Typical uses of the O&M manuals.
- F. Product- and System-Specific Training:
1. Review the applicable O&M manuals.
 2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
 3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
 4. Provide hands-on training on all operational modes possible and preventive maintenance.
 5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
 6. Discuss common troubleshooting problems and solutions.
 7. Discuss any peculiarities of equipment installation or operation.
 8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
 9. Review recommended tools and spare parts inventory suggestions of manufacturers.
 10. Review spare parts and tools required to be furnished by Contractor.
 11. Review spare parts suppliers and sources and procurement procedures.
- G. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION

SECTION 02 4100

DEMOLITION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Building demolition excluding removal of hazardous materials and toxic substances.
- B. Selective demolition of built site elements.
- C. Selective demolition of building elements for alteration purposes.
- D. Abandonment and removal of existing utilities and utility structures.

1.2 RELATED REQUIREMENTS

- A. Section 01 1000 - Summary: Description of items to be salvaged or removed for re-use by Contractor.
- B. Section 01 6000 - Product Requirements: Handling and storage of items removed for salvage and relocation.
- C. Section 01 7000 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.
- D. Section 07 0150 - Preparation for Reroofing: Removal of existing roofing, roof insulation, flashing, trim and accessories.
- E. Section 31 1000 - Site Clearing: Removal of trees and vegetation, clearing and grubbing, removing above- and below-grade improvements.
- F. Section 32 9300 - Planting: Relocation of existing trees, shrubs, and other plants, and pruning of existing trees to remain.

1.3 REFERENCE STANDARDS

- A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.
- B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2013.

1.4 SUBMITTALS

- A. Site Plan: Showing:
 - 1. Vegetation to be protected.
 - 2. Areas for temporary construction and field offices.
 - 3. Areas for temporary and permanent placement of removed materials.
- B. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

PART 3 EXECUTION

2.1 SCOPE

- A. See Section 01 1000 - Summary for a description of items to be salvaged or removed for re-use by Contractor.
- B. Remove portions of existing buildings as shown on the demolition plans or as required by new work shown on the Construction Drawings.

- C. Salvage brick for reinstallation by contractor as indicated on drawings.
- D. Remove paving and curbs as required to accomplish new work.
- E. Remove concrete slabs on grade as required to accomplish new work.
- F. Remove manholes and manhole covers, curb inlets and catch basins as required to accomplish new work.
- G. Remove other items indicated, for salvage, relocation, and recycling.
- H. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as specified in Section 31 2000.

2.2 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.
 - 2. Comply with applicable requirements of NFPA 241.
 - 3. Use of explosives is not permitted.
 - 4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 - 5. Provide, erect, and maintain temporary barriers and security devices.
 - 6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
 - 7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 - 8. Do not close or obstruct roadways or sidewalks without permit.
 - 9. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
 - 10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
- B. Do not begin removal until receipt of notification to proceed from Owner.
- C. Do not begin removal until built elements to be salvaged or relocated have been removed.
- D. Do not begin removal until vegetation to be relocated has been removed and specified measures have been taken to protect vegetation to remain.
- E. Protect existing structures and other elements that are not to be removed.
 - 1. Provide bracing and shoring.
 - 2. Prevent movement or settlement of adjacent structures.
 - 3. Stop work immediately if adjacent structures appear to be in danger.
- F. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- G. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.

- H. Perform demolition in a manner that maximizes salvage and recycling of materials.
 - 1. Dismantle existing construction and separate materials.
 - 2. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.
- I. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

2.3 EXISTING UTILITIES

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.
- H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.

2.4 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 - 1. Verify that construction and utility arrangements are as indicated.
 - 2. Report discrepancies to Architect before disturbing existing installation.
 - 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Separate areas in which demolition is being conducted from other areas that are still occupied.
 - 1. Provide, erect, and maintain temporary dustproof partitions of construction .
- C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
- D. Remove existing work as indicated and as required to accomplish new work.
 - 1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction specified.
 - 2. Remove items indicated on drawings.
- E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.

1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 3. See Section 01 1000 for other limitations on outages and required notifications.
 4. Verify that abandoned services serve only abandoned facilities before removal.
 5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
- F. Protect existing work to remain.
1. Prevent movement of structure; provide shoring and bracing if necessary.
 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 3. Repair adjacent construction and finishes damaged during removal work.
 4. Patch as specified for patching new work.
- 2.5 DEBRIS AND WASTE REMOVAL
- A. Remove debris, junk, and trash from site.
 - B. Leave site in clean condition, ready for subsequent work.
 - C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 03 3000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Footings.
 - 2. Foundation walls.
 - 3. Slabs-on-grade.
- B. Related Sections:
 - 1. Division 31 for drainage fill under slabs-on-grade.
 - 2. Division 32 for concrete pavement and walks.

1.3 DEFINITIONS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - 1. Location of construction joints is subject to approval of the Architect.
- E. Samples: For vapor retarder.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Welding certificates.

- C. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Steel reinforcement and accessories.
 - 4. Curing compounds.
 - 5. Bonding agents.
 - 6. Adhesives.
 - 7. Vapor retarders.
 - 8. Semirigid joint filler.
 - 9. Joint-filler strips.
 - 10. Repair materials.
- D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 - 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- F. Field quality-control reports.
- G. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."
- E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5 and Section 7, "Lightweight Concrete."
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
 - 1. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

- a. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
 - b. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- G. Preinstallation Conference: Conduct conference at Project site.
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.
 - e. Special concrete finish subcontractor.
 - 2. Review testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.
 - 3. Review floor finishes to be installed and coordinate with curing methods to be used.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- B. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- C. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

2.3 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 1. Portland Cement: ASTM C 150, Type I/II. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F.
- B. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
 1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94/C 94M and potable.

2.5 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
- C. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494/C 494M, Type C.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Axim Italcementi Group, Inc.; CATEXOL CN-CI
 - b. BASF Construction Chemicals - Building Systems; Rheocrete CNI
 - c. Euclid Chemical Company (The), an RPM company; ARRMATECT, EUCON BCN, or EUCON CIA
 - d. Grace Construction Products, W. R. Grace & Co.; DCI
 - e. Sika Corporation; Sika CNI
- D. Synthetic Macro-Fiber: Polyolefin macro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, 1 to 2-1/4 inches (25 to 57 mm) long.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Euclid Chemical Company (The), an RPM company; Tuf-Strand SF.
 - b. FORTA Corporation; FORTA FERRO.
 - c. Grace Construction Products, W. R. Grace & Co.; Strux 90/40.
 - d. Nycon, Inc.; XL.

- e. Propex Concrete Systems Corp.; Fibermesh 650.
- f. Sika Corporation; Sika Fiber MS.

2.6 VAPOR RETARDERS

- A. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape. Maximum perm rating of 0.02.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fortifiber Building Systems Group; Moistop Ultra 15
 - b. Grace Construction Products, W. R. Grace & Co.; Florprufe 120
 - c. Insulation Solutions, Inc.; Viper VaporCheck II
 - d. Meadows, W. R., Inc.; Perminator 15 mil
 - e. Raven Industries Inc.; Vapor Block 15
 - f. Reef Industries, Inc.; Griffolyn 15 mil Green
 - g. Stego Industries, LLC; Stego Wrap 15 mil Class A
 - 2. Provide manufacturer's compatible sealer system for penetrations.
- B. Granular Fill: Provide one of the following:
 - a. Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.
 - b. Clean sands with less than 3 percent fines. Materials to be verified by a qualified Geotechnical Engineer.

2.7 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Construction Chemicals - Building Systems; Confilm
 - b. ChemMasters; SprayFilm
 - c. Conspec by Dayton Superior; Aquafilm
 - d. Dayton Superior Corporation; Sure Film (J-74)
 - e. Euclid Chemical Company (The), an RPM company; Eucobar
 - f. L&M Construction Chemicals, Inc.; E-CON
 - g. Meadows, W. R., Inc.; EVAPRE
 - h. Sika Corporation; SikaFilm
 - i. Symons by Dayton Superior; Finishing Aid
 - j. Unitex; PRO-FILM
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Anti-Hydro International, Inc.; AH Clear Cure WB
 - b. BASF Construction Chemicals - Building Systems; Kure-N-Seal WB
 - c. ChemMasters; Safe-Cure & Seal 20
 - d. Conspec by Dayton Superior; Cure and Seal WB
 - e. Cresset Chemical Company; Crete-Trete 309-VOC Cure & Seal
 - f. Dayton Superior Corporation; Safe Cure and Seal (J-18)
 - g. Euclid Chemical Company (The), an RPM company; Aqua Cure VOX; Clearseal WB 150
 - h. L&M Construction Chemicals, Inc.; Dress & Seal WB
 - i. Meadows, W. R., Inc.; Vocomp-20
 - j. Symons by Dayton Superior; Cure & Seal 18 Percent E

2.8 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.9 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.10 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash: 25 percent.
 - 2. Combined Fly Ash and Pozzolan: 25 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 - 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.11 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Footings: Proportion normal-weight concrete mixture as follows:
 - 1. Minimum Compressive Strength: 3000 psi at 28 days.
 - 2. Slump Limit: 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
- B. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:
 - 1. Minimum Compressive Strength – typical interior slab: 3000 psi at 28 days.
 - 2. Minimum Compressive Strength – typical exterior slab: 4000 psi (27.6 MPa) at 28 days.
 - 3. Slump Limit: 4 inches, plus or minus 1 inch.
 - 4. Air Content: For exterior broom finished concrete only; 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
 - 5. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
 - 6. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 3.0 lb/cu. yd. (1.5 kg/cu. m).

2.12 FABRICATING REINFORCEMENT

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

2.13 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- B. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
 1. Class A, 1/8 inch for smooth-formed finished surfaces.
- C. Construct forms tight enough to prevent loss of concrete mortar.
- D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 1. Install keyways, reglets, recesses, and the like, for easy removal.
 2. Do not use rust-stained steel form-facing material.
- E. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- F. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- G. Chamfer exterior corners and edges of permanently exposed concrete.
- H. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.3 VAPOR RETARDERS

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Lap joints 6 inches and seal with manufacturer's recommended tape.
 - 2. Seal around all penetrations with manufacturer's recommended system.

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 - 1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.5 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 - 3. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 - 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
 - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.
 - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

G. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.7 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.
 1. Apply scratch finish to surfaces indicated and to receive mortar setting beds for bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
 1. Apply float finish to surfaces indicated to receive trowel finish.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.9 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.10 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

3.11 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.12 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.
- 3.13 FIELD QUALITY CONTROL
- A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
1. Steel reinforcement placement.

2. Steel reinforcement welding.
 3. Headed bolts and studs.
 4. Verification of use of required design mixture.
 5. Concrete placement, including conveying and depositing.
 6. Curing procedures and maintenance of curing temperature.
 7. Verification of concrete strength before removal of shores and forms from beams and slabs.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Samples for strength tests of each class of concrete placed each day shall be taken not less than once a day, nor less than once for each 150 cu. yd. (114 cu. m) of concrete, nor less than once for each 5,000 sq. ft. of surface area for slabs or walls.
 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 6. Compression Test Specimens: ASTM C 31/C 31M.
 - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
 7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
 8. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
 9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
 10. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
 11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- D. Measure floor and slab flatness and levelness according to ASTM E 1155 within 48 hours of finishing.

END OF SECTION 033000

SECTION 04 0100

MAINTENANCE OF MASONRY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Repointing mortar joints to extent indicated on drawings.

1.2 RELATED REQUIREMENTS

- A. Section 04 2000 - Unit Masonry: Brick and Block masonry units.
- B. Section 04 2000 - Unit Masonry: Mortar and grout.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week prior to commencing work of this section.
 - 1. Require attendance of parties directly affecting work of this section.
 - 2. Review conditions of installation, installation procedures, and coordination with related work.

PART 2 PRODUCTS

2.1 MORTAR MATERIALS

- A. Comply with requirements of Section 04 2000.

2.2 MASONRY MATERIALS

- A. Brick: Section 04 2000.
- B. Block: Section 04 2000.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces to be restored, extents indicated on drawings, are ready for work of this section.

3.2 PREPARATION

- A. Protect surrounding elements from damage due to restoration procedures.
- B. Carefully remove and store removable items located in areas to be restored, including fixtures, fittings, finish hardware, and accessories; reinstall upon completion.
- C. Separate areas to be protected from restoration areas using means adequate to prevent damage.
- D. Cover existing landscaping with tarpaulins or similar covers.

3.3 REPOINTING

- A. Cut out loose or disintegrated mortar in joints to minimum 1/2 inch (6 mm) depth or until sound mortar is reached.
- B. Use power tools only after test cuts determine no damage to masonry units will result.
- C. Do not damage masonry units.
- D. When cutting is complete, remove dust and loose material by brushing.
- E. Premoisten joint and apply mortar. Pack tightly in maximum 1/4 inch (6 mm) layers. Form a smooth, compact concave joint to match existing.

3.4 CLEANING

- A. Immediately remove stains, efflorescence, or other excess resulting from the work of this section.
- B. Remove excess mortar, smears, and droppings as work proceeds and upon completion.
- C. Clean surrounding surfaces.

END OF SECTION

SECTION 04 2000

UNIT MASONRY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Concrete block.
- B. Clay facing brick.
- C. Mortar and grout.
- D. Reinforcement and anchorage.
- E. Flashings.
- F. Accessories.

1.2 RELATED REQUIREMENTS

- A. Section 01 1000 - Summary: Brick salvaged for reuse.
- B. Section 05 5000 - Metal Fabrications: Loose steel lintels and fabricated steel items.
- C. Section 07 2100 - INSULATION: Insulation for cavity spaces.
- D. Section 07 2123 - Loose-Fill Insulation: Granular insulation for masonry unit cores.
- E. Section 07 9200 - Joint Sealants: Sealing control and expansion joints.

1.3 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- B. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2016.
- C. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2015.
- D. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2014.
- E. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units; 2011.
- F. ASTM C150/C150M - Standard Specification for Portland Cement; 2015.
- G. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale); 2014.
- H. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2014a.
- I. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2011.
- J. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2010.
- K. BIA Technical Notes No. 13 - Ceramic Glazed Brick Exterior Walls; 2017.
- L. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2016.
- M. UL (FRD) - Fire Resistance Directory; current edition.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
- C. Samples: Submit two samples of decorative block and facing brick units to illustrate color, texture, and extremes of color range.
- D. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
- E. Manufacturer's Certificate: Certify that water repellent admixture manufacturer has certified masonry unit manufacturer as an approved user of water repellent admixture in the manufacture of concrete block.
- F. Test Reports: Concrete masonry manufacturer's test reports for units with integral water repellent admixture.

1.6 QUALITY ASSURANCE

- A. Comply with provisions of ACI 530.1/ASCE 6/TMS 602, except where exceeded by requirements of the contract documents.
 - 1. Maintain one copy of each document on project site.
- B. Fire Rated Assemblies: Conform to applicable code for requirements for fire rated masonry construction. See drawings for locations of rated assemblies.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

PART 2 PRODUCTS

2.1 CONCRETE MASONRY UNITS

- A. Manufacturers:
 - 1. Adams: www.adamsproducts.com.
 - 2. Carolina Prestress: www.carolinaprestress.com.
 - 3. Fay Block: www.fayblock.com.
 - 4. Johnson Concrete: www.johnsoncmu.com.
- B. Concrete Block: Comply with referenced standards and as follows:
 - 1. Size: Standard units with nominal face dimensions of 16 by 8 inches (400 by 200 mm) and nominal depths as indicated on drawings for specific locations.
 - 2. Special Shapes: Provide non-standard blocks configured for corners and other detailed conditions.
 - 3. Load-Bearing Units: ASTM C90-14, lightweight.
 - a. Both hollow and solid block, as indicated.
 - b. Exposed Faces: Manufacturer's standard color and texture; provide ground-face units where indicated on drawings. Basis of design for ground-face units: Adams

Trendstone Ground Face, price groups 1 & 2. If another manufacturer is selected, provide aggregate and matrix options similar to Adams units.

4. Non-Loadbearing Units: ASTM C129.
 - a. Both hollow and solid block, as indicated.
 - b. Lightweight.

2.2 BRICK UNITS

- A. Salvaged Brick: As indicated on drawings.
- B. Brick Manufacturers: Bricks listed below are intended to indicate a color range, texture and level of quality. Architect to make final color selection from gray range. Basis of design product: Forterra Brick; Light Grey 761 Modular: www.forterrabrick.com.
 1. Other Manufacturers:
 - a. General Shale Brick: www.generalshale.com.
 - b. Palmetto Brick Company: www.palmettobrick.com.
 - c. Taylor Clay Products: www.taylorclaybrick.com.
 - d. Substitutions: See section 01 6000 - Product Requirements.
- C. Facing Brick: ASTM C216, Type FBS, Grade SW.
 1. Nominal size: Utility.
 2. Special shapes: Molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect. Provide solid units where needed to avoid exposed cores.

2.3 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C150, Type I; color as required to produce approved color sample.
- B. Grout Aggregate: ASTM C404.
- C. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
 1. Color(s): As selected by Architect from manufacturer's full range.
- D. Water: Clean and potable.
- E. Moisture-Resistant Admixture: Water repellent compound designed to reduce capillarity.
- F. Integral Water Repellent Admixture for Mortar: Polymeric liquid admixture added to mortar at the time of manufacture.
 1. Use only in combination with masonry units manufactured with integral water repellent admixture.
 2. Use only water repellent admixture for mortar from the same manufacturer as water repellent admixture in masonry units.
 3. Meet or exceed performance specified for water repellent admixture used in masonry units.

2.4 REINFORCEMENT AND ANCHORAGE

- A. Reinforcing Steel: Type and size as indicated on drawings.

- B. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.
- C. Adjustable Multiple Wythe Joint Reinforcement: ASTM A951/A951M.
 - 1. Type: Truss, with adjustable ties or tabs spaced at 16 in (406 mm) on center.
 - 2. Material: ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/A153M, Class B.
 - 3. Size: 0.1875 inch (4.8 mm) side rods with 0.1875 inch (4.8 mm) cross rods and adjustable components of 0.1875 inch (4.8 mm) wire, width of components as required to provide not less than 5/8 inch (16 mm) of mortar coverage from each masonry face.
- D. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
 - 1. Anchor plates: Not less than 0.075 inch (1.91 mm) thick, designed for fastening to structural backup through sheathing by two fasteners; provide design with legs that penetrate sheathing and insulation to provide positive anchorage.
 - 2. Wire ties: Manufacturer's standard shape, 0.1875 inch (4.75 mm) thick.
 - 3. Vertical adjustment: Not less than 3-1/2 inches (89 mm).

2.5 FLASHINGS

- A. Copper/Polymer Film or Fabric Flashing: 3 oz/sq ft (0.915 kg/sq m) copper sheet laminated between two sheets of polymer or fiberglass fiber-reinforced film.

2.6 ACCESSORIES

- A. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
 - 1. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations.
- B. Weeps:
 - 1. Type: Clear polymer grid, 3/8 x 3-5/8 x 2-1/2 inch..
- C. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.7 MORTAR AND GROUT MIXING

- A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
- B. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.
- C. Grout for Unit Masonry: ASTM C476, using the Proportion Specification.
- D. Aggregate for Grout: ASTM C404.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.2 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.3 COLD AND HOT WEATHER REQUIREMENTS

- A. Comply with requirements of ACI 530/530.1/ERTA or applicable building code, whichever is more stringent.

3.4 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
 - 1. Bond: Running.
 - 2. Coursing: One unit and one mortar joint to equal 8 inches (200 mm).
 - 3. Mortar Joints: Concave.
- D. Brick Units:
 - 1. Bond: One-third running.
 - 2. Coursing: Three units and three mortar joints to equal 8 inches (200 mm).
 - 3. Mortar Joints: Concave.

3.5 PLACING AND BONDING

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Lay hollow masonry units with face shell bedding on head and bed joints.
- C. Remove excess mortar and mortar smears as work progresses.
- D. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.
- E. Interlock intersections and external corners.
- F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- H. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.
- I. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.
- J. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

3.6 WEEPS/CAVITY VENTS

- A. Install weeps in veneer and cavity walls at 16 inches (406 mm) on center horizontally above through-wall flashing, above shelf angles and lintels, and at bottom of walls.

3.7 CAVITY MORTAR CONTROL

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.
- B. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.8 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

- A. Masonry Back-Up: Embed anchors to bond veneer at maximum 16 inches (400 mm) on center vertically and 16 inches (400 mm) on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches (200 mm) on center.
- B. Stud Back-Up: Secure veneer anchors to stud framed back-up and embed into masonry veneer at maximum 16 inches (400 mm) on center vertically and 16 inches (400 mm) on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches (200 mm) on center.

3.9 LINTELS

- A. Install loose steel lintels over openings.
- B. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled.

3.10 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control or expansion joints.

3.11 BUILT-IN WORK

- A. As work progresses, install built-in metal door frames, glazed frames, anchor bolts, and plates and other items to be built into the work and furnished under other sections.
- B. Install built-in items plumb, level, and true to line.
- C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
- D. Do not build into masonry construction organic materials that are subject to deterioration.

3.12 TOLERANCES

- A. Maximum Variation from Alignment of Columns: 1/4 inch (6 mm).
- B. Maximum Variation From Unit to Adjacent Unit: 1/16 inch (1.6 mm).
- C. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft (6 mm/3 m) and 1/2 inch in 20 ft (13 mm/6 m) or more.
- D. Maximum Variation from Plumb: 1/4 inch (6 mm) per story non-cumulative; 1/2 inch (13 mm) in two stories or more.
- E. Maximum Variation from Level Coursing: 1/8 inch in 3 ft (3 mm/m) and 1/4 inch in 10 ft (6 mm/3 m); 1/2 inch in 30 ft (13 mm/9 m).
- F. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch (minus 6.4 mm, plus 9.5 mm).
- G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch (6 mm).

3.13 CUTTING AND FITTING

- A. Cut and fit for chases, pipes, conduit, and sleeves. Coordinate with other sections of work to provide correct size, shape, and location.
- B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.14 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests.
- B. At the end of every work day, and during any precipitation event, keep masonry walls covered with plastic sheet, secured to resist blowing off of wall.

3.15 CLEANING

- A. Remove excess mortar and mortar droppings.
- B. Clean soiled surfaces with cleaning solution.

3.16 PROTECTION

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION

SECTION 05 1200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Structural steel.
 - 2. Grout.
- B. Related Sections:
 - 1. Section 014000 "Quality Requirements" for independent testing agency procedures and administrative requirements.
 - 2. Section 053100 "Steel Decking".
 - 3. Section 055000 "Metal Fabrications" for miscellaneous steel fabrications not defined as structural steel.
 - 4. Section 055100 "Metal Stairs."
 - 5. Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for surface-preparation and priming requirements.

1.3 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.4 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.
 - 1. Select and complete connections using schematic details indicated and AISC 360.
 - 2. Use LRFD; data are given at factored-load level.
- B. Construction: Steel Braced Frames

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication of structural-steel components.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Include embedment drawings.
 - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts.

5. Identify demand critical welds.
 6. For structural-steel connections indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," 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.
- 1.6 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For qualified Installer, fabricator, professional engineer and testing agency.
- 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, including chemical and physical properties.
- E. Product Test Reports: For the following:
1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 2. Shop primers.
 3. Nonshrink grout.
- F. Source 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 STD.
- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.
- D. Comply with applicable provisions of the following specifications and documents:
1. AISC 303.
 2. AISC 341 and AISC 341s1.
 3. AISC 360.
 4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- E. Preinstallation Conference: Conduct conference at Project site.

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 F 1852 fasteners and for retesting fasteners after lubrication.

1.9 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. W-Shapes: ASTM A 992/A 992M.
- C. Channels and Angles: ASTM A 36/A 36M.
- D. Plate and Bar: ASTM A 36/A 36M.
- E. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.
- F. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
 - 1. Weight Class: Standard unless noted otherwise.
 - 2. Finish: Black except where indicated to be galvanized.
- G. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.

- B. High-Strength Bolts, Nuts, and Washers: ASTM A 490 (ASTM A 490M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH, (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers with plain finish.
- C. Unheaded Anchor Rods: ASTM F 1554, Grade 36.
 - 1. Configuration: Straight.
 - 2. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
 - 3. Plate Washers: ASTM A 36/A 36M carbon steel.
 - 4. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
 - 5. Finish: Plain.
- D. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.
 - 1. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
 - 2. Plate Washers: ASTM A 36/A 36M carbon steel.
 - 3. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
 - 4. Finish: Plain.
- E. Threaded Rods: ASTM A 36/A 36M.
 - 1. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
 - 2. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
 - 3. Finish: Plain.

2.3 PRIMER

- A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

2.4 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
 - 1. Camber structural-steel members where indicated.
 - 2. Fabricate beams with rolling camber up.
 - 3. Identify high-strength structural steel according to ASTM A 36/A 36M and maintain markings until structural steel has been erected.
 - 4. Mark and match-mark materials for field assembly.
 - 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning."
- F. Welded Door Frames: Build up welded door frames attached to structural steel. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches o.c. unless otherwise indicated.
- G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 - 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.7 SOURCE QUALITY CONTROL

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
- B. The Fabricator shall be a designated AISC-Certified Plant, Category STD or the Fabricator at their expense shall engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports, this expense shall be added to the Non-Certified Fabricator's bid.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- C. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- D. Bolted Connections: Shop-bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- E. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - 1. Liquid Penetrant Inspection: ASTM E 165.
 - 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - 3. Ultrasonic Inspection: ASTM E 164.
 - 4. Radiographic Inspection: ASTM E 94.

2.8 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
 - 2. Surfaces to be field welded.
 - 3. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - 1. SSPC-SP 2, "Hand Tool Cleaning."
 - 2. SSPC-SP 3, "Power Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - 1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Base Bearing 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, where indicated.
 - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened unless otherwise indicated.
- 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 AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.
- B. Bolted Connections: Bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.
 - 1. In addition to visual inspection, field welds will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.

- D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - 1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - 2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.
- E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.6 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.
- B. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

END OF SECTION 051200

SECTION 05 1213

ARCHITECTURALLY-EXPOSED STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Additional requirements for structural steel members designated as architecturally-exposed structural steel (AESS).

1.2 RELATED REQUIREMENTS

- A. Section 05 1200 - Structural Steel Framing: General requirements for structural steel members, including AESS framing specified in this section.
- B. Section 09 9113 - Exterior Painting: Finish coat requirements and coordination with primer and surface preparation specified in this section.
- C. Section 09 9123 - Interior Painting: Finish coat requirements and coordination with primer and surface preparation specified in this section.
- D. Section 09 9600 - High-Performance Coatings: Finish coat requirements and coordination with primer and surface preparation specified in this section.

1.3 DEFINITIONS

- A. Architecturally-Exposed Structural Steel: Structural steel complying with designated AESS category as defined in AISC 303.

1.4 REFERENCE STANDARDS

- A. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges; 2016.
- B. AISC 360 - Specification for Structural Steel Buildings; 2010.
- C. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling; 2014.
- D. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.
- E. ASTM A1085/A1085M - Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS); 2015.
- F. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.
- G. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.
- H. SSPC-SP 1 - Solvent Cleaning; 2015.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Detailing for fabrication of AESS components.
 - 1. Provide erection documents clearly indicating which members are AESS members and the AESS category of each part.
 - 2. Include details that clearly identify AESS requirements found in this specification. Provide connections for AESS consistent with concepts shown on drawings.

3. Indicate welds by AWS A2.4 symbols, distinguishing between shop and field welds, and show size, length and type of each weld. Identify grinding, finish and profile of welds as defined by the designated AESS category.
4. Indicate which surfaces or edges are exposed and what class of surface preparation is being used.
5. Indicate special tolerances and erection requirements as noted on drawings or defined by the designated AESS category.
6. Indicate vent or drainage holes for HSS members.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: In addition to those qualifications listed in Section 05 1200, engage an AISC Certified Fabricator, experienced in fabricating AESS similar to that indicated for this project with a record of successful in-service performance, as well as sufficient production capacity to fabricate AESS without delaying the work.
- B. Erector Qualifications: In addition to those qualifications listed in Section 05 1200, engage an AISC Certified Erector, experienced in erecting AESS work similar in material, design, and extent to that indicated for this project and with a record of successful in-service performance.
- C. Comply with applicable provisions of AISC 303, Section 10 for the designated AESS category.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handle finished pieces in accordance with Section 10 of AISC 303, using nylon-type slings, or chains with softeners, or wire ropes with softeners such that they are not damaged.
- B. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration. Use special care in handling to prevent twisting or warping of AESS members.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Comply with Section 05 1200, except as amended in this section for aesthetic purposes.

2.2 FABRICATION

- A. Fabricate and assemble AESS in shop to greatest extent possible. Locate field joints in AESS assemblies at concealed locations or as approved by Architect. Detail AESS assemblies to minimize field handling and expedite erection.
- B. Permissible tolerances for member depth, width, out of square, and camber and sweep to be as specified in ASTM A6/A6M, ASTM A500/A500M, and ASTM A1085/A1085M.
- C. Use special care in handling and shipping of AESS both before and after shop painting to minimize damage to any shop finish. Use nylon-type slings or softeners when using chains or wire rope slings.
- D. Bolted Connections:
 1. Make in accordance with Section 05 1200. Provide bolt type and finish as noted herein.
- E. Welded Connections:
- F. Surface Preparation:
 1. Remove blemishes or unsightly surfaces resulting from temporary braces or fixtures.
 2. Remove backing and run out tabs.

G. Fabricate AESS in accordance with categories defined in AISC 303, as follows:

1. AESS 1: Columns, beams and associated connections above 15' AFF at Lobby L1, Vestibule V1 and Reception 100.
2. AESS 3: Columns, beams and associated connections from finished floor to 15' AFF at Lobby L1, Vestibule V1 and Reception 100.

2.3 PAINT SYSTEM

- A. Compatibility: All components/procedures of AESS paint system to comply with coating system specified, submitted, and approved per Sections 09 9113, 09 9123, and 09 9600. As a minimum, identify required surface preparation, primer, intermediate coat (if applicable), and finish coat. Primer, intermediate coating, and finish coating to be from a single manufacturer combined in a system documented by manufacturer with adequate guidance for fabricator to procure and execute.
- B. Finish Coating: Field apply intermediate and top coats per Sections 09 9113, 09 9123, and 09 9600.

2.4 SHOP PRIMING

- A. Surface Preparation:
 1. Provide surface preparations to meet SSPC-SP 3, "Power Tool Cleaning."
 2. Prior to blasting, remove any grease and oil using solvent cleaning to meet SSPC-SP 1.
 3. Remove weld spatter, slivers and similar surface discontinuities.
 4. Ease sharp corners resulting from shearing, flame cutting or grinding.
- B. Shop prime structural steel members. Do not prime surfaces that will be field welded, in contact with concrete, or high strength bolted with slip-critical connections.
 1. Extend priming of members partially embedded in concrete or mortar to a depth of 2 inches (50.8 mm).
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's instructions to provide a dry film thickness of not less than 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Erector to check all AESS members upon delivery for twist, kinks, gouges or other imperfections which may result in rejection of appearance of member. Coordinate remedial action with fabricator prior to erecting steel.
- B. Verify, with steel erector present, elevations of concrete and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
- C. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide connections for temporary shoring, bracing and supports only where noted on approved fabrication documents. Temporary connections not shown are to be made at locations not exposed to view in final structure or as approved by Architect.
- B. Handle, lift and align pieces using nylon straps or chains with softeners required to maintain appearance of AECS through process of erection.

3.3 ERECTION

A. AECS 1:

1. Employ special care to handle and erect AECS. Erect finished pieces using nylon straps or chains with softeners such that they are not damaged.
2. Place weld tabs for temporary bracing and safety cabling at points concealed from view in completed structure or where approved by Architect during pre-installation meeting. Obtain Architect approval of methods for removing temporary devices and finishing AECS members prior to erection.
3. AECS Erection Tolerances: Erect to standard frame tolerances for structural steel per Chapter 7 of AISC 303.
4. Set AECS accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
5. Remove blemishes or unsightly surfaces resulting from temporary braces or fixtures.
6. Remove all backing and run out tabs.
7. When temporary braces or fixtures are required to facilitate erection, take care to avoid any blemishes, holes or unsightly surfaces resulting from use or removal of such temporary elements.
8. Bolted Connections: Align bolt heads on same side of connection as indicated on approved fabrication or erection documents.
9. Welded Connections: Comply with AWS D1.1/D1.1M and Section 05 1200. Appearance and quality of welds to be consistent. Employ methods that will maintain alignment of members without warp exceeding tolerance of this section.
10. Remove weld spatter exposed to view.
11. Grind off projections larger than 1/16 inch (1.5875 mm) at field butt and plug welds.
12. Continuous Welds: Where continuous welding is noted on drawings, provide continuous welds of a uniform size and profile.

B. AECS 3:

1. Erect to requirements of AECS 1 and 2 and as follows:
2. Fabricate AECS with exposed surfaces smooth, and square.
3. Grind projections at butt and plug welds to be smooth with the adjacent surface.
4. Orientation of HSS seams shall be located on face with minimal visibility in installed condition. Indicate seam locations on shop drawings.
5. Copes, miters and cuts in surfaces exposed to view shall have a maximum gap of 1/8 inch in an open joint. If the gap is shown to be in contact, the contact shall be uniform within 1/16 inch.

6. Mill marks shall not be exposed to view. If it is not possible to hide mill marks, then the mill marks are to be removed by appropriate length cutting of mill material. If this is not possible, the fabricator shall remove the mill marks, grind, and fill the surface.
7. Provide a continuous appearance to all welded joints including tack welds. Provide joint filler at intermittent welds.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Structural Requirements:
 1. Comply with quality control requirements per AISC 360, Chapter N and AISC 303, Section 10. Refer to Section 05 1200 for additional requirements.
 2. Quality assurance agency to review work for compliance with requirements of AISC 360, Chapter N and AISC 303, Section 10.
- C. AESS 1 Acceptance: [] to observe AESS in place and determine acceptability based on qualification data and submittals. Quality assurance agency has no responsibility for enforcing requirements related to aesthetic effect.
- D. AESS 3 Acceptance: Architect to observe AESS in place and determine acceptability based on qualification data and submittals. Quality assurance agency has no responsibility for enforcing requirements related to aesthetic effect.

3.5 CLEANING

- A. Touch-up Painting: Complete cleaning and touch-up painting of field welds, bolted connections, and abraded areas of shop paint to blend with adjacent surfaces of AESS. Perform touch-up work in accordance with manufacturer's instructions and as specified in Section 09 9113, 09 9123, and 09 9600.

END OF SECTION

SECTION 05 3100 - STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Roof deck.
 - 2. Acoustical roof deck.
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. Shop Drawings:
 - 1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Certificates: For each type of steel deck.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
 - 1. Power-actuated mechanical fasteners.
- D. Evaluation Reports: For steel deck.
- E. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
- C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

2.2 ROOF DECK

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. ASC Profiles, Inc.; a Blue Scope Steel company.
 - 2. Canam United States; Canam Group Inc.
 - 3. CMC Joist & Deck.
 - 4. Consolidated Systems, Inc.; Metal Dek Group.
 - 5. Cordeck.
 - 6. DACS, Inc.
 - 7. Epic Metals Corporation.
 - 8. Marlyn Steel Decks, Inc.
 - 9. New Millennium Building Systems, LLC.
 - 10. Nucor Corp.; Vulcraft Group.

11. Roof Deck, Inc.
12. Valley Joist; Subsidiary of EBSCO Industries, Inc.
13. Verco Manufacturing Co.
14. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

- B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:

1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 (230), G90 (Z275) zinc coating.
2. Deck Profile: Type WR, wide rib.
3. Profile Depth: 1-1/2 inches (38 mm).
4. Design Uncoated-Steel Thickness: 0.0358 inches.
5. Span Condition: Triple span or more.
6. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.3 ACOUSTICAL ROOF DECK

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ASC Profiles, Inc.; a Blue Scope Steel company.
2. Canam United States; Canam Group Inc.
3. CMC Joist & Deck.
4. Consolidated Systems, Inc.; Metal Dek Group.
5. Cordeck.
6. DACS, Inc.
7. Epic Metals Corporation.
8. Marlyn Steel Decks, Inc.
9. New Millennium Building Systems, LLC.
10. Nucor Corp.; Vulcraft Group.
11. Roof Deck, Inc.
12. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

- B. Acoustical Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:

1. Prime-Painted Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), Grade 33 (230) minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: Manufacturer's standard White.
2. Deck Profile: As indicated.
3. Cellular Deck Profile: As indicated.
4. Profile Depth: 1-1/2 inches (38 mm).
5. Design Uncoated-Steel Thickness: 0.0358 inch (0.91 mm).
6. Span Condition: Triple span or more.
7. Side Laps: Overlapped or interlocking seam at Contractor's option.

8. Acoustical Perforations: Deck units with manufacturer's standard perforated vertical webs.
9. Sound-Absorbing Insulation: Manufacturer's standard premolded roll or strip of glass or mineral fiber. Weight: 7.0 pounds-per-cubic-foot per ASTM C303; Flame Spread: 25; Smoke Developed: 50; Thickness: 1-1/2 inches.
 - a. Installation of sound-absorbing insulation is specified in Division 07 Section "2216 – Roof Insulation."
10. Acoustical Performance: NRC 0.80, tested according to ASTM C 423.

2.4 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven stainless steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, stainless 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 (230 MPa), of same material and finish as deck, and of thickness and profile indicated.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.
- I. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck, with 3-inch- (76-mm-) wide flanges and level recessed pans of 1-1/2-inch (38-mm) minimum depth. For drains, cut holes in the field.
- J. Galvanizing Repair Paint: ASTM A 780.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION

- A. Fasten roof-deck panels to light gauge roof trusses with self-tapping TEK stainless steel screws as follows:
 - 1. TEK Screw size: #12.
 - 2. Screw spacing: 6 inches on center, except at corners where (2) #12 screws are required at 6"oc.
- B. Fasten roof-deck panels to steel supporting members as follows:
 - 1. Provide Hilti X-HSN 24 pins at bar joist supports.
 - 2. Provide Hilti X-ENP 19 pins at structural steel supports, for steel 1/4" thick or greater.
 - 3. Fastener spacing: Within 4'-0" of perimeter fasten in a 36/7 pattern. Provide a 36/4 fastening pattern otherwise unless noted on plan.
- C. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or 36 inches (914 mm), or as noted on plans and as follows:
 - 1. Mechanically fasten with self-drilling, Hilti S-SLC 01 or approved equal, carbon-steel screws.

- D. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:
 - 1. End Joints: Lapped 2 inches (51 mm) minimum or butted at Contractor's option.
- E. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 12 inches (305 mm) apart with at least one fastener at each corner.
 - 1. Install reinforcing channels or zees in ribs to span between supports and mechanically fasten.
- F. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.
 - 1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.
- G. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Field welds will be subject to inspection.
- C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.
- D. Remove and replace work that does not comply with specified requirements.
- E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 053100

SECTION 054 000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Exterior non-load-bearing wall framing.
 - 2. Roof rafter framing.
 - 3. Soffit framing.
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for masonry shelf angles and connections.
 - 2. Section 092216 "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.
 - 1. Design Loads: As indicated.
 - 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/240 of the wall height.
 - b. Interior Non-Load-Bearing Wall Framing: Horizontal deflection of 1/240 of the wall height under a horizontal load of 5 lbf/sq. ft. (239 Pa).
 - c. Ceiling Joist Framing: Vertical deflection of 1/360 of the span.
 - 3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F (67 deg C).
 - 4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
 - a. Upward and downward movement of 3/4 inch (19 mm) at non-load bearing walls only.

- B. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."
 - 1. Headers: Design according to AISI's "Standard for Cold-Formed Steel Framing - Header Design."
 - 2. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of cold-formed steel framing product and accessory.
- B. Shop Drawings:
 - 1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
 - 2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
- C. Delegated-Design Submittal: For cold-formed steel framing.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Welding certificates.
- C. Product Test Reports: For each listed product, for tests performed by manufacturer and witnessed by a qualified testing agency.
 - 1. Steel sheet.
 - 2. Expansion anchors.
 - 3. Power-actuated anchors.
 - 4. Mechanical fasteners.
 - 5. Vertical deflection clips.
 - 6. Horizontal drift deflection clips
 - 7. Miscellaneous structural clips and accessories.
- D. Research Reports: For non-standard cold-formed steel framing, from ICC-ES.

1.6 QUALITY ASSURANCE

- A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed

for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.

- C. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- D. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- E. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
- F. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
- G. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."
 - 1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Truss Design."
 - 2. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."
- H. Preinstallation Conference: Conduct conference at Project site.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. AllSteel & Gypsum Products, Inc.
 - 2. California Expanded Metal Products Company.
 - 3. ClarkWestern Building Systems, Inc.
 - 4. Consolidated Fabricators Corp.; Building Products Division.
 - 5. Craco Mfg., Inc.
 - 6. Custom Stud Inc.
 - 7. Design Shapes in Steel.
 - 8. Dietrich Metal Framing; a Worthington Industries Company.
 - 9. Formetal Co. Inc. (The).
 - 10. MarinoWARE.

11. Nuconsteel; a Nucor Company.
12. Olmar Supply, Inc.
13. Quail Run Building Materials, Inc.
14. SCAFCO Corporation.
15. Southeastern Stud & Components, Inc.
16. State Building Products, Inc.
17. Steel Construction Systems.
18. Steel Network, Inc. (The).
19. Steel Structural Systems.
20. Steeler, Inc.
21. Super Stud Building Products, Inc.
22. Telling Industries, LLC.
23. United Metal Products, Inc.
24. United Steel Manufacturing.

B. Cold-Formed Steel Framing Design Standards:

1. Wall Studs: AISI S211.
2. Headers: AISI S212.
3. Lateral Design: AISI S213.

C. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.

D. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

1. Grade: As required by structural performance.
2. Coating: G90 (Z275).

C. Steel Sheet for Vertical Deflection Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: As required by structural performance.
2. Coating: G90 (Z275).

2.3 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 (1.09 mm).
 - 2. Flange Width: As required by design..
 - 3. Section Properties: As required by design..
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: Matching steel studs.
 - 2. Flange Width: 1-1/4 inches (32 mm).
- C. Vertical Deflection Clips: Manufacturer's standard head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. AllSteel & Gypsum Products, Inc.
 - b. ClarkWestern Building Systems, Inc.
 - c. Dietrich Metal Framing; a Worthington Industries company.
 - d. MarinoWARE.
 - e. SCAFCO Corporation.
 - f. Steel Network, Inc. (The).
 - g. Steeler, Inc.
- D. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
 - 1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
 - a. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
 - b. Flange Width: 1 inch (25 mm) plus the design gap of 3/4 inch.
 - 2. Inner Track: Of web depth indicated, and as follows:
 - a. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
 - b. Flange Width: 2 ¾ inches.

2.4 ROOF-RAFTER FRAMING

- A. Steel Rafters: Manufacturer's standard C-shaped steel sections, of web depths indicated, unpunched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
2. Flange Width: As required by design.
3. Section Properties: As required by design.

- B. Built-up Members: Built-up members of manufacturer's standard C-shaped steel section, with stiffened flanges, nested into a U-shaped steel section joist track, with unstiffened flanges; unpunched; of web depths indicated; and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
2. Flange Width: As required by design.

2.5 SOFFIT FRAMING

- A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
2. Flange Width: 1-5/8 inches (41 mm), minimum.
3. Section Properties: As required by design.

2.6 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers and knee braces.
9. Joist hangers and end closures.
10. Hole reinforcing plates.
11. Backer plates.

2.7 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

- B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.

- C. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.
- D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
- E. Mechanical Fasteners: ASTM C 1513, stainless steel, self-drilling, self-tapping, steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
- F. Welding Electrodes: Comply with AWS standards.

2.8 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B.
- B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107/C 1107M, with fluid consistency and 30-minute working time.
- D. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.9 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.

4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.6 mm).
- D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
 1. Cut framing members by sawing or shearing; do not torch cut.
 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

- b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- H. Install insulation, specified in Section 072100 "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.
- J. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
 - 1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.3 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 top and bottom track unless otherwise indicated. Space studs as follows:
 - 1. Stud Spacing: As indicated.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 - 1. Install double deep-leg deflection tracks and anchor outer track to building structure.
 - 2. Connect vertical deflection clips to infill studs and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.

1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.4 JOIST INSTALLATION

- A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.
- B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm).
 2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated on Shop Drawings.
- C. Space joists not more than 2 inches (51 mm) from abutting walls, and as follows:
1. Joist Spacing: As indicated.
- D. Frame openings with built-up joist headers consisting of joist and joist track, 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.
1. Install web stiffeners to transfer axial loads of walls above.
- 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.
 2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.
- G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.
- H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.5 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Remove and replace work where test results indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 06 10 00

ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Rough Carpentry work required to facilitate installation of new roof assembly including:
1. Provide pressure treated wood blocking and plywood sheathing.
 2. Re-securement of existing rough carpentry to remain in place.
 3. Removal and replacement of damaged, rotted or deteriorated rough carpentry with pressure treated rough carpentry to match existing.

1.02 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section, including but not limited to:
- | | | |
|----|----------------------------------|------------------|
| 1. | Roof Insulation | Section 07 22 16 |
| 2. | Thermoplastic Single Ply Roofing | Section 07 54 00 |
| 3. | Sheet Metal Flashing and Trim | Section 07 62 00 |

1.03 REFERENCES

- A. Refer to the following references, current edition for specification compliance:
1. NC State Building Code
 2. American Society for Testing and Materials (ASTM)
 3. American Wood-Preserver's Association (AWPA)
 - a. AWPA E12 - Standard Method of Determining the Corrosion of Metal in Contact with Wood.
 - b. AWPA M4 - Standard for the Care of Preservative Treated Wood Products.
 - c. AWPA P5 - Standard for Waterborne Preservatives.
 - d. AWPA P25 - Standard for Inorganic Boron (SBX).
 - e. AWPA P26 - Standard for Alkaline Copper Quat Type A (ACQ-A).
 - f. AWPA P27 - Standard for Alkaline Copper Quat Type B (ACQ-B).
 - g. AWPA P28 - Standard for Alkaline Copper Quat Type C (ACQ-C).
 - h. AWPA P29 - Standard for Alkaline Copper Quat Type D (ACQ-D).
 - i. AWPA P47 - Standard for DCOI/Imidacloprid/Stabilizer, Waterborne (EL2).
 - j. AWPA P48 - Standard for Copper Azole Type C (CA-C).
 - k. AWPA T1 - Use Category System: Processing and Treatment Standard.
 - l. AWPA U1 - Use Category System: User Specification for Treated Wood.
 4. American Plywood Association (APA)
 5. American National Standard
 - a. ANSI/SPRI ES-1 Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems

6. Underwriters Laboratories, Inc. (UL)
7. FM Global/Factory Mutual Research (FM)

1.04 DEFINITIONS

- A. Rough Carpentry includes carpentry work not specified as part of other Sections and generally not exposed.
- B. KDAT: Kiln Dried After Treatment.

1.05 SUBMITTALS

- A. Refer to Section 01 33 00-Submittal Procedures for Submittals.
- B. Manufacturer's Product Data Sheets for all materials specified certifying material complies with this specification.

1.06 QUALITY ASSURANCE

- A. Contractor shall inspect wood to be installed for damage, warping, splits, and moisture content as defined by the applicable wood products industry standards. Materials that do not comply shall be rejected.
- B. Rough carpentry installation shall present a smooth, consistent substrate for roof system and flashing installation.
- C. Qualifications of workers: Provide sufficient, competent and skilled carpenters in accordance with accepted practices and supervisors who shall be present at all times during execution of this portion of the work, and who shall be thoroughly familiar with type of construction involved in this section and related work and techniques specified.
- D. Moisture Content:
 1. Treated wood products shall be KDAT.
 2. Treated lumber used in the roofing assembly shall not be stored or installed in a manner exposing it to rain.
 3. Moisture content of treated lumber shall be 19 percent or less before being covered/enclosed into roofing assembly.
 4. Contractor shall be responsible for ensuring lumber is delivered, stored and installed at 19% or less moisture content.
 5. Plywood shall be 18% or less before being covered/enclosed into roofing assembly.
- E. Each piece of treated lumber and plywood shall bear the stamp of the AWP Quality Mark, indicating compliance with the requirements of the AWP Quality Control Program.
- F. Lumber Standards: Comply with PS 20 and applicable rules of respective grading and inspecting agencies for species and products indicated.
- G. Plywood Product Standards: Comply with PS 1 (ANSI A 199.1) or, for products not manufactured under PS 1 provisions, with applicable APA Performance Standard for type of panel indicated.

- H. Installation of all required new rough carpentry for roofing and flashing terminations to ensure plumb, uniform and level metal flashings.
- I. Rough carpentry installation shall ensure roof membrane flashing transitions are smooth for complete roof drainage and appearance.
- J. Installation of all fasteners and associated materials to secure rough carpentry as detailed and specified.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces. Store a minimum of four inches above ground on framework or blocking. Stack lumber as well as plywood and other panels; provide for air circulation within and around stacks. Cover with protective waterproof covering providing for adequate air circulation and ventilation
- B. Exposure to precipitation during shipping, storage or installation shall be avoided. If material does become wet, it shall be replaced or permitted to dry prior to covering or enclosure by other roofing, sheet metal or other construction materials (except for protection during construction).
- C. Immediately upon delivery to job site, place materials in area protected from weather.
- D. Do not store seasoned materials in wet or damp portions of building.
- E. Protect sheet materials from corners breaking and damaging surfaces, while unloading.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Lumber: Shall Be No. 2 or better spruce or southern yellow pine. Shall be sound, thoroughly seasoned, dressed to nominal finish dimension, and free of warpage, cupping, and bowing. Dimensions shall be determined by job conditions or as indicated in detail drawings.
- B. Plywood Sheathing: Shall be structural 1 rated. Plywood shall be stamped APA RATED SHEATHING grade-C or better, and shall be manufactured with exterior glue (exposure 1). Plywood shall have a minimum thickness of 3/4 inch or as required to match existing.
- C. Preservative Treatment for Above Ground Use:
 - 1. Treatment: ACQ as manufactured for Viance in accordance with AWPA U1 and P5, P26, P27, P28, P29 as appropriate.
 - a. Use 0.15 lb/cu ft (2.4 kg/m3) of ACQ in accordance with AWPA U1: (UC3B) as appropriate.
 - 2. Treatment: Ecolife or EL2 as manufactured by Viance.
 - a. Use 0.019 lb/cu ft (0.3 kg/m3) of Ecolife or EL2 (+ 0.2 lb/cu ft MCS) in accordance with AWPA U1 (UC3B) as appropriate.

3. Treat wood in the following locations:
 - a. In contact with roofing, flashing, or waterproofing.
 - b. In contact with masonry or concrete.
 - c. Within 18 inches (450 mm) of grade.
 - d. Exposed to weather.
 - e. Other locations indicated.

2.02 FASTENERS

A. General:

1. All fasteners shall be stainless steel or as approved by Engineer.
2. Fasteners securing pressure treated lumber shall be manufactured for corrosion resistance and exposures associated with pressure treated wood applications.
3. Nails shall not be used at roof edges to fasten rough carpentry, lumber, plywood, etc. Screws, anchors, and/or machine bolts shall be used to secure rough carpentry at roof perimeter edges.
4. Masonry screws, spikes, and drive-pins shall not be used to fasten edge/perimeter nailers to concrete decks. Minimum 1/2" diameter anchors or bolts shall be used to secure roof edge nailers to concrete substrates.

B. Wood to steel deck and light gage steel framing (16-ga. or less):

1. Shall be #14-13 DP1, pancake or panhead, corrosion resistant, ASTM A153, FM Approved, self-drilling and self-tapping screw, length to provide minimum 3 pitches of thread through metal thicknesses. Acceptable manufacturers include:
 - a. ITW Buildex Teks
 - b. Concealor®
 - c. Blazer
 - d. SFS Intec
 - e. Engineers accepted equivalent.

C. Wood to wood:

1. Screws: No. 10 or greater, stainless steel wood screws with flat head, or insulation screws. Length to embed into base substrate a minimum of 1-1/2".
2. Nails: 8, 10 or 16 penny, stainless steel, ring shank nails. Length to embed into base substrate a minimum 1-1/2". Acceptable manufacturers include:
 - a. Maze Nails
 - b. Anchor Staple and Nail
 - c. Swan Secure Products
 - d. Manasquan Premium Fasteners
 - e. Engineers accepted equivalent.

D. Wood to brick, concrete block, other masonry units, and solid concrete substrates:

1. Epoxy adhesive anchoring system: Minimum 1/2 inch diameter, corrosion resistant threaded rods supplied by the anchoring system manufacturer, length as required to provide minimum embedment as required by fastener manufacturer based upon substrate being secured. Screen for substrate provided by fastener manufacturer. Corrosion resistant nut and 1-1/2" diameter flat washer.

Acceptable manufacturers include:

- a. Hilti Hit Hy-10 Plus
- b. Powers Fasteners, Inc. AC100 Anchoring System
- c. ITW Ramset Epcon C6 Fast Curing Epoxy
- d. Engineers accepted equivalent

E. Wood to solid concrete substrates:

1. Masonry screws, 1/4 inch minimum diameter, Type 410 stainless steel with flat head. Length to provide minimum 1" embedment into substrate. Acceptable manufacturers include:
 - a. Tapcon by ITW Buildex,
 - b. KWIK-CON II by Hilti
 - c. Powers Fasteners Tapper +
 - d. Engineers accepted equivalent.
2. Sleeve-Type, or Wedge-Type, Expansion Anchor: Minimum 1/2 inch diameter, Type 304 or 316 Stainless Steel, Expansion Anchor Bolt Assembly of length as required to provide minimum embedment as required by fastener manufacturer based upon substrate being secured. Acceptable manufacturers include:
 - a. Lok/Bolt, Power Bolt or Power-Stud by Powers Fasteners
 - b. Redi-Bolt, Dynabolt or Trubolt by Red Head Anchoring Systems
 - c. Kwik Bolt by Hilti
 - d. Engineers accepted equivalent.

F. Wood to structural steel (greater than 12-GA.):

1. #12-24 DP5 (for steel thickness up to 1/2") or DP4 (for steel thickness from 1/8" to 3/8"), flat or hex head, corrosion resistant, self-drilling/self-tapping fastener of length to provide minimum 3 pitches of thread through metal thicknesses. Acceptable manufacturers include:
 - a. ITW Buildex Tek
 - b. SFS Intec
 - c. Blazer
 - d. Engineers accepted equivalent

G. Wood to Grouted Cavity:

1. Grout: High strength, non-metallic, non-shrink grout for precision grouting and general construction Conform to ASTM C476 and ASTM C 1107. Acceptable manufacturers include Commercial Grade Quikrete, Precision Grout, Kauffman SureGrout or Engineers accepted equivalent. Grout type proportioned by volume as follows:
 - a. Portland cement or blended hydraulic cement: one part.
 - b. Hydrated lime: 0 to 1/10 part.
 - c. Fine aggregate: 2-1/4 to three times sum of volumes of cement and lime used.
 - d. Coarse aggregate: one to two times sum of volumes of cement and lime used.

- e. Sum of volumes of fine and coarse aggregates: Do not exceed four times sum of volumes of cement and lime used.
- 2. Bolt: corrosion resistant threaded J bolt meeting ASTM A 307, Grade A with ASTM A 563 hex nuts and flat washers, diameter of 1/2".
- H. Toggle Bolt: Shall be 1/4" diameter toggle bolt consisting of machine screw and spring wing toggle with flat mushroom head, length as required by conditions.
- I. Washers: Fasteners heads for screws, anchors and bolts terminating at the surface of nailers shall be provided with a minimum 5/8 inch diameter, stainless steel or similar corrosion resistance flat washer provided by fastener manufacturer, unless washer is provided from factory as part of the fastener assembly.

PART 3 EXECUTION

3.01 INSPECTION

- A. Contractor shall inspect substrates to receive rough carpentry, and ensure substrates are in satisfactory condition prior to installation of rough carpentry.
- B. Contractor shall inspect all new and existing rough carpentry including fasteners for material condition before proceeding with installation. Deteriorated, rotted, damaged, split, warped, twisted or wet materials shall be removed and replaced with specified materials. Refer to Section 01 22 00-Unit Prices.
- C. Contractor shall remove old cants, tapered edge strips, debris, old fasteners, etc. that interfere with the installation of new rough carpentry.
- D. Contractor shall notify Engineer in writing of unsatisfactory conditions.
- E. Commencement of work signifies Contractor's acceptance of substrates. Any defects in roofing work resulting from such accepted substrates shall be corrected at no additional expense to the Owner.

3.02 PREPARATION

- A. Steel/Metal Substrates:
 - 1. Any pressure treated wood to contact steel or metal shall have the steel/metal coated with a heavy coating of asphalt primer.
- B. Roof Deck and Structure:
 - 1. Roof deck and structure shall be dried and broomed and/or vacuumed clean of debris and foreign matter prior to installation of the new rough carpentry.
 - 2. Contractor shall adjust substrates to receive rough carpentry to ensure completed rough carpentry installation is acceptable for roofing and sheet metal flashings.
 - 3. Steel decking shall be coated with a uniform, heavy application of asphalt primer, or separated by membrane or other acceptable means to prevent contact between steel and treated wood products.
 - 4. Treated lumber shall not make direct contact with light gage steel decking.
- C. Masonry Walls:

1. Adhesive anchors:
 - a. Contractor shall follow adhesive anchor manufacturer's published instructions for preparation and installation.
 - b. Pre-drill hole or clean-out existing gap/hole for adhesive anchors.
 - c. Use compressed air to blow-out all dust and moisture. Dust and moisture will result in failure of anchors and shall be removed before installing adhesive anchors.
2. Grouted anchors:
 - a. Contractor shall follow grout manufacturers published instructions for preparation and installation.
 - b. Clean masonry cavity and install grout stop to prevent grout from entering below the desired cavity area.

3.03 INSTALLATION

- A. Remove existing damaged or deteriorated wood blocking, nailers, and curbs and replace with new material of same dimensions.
- B. Re-secure all existing wood nailers at roof edges that are to remain. Fastener type and spacing shall comply with this specification.
- C. Install new wood blocking, nailers, and curbs to achieve a minimum eight inch flashing height above the roof membrane. Wood nailers at perimeter roof edges and expansion joints shall be installed to match insulation height. Maintain constant nailer height at perimeter edges.
- D. Wood blocking and nailers shall be installed concurrently with roof system installation. Removal of insulation and/or folding back of roof membrane to install wood blocking and nailers at a later date is not acceptable.
- E. Set rough carpentry to required levels and lines, with members plumb, true to line, material cut to fit, and braced to hold work in proper position. Use a belt sander to remove any obtrusive surface irregularities. Drive nails and spikes home; and pull bolt nuts tight with heads and washers in close contact with the wood.
- F. Fit rough carpentry to other construction; scribe and cope for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction. All joints between wood shall be installed for a smooth transition.
- G. Attachment:
 1. The Contractor shall consult the fastener manufacturer's published literature and follow the recommended requirements for pre-drilling, cleaning, placement and compatibility of substrates. Follow manufacturer's requirements for fasteners spacing, substrate preparation and substrate embedment where not specified.
 2. Securely attach rough carpentry work to substrate with fasteners. Anchor to resist a minimum force of 300 lbs/lineal foot in any direction.
 3. Rough carpentry attachment shall meet the requirements herein and that of the current FM Loss Prevention Data Sheet 1-49, Perimeter Flashing.
 4. Install bolts flush with the top surface of nailers where possible to avoid countersinking. Bolt bottom nailers then fasten upper nailers where possible.

- Countersink bolts, nuts and screws flush with wood surfaces only as detailed.
5. Install fasteners without splitting wood. Pre-drill where necessary. Split or damaged wood shall be removed, or repaired and/or re-secured to provide acceptable conditions.
 6. For anchors, pre-drill concrete and masonry units to prevent damage or cracking of the masonry. Consult fastener manufacturer's published guides. Damaged masonry shall be repaired, and fasteners shall be removed and re-installed in an acceptable location.
 7. Fastener spacing: Fasteners shall be staggered $\frac{1}{3}$ the board width and installed within 6" of each end.
 - a. Bolts, adhesive anchors, wedge and sleeve anchors, and machine bolts securing nailers shall be spaced 48 inches on center, staggered and an additional fastener within 6 inches of each end of nailer to prevent boards from twisting at board joints. Secure at 24" on center in corners (Zone 3) of the roof area.
 - b. Screws and 1/4 inch diameter anchors securing wood to concrete or masonry units shall be spaced 12 inches on center maximum, staggered, with fasteners installed at each end of nailer lengths to prevent wood from twisting at board joints.
 - c. Screws securing wood to wood shall be installed 12 inches apart, staggered, with two screws installed within 6 inches of each end of nailer lengths to prevent wood from twisting at board joints.
 - d. Screws securing wood to steel decking shall be 12 inches apart.
 - e. Self-drilling, and/or pre-drilled self-tapping screws securing wood to structural steel shall be spaced 12 inches apart, staggered, with one screw within 6 inches of each end of nailer lengths to prevent wood from twisting at board joints.
 - f. Nails securing wood to wood shall be spaced 12 inches apart, staggered, with two nails installed within 6 inches of each end of nailer lengths to prevent wood from twisting at board joints.
- H. Select fasteners of size and length that will not be exposed from the building interior and/or from the ground, or remove protruding fasteners, paint or finish to eliminate exposure.
- I. Thickness of wood nailers shall be flush with adjacent insulation and other materials. Additional fasteners shall be installed to ensure nailers are flush.
- J. Unless otherwise detailed, plywood used as blocking or shim shall be installed below dimensional lumber such that the fastener head terminates at the dimensional lumber surface.
- K. Wood nailers at roof perimeters, expansion joints, roof area dividers, etc. shall not be less than 3 feet long.
- L. When multiple nailers are installed stacked two high or more, offset nailers no less than 12" such that joints at nailer end do not line-up vertically.
- M. Each end of nailers shall be fastened with additional fasteners to ensure a smooth transition at butted joints, and to prevent warping and/or twisting.
- N. Shims:

1. The Contractor shall add plywood and lumber shims as required for the specified height and thickness.
2. Shims shall make full contact with stacked rough carpentry. Partial shim contact, and small shim pieces spaced apart are not acceptable.
3. Plywood used as blocking or shim shall be installed below dimensional lumber such that the fastener head terminates at the dimensional lumber surface.

O. Curbs:

1. Adjust wood curbs to support rooftop piping, ducts, equipment, etc.
2. Raise equipment to provide required flashing height for roofing.

3.04 CLEAN-UP

- A. The Contractor shall ensure the site and building are cleaned to meet pre-construction conditions, as accepted by the Owner.
- B. The site and building shall be free of saw dust from pressure treated lumber, fasteners and other debris.
- C. Damages to the building, grounds, equipment and site shall be repaired or replaced by the Contractor to meet pre-construction conditions, as accepted by the Owner.

END OF SECTION 06 10 00

SECTION 06 4100

ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Specially fabricated cabinet units.
- B. Hardware.

1.2 RELATED REQUIREMENTS

- A. Section 12 3600 - Countertops.

1.3 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
- B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.
- C. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Submit CAD production drawings for casework, showing plan views, elevations and sections in relation to adjacent construction. Indicate materials, component profiles, fastening methods, jointing details, and accessories.
- C. Product Data: Provide data for hardware accessories.
- D. Samples: Submit samples of manufacturer's full line of edge banding and decorative laminate colors, patterns and texture. Samples of other materials or hardware shall be made available if requested. Architect may request representative full size samples for evaluation prior to approval.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from moisture damage.

1.7 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. All materials and workmanship for this section shall carry a three (3) year warranty from date of substantial completion. This warranty is a warranty of replacement and repair only, whereby the manufacturer will correct defects in material and/or workmanship without charge. It does not warrant any products that have been abused, exposed to excessive loads or left in unconditioned air after occupancy.
- C.

1.8 FIELD CONDITIONS

- A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.1 CABINETS

- A. Quality Grade: Unless otherwise indicated provide products of quality specified by AWI/AWMAC/WI (AWS) for Custom Grade.
- B. Plastic Laminate Faced Cabinets: Custom grade.
- C. Cabinets:
 - 1. Finish - Exposed Exterior Surfaces: Decorative laminate.
 - 2. Finish - Exposed Interior Surfaces: Decorative laminate.
 - 3. Finish - Concealed Surfaces: Melamine.
 - 4. Door and Drawer Front Edge Profiles: Square edge with thick applied band.
 - 5. Casework Construction Type: Type A - Frameless.
 - 6. Interface Style for Cabinet and Door: Style 1 - Overlay; reveal overlay.
 - 7. Adjustable Shelf Loading: 50 lbs. per sq. ft.
 - 8. Cabinet Style: Flush overlay.
 - 9. Cabinet Doors and Drawer Fronts: Flush style.
 - 10. Drawer Side Construction: Multiple-dovetailed.

2.2 WOOD-BASED COMPONENTS

- A. Provide particle board and adhesives containing no added urea formaldehyde.

2.3 LAMINATE MATERIALS

- A. Manufacturers:
 - 1. Arborite; Standard and Premium Laminate: www.arborite.com.
 - 2. Formica Corporation; Formica Laminate: www.formica.com.
 - 3. Panolam Industries International, Inc\Nevamar; Nevamar HPL: www.nevamar.com.
 - 4. Wilsonart, LLC; Wilsonart High Pressure Laminate: www.wilsonart.com.
 - 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.
- C. Provide specific types as follows:
 - 1. Horizontal Surfaces: HGS, 0.048 inch (1.22 mm) nominal thickness, through color, color as selected, finish as indicated.
 - 2. Vertical Surfaces: VGS, 0.028 inch (0.71 mm) nominal thickness, through color, color as selected, finish as selected.
 - 3. Cabinet Liner: CLS, 0.020 inch (0.51 mm) nominal thickness, through color, color as selected, finish as selected.
 - 4. Laminate Backer: BKL, 0.020 inch (0.51 mm) nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

2.4 COUNTERTOPS

- A. Countertops are specified in Section 12 3600.

2.5 ACCESSORIES

- A. Adhesive: Type recommended by fabricator to suit application.
- B. Plastic Edge Banding: Extruded PVC, flat shaped; smooth finish; self locking serrated tongue; of width to match component thickness.
 - 1. Color: As selected by Architect from manufacturer's full range of colors, textures & patterns. If Architect does not find an edge banding that is an acceptable match for the selected HPL, provide HPL edge banding at no additional cost to the Owner.
 - 2. Use at all exposed plywood edges.
 - 3. Use at all exposed shelf edges.
- C. Grommets: Standard plastic grommets for cut-outs, in color to blend with adjacent surface.

2.6 HARDWARE

- A. Adjustable Shelf Supports: Standard side-mounted system using multiple holes for pin supports and coordinated self rests, satin chrome finish, for nominal 1 inch (25 mm) spacing adjustments.
- B. Fixed Americans with Disabilities Act (ADA)-Compliant Vanity and Countertop Brackets:
 - 1. Material: Steel.
 - 2. Finish: Manufacturer's standard, factory-applied powder coat.
 - 3. Color: Selected by Architect from manufacturer's standard range.
- C. Drawer and Door Pulls: "U" shaped wire pull, steel with satin finish, 4 inch centers ("U" shaped wire pull, steel with satin finish, 100 mm centers).
- D. Cabinet Locks: Keyed cylinder, two keys per lock, steel with satin finish.
- E. Drawer Slides:
 - 1. Type: Full extension with overtravel.
 - 2. Static Load Capacity: Heavy Duty grade.
 - 3. Mounting: Side mounted.
 - 4. Features: Provide self closing/stay closed type.
 - 5. Manufacturers:
 - a. Accuride International, Inc; : www.accuride.com/#sle.
 - b. Hettich America, LP: www.hettich.com/#sle.
 - c. Knappe & Vogt Manufacturing Company: www.knappeandvogt.com/#sle.
 - d. Substitutions: See Section 01 6000 - Product Requirements.
- F. Hinges: Butt self-closing type, BHMA No. Grade 1, steel with satin finish.
 - 1. Manufacturers:
 - a. Grass America Inc; Tiomos Hinge System: www.grassusa.com/#sle.
 - b. Hettich America, LP; Sensys: www.hettich.com/#sle.
 - c. Blum, Inc; CLIP top BLUMOTION: www.blum.com/#sle.
 - d. Substitutions: See Section 01 6000 - Product Requirements.

2.7 FABRICATION

- A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
- D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises.
- E. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this section.

3.2 INSTALLATION

- A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.
- B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- C. Use concealed joint fasteners to align and secure adjoining cabinet units.

3.3 ADJUSTING

- A. Adjust installed work.
- B. Adjust moving or operating parts to function smoothly and correctly.

3.4 CLEANING

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

SECTION 07 01 50

PREPARATION FOR REROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preparatory work to be completed prior to roof installation including but not limited to:
 - 1. Water test of roof drains.
 - 2. Soil pipe/overflow pipe extensions.
 - 3. Raising of mechanical units/HVAC units to meet the required minimum flashing height.

1.02 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section, including but not limited to:
 - 1. Rough Carpentry Section 06 10 00
 - 2. Roof Insulation Section 07 22 16
 - 3. Thermoplastic Single Ply Roofing Section 07 54 00

1.03 DEFINITIONS

- A. Removal: Remove and legally dispose of items except those indicated to be reinstalled, salvaged, or to remain property of the Owner.
- B. Existing to remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Engineer, items may be removed to a suitable, protected storage location during selective demolition and then cleaned and reinstalled in their original locations.
- C. Material ownership: 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.

1.04 EXISTING ROOF ASSEMBLIES*

- A. A1
 - 1. Adhered EPDM.
 - 2. ½" Wood fiber cover board.
 - 3. Tapered EPS insulation.
 - 4. 1" Fiberglass insulation.
 - 5. ½" gypsum thermal barrier.
 - 6. Steel deck.
- B. A2, A3, A5, A6
 - 1. Adhered EPDM.
 - 2. Tapered Polyisocyanurate.
 - 3. Steel deck.

- C. A4, A7, A9, A10, A11
 - 1. 4-Ply Gravel surface built up roof.
 - 2. ¾" Perlite.
 - 3. 2" Polyisocyanurate insulation.
 - 4. Steel deck.

- D. A8
 - 1. 4-Ply Gravel surface built up roof.
 - 2. ¾" Perlite.
 - 3. 2" Polyisocyanurate insulation.
 - 4. ½" gypsum thermal barrier.
 - 5. Steel deck.

*Roof system composition is based on random sampling. Contractor is responsible for verification of roof system composition.

1.05 SUBMITTALS

- A. Refer to Section 01 33 00-Submittal Procedures for Submittals.
- B. Manufacturer's Product Data Sheets for all materials specified certifying material complies with this specification.

1.06 QUALITY ASSURANCE

- A. Qualifications: Previous experience removing existing roof systems.
- B. Requirements: Contractor to comply with governing EPA regulations and hauling/disposal regulations of authorities having jurisdiction.

1.07 SCHEDULING

- A. Conduct demolition so that Owner's operations will not be disrupted. Provide 72 hours notification to Owner of activities that will affect Owner's operations.

1.08 WARRANTIES

- A. Any damage to existing items under warranty shall be repaired/replaced with materials acceptable to the Warrantor.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Steel Deck
 - 1. Refer to Specification Section 05 31 23.
- B. Soil Pipe Extensions:
 - 1. Acceptable Manufacturer:

- a. OMG Tubos
 - b. Engineers accepted equivalent
- 2. Soil Pipe Extension: Solid-wall PVC fitting consisting of pipe and splice sleeve inserts, configured for insertion and sealing to existing plumbing vent piping, sized to fit inside diameter of plumbing vent piping, enabling extension of piping to field-determined height:
 - a. Material: Solid-wall PVC, white.
 - b. Splice Sleeve Insert:
 - i. 6 inches Length at both ends of precut extension.
 - ii. Outside Diameter to be 1/4" less than outside diameter of soil pipe.
 - c. Length:
 - i. Overall Length: 28 inches.
 - ii. Net Usable Length: 16 inches excluding Splice Sleeve Inserts.
 - d. Sealant: Single-Component, Nonsag, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT, and acceptable to roofing membrane manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Survey existing conditions to determine extent of demolition.
- B. Record the conditions of items to be removed/reinstalled and items to be removed/salvaged.
- C. Contractor shall not remove any element that may result in structural deficiency or collapse of any part of the structure or adjacent structures during demolition.
- D. Contractor to inspect substrate for soundness and notify Engineer in writing of any deficiencies. Commencement of work signifies Contractor's acceptance of site conditions.

3.02 UTILITIES/SERVICES

- A. Maintain existing utilities that are to remain in service and protect them against damage during selective site demolition unless authorized in writing by the Owner and authorities having jurisdiction.
 - 1. Locate all conduits and equipment attached to the underside of the decking prior to reroofing. Insulation fastener locations are not to disturb existing conduits or interior components/equipment.
 - 2. If utilities serving occupied portions of the site must be shut down, temporary services shall be provided.
 - 3. Provide 72 hours notice to Owner if shut down is required.
 - 4. Where services are to be removed, relocated or abandoned, provide necessary bypass connections to remaining occupied buildings and areas.

3.03 PREPARATION

- A. Do not begin demolition until utilities have been disconnected/sealed and have been verified as such in writing.
- B. Do not close off or obstruct streets, walks or other adjacent occupied facilities without permission from Owner and authorities having jurisdiction.
- C. Provide safe conditions for pedestrians. Erect temporary protection such as walkways, fences, railings and canopies as required by OSHA and other governing authorities.
- D. Provide protection for adjacent building, appurtenances and landscaping to remain. Erect temporary fencing around trees to remain.
- E. Provide temporary weather protection as required to prevent water leakage and damaged to exterior or interior of adjacent structures.

3.04 POLLUTION CONTROLS

- A. Use water, mist, temporary enclosures and other suitable methods to limit the spread of dust and dirt. Comply with local EPA regulations.
 - 1. Do not use water where damage may occur or where hazardous conditions would be created such as ice or flooding.

3.05 REMOVALS

- A. Demolish and remove existing construction only to the extent required by new construction.
- B. Remove wet existing roofing, roof insulation, membrane and sheet metal and discard.
- C. Remove or correct any obstruction which might interfere with the proper application of new materials.
- D. Lift or remove all existing equipment so that existing flashings can be totally removed and new flashings installed.
- E. Remove any existing stainless counterflashing in a receiver and reinstall after recover roof system installation.
- F. Remove debris from existing materials to provide clean, dry substrate.
- G. Remove and transport debris in a manner that will prevent damage/spills to adjacent buildings and areas.
- H. Dispose of demolished items and materials on a daily basis. On-site storage of removed items is not permitted.
- I. Transport demolished materials off-site and dispose of materials in a legal manner.
- J. Perform progress inspections to detect hazards resulting from demolition activities.

3.06 FLASHING HEIGHTS

- A. Permanently raise roof top equipment as required to achieve 8” minimum flashing height.
- B. Provide additional wood blocking to top of parapet walls and expansion joints to achieve minimum 8” flashing height.
- C. Extend all existing sanitary vents to height required by the applicable Plumbing Code, but no less than 8 inches and no more than 12 inches above the finished roof system. Refer to Soil Pipe Extension as indicated below.

3.07 SOIL PIPE EXTENSION

- A. Preparation
 - 1. Remove existing flashing from plumbing vent piping to extent required to enable installation of new plumbing vent pipe extensions and completion of flashings.
 - 2. Clean plumbing vent piping to ensure that joint surfaces are clean, dry, and free from contamination including dirt, oils, grease, tar, wax, rust, and other substances that may inhibit adhesive or sealant performance.
- B. Installation
 - 1. Insert end of plumbing vent pipe extension into existing plumbing vent piping.
 - a. Verify circumference of existing plumbing vent piping and plumbing vent pipe extension is appropriate to achieve secure, rigid installation.
 - b. Mark plumbing vent pipe extension at required height above finished roof surface level, and cut to required length.
 - c. Apply adhesive or sealant to plumbing vent piping as appropriate to existing pipe material and plumbing vent pipe extension, and mate plumbing vent pipe extension to existing piping. Apply adequate adhesive or sealant to achieve secure, rigid installation.

3.08 COUNTERFLASHING PREPARATION

- A. Counterflashing to Remain: Neatly bend existing counterflashing up at walls as required to completely remove existing base flashings and to install new base flashings. After installation of new base flashings, neatly bend counterflashing back in place using sufficient care to prevent deformation to the finished counterflashing.
- B. Receiver Flashing to Remain: Neatly bend existing receiver up at walls as required to completely remove existing base flashings and counterflashings and to install new base flashings and counterflashings. After installation of new base flashings and counterflashings, neatly bend counterflashing receiver back in place using sufficient care to prevent deformation to the finished counterflashing.
- C. Saw reglet to a maximum depth of 1-1/4 inches in a straight line to allow proper installation of new counterflashings. Utilize all procedures necessary including, but not limited to, saw guides to ensure straight, clean reglets.

3.09

ROOF DRAINS AND LEADERS

- A. Prior to commencement of any work on the project the Contractor shall inspect each existing roof drain for damage and water flow.
 - 1. Each drain shall be cleaned of accumulated debris and loose granules. Drain bowl and drain outlet shall be cleaned of bitumen build-up to bare metal by hand scraping.
 - 2. A power vacuum shall be provided by the Contractor and utilized to vacuum debris, loose gravel, and bitumen scraping. Vacuum hose shall be of sufficient length to reach the first elbow in the drain line in order to vacuum the line.
 - 3. After cleaning bitumen from the drain bowl, Contractor shall inspect the bowl carefully for cracks, and the drain pipe connection for possible deterioration.
 - 4. Each drain/leader shall be water tested for proper flow utilizing a minimum 3/4-inch hose. Water shall flow into the line under maximum pressure available for a period of not less than 15 minutes. Plug piping at the first elbow.
 - 5. Inspection and testing operation shall precede any roofing tear-off. If deficiencies or damages are observed, Contractor shall record the deficiency on a Roof Plan and forward to the Engineer. The Engineer will notify the Owner's Maintenance Department accordingly. Contractor shall allow 48 hours after notification for any corrective work by the Owner.
 - 6. If no deficiencies or damages are reported to the Owner prior to commencement of work, Contractor shall assume full responsibility for the condition and operation of the drains/leaders.
- B. Roof drain lowering/sumps
 - 1. Inspect all existing drain bowls for elevation relative to top surface of roof deck.
 - 2. Remove vertical portion of drain leader and lower bowl so flange is located where indicated in Contract Drawings.

3.10

SCUPPER INSTALLATION

- A. Existing scupper locations and dimensions shall remain, but remove existing stainless scupper sleeve. Install new coated metal scupper sleeve as shown on contract drawings.
- B. Provide finished openings as indicated.

3.11

CLEANING

- A. Inspect the site daily and clean up debris and hazards at the end of each day. Adjacent roads, drives and walkways shall remain in operation and free from construction materials debris.
- B. Clean adjacent structures of dust dirt and debris. Return adjacent areas to original conditions to the satisfaction of the Owner.

END OF SECTION 07 01 50

SECTION 07 1900

WATER REPELLENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Water repellents applied to exterior, masonry surfaces.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a meeting at least one week prior to starting work; require attendance of affected installers; invite Architect and Owner.

1.3 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide product description.
- C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention; cautionary procedures required during application.
- D. Manufacturer's Field Reports: Report whether manufacturer's "best practices" are being followed; if not, state corrective recommendations. Email report to Architect the same day as inspection occurs; mail report on manufacturer's letterhead to Architect within 2 days after inspection.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.

1.4 MOCK-UP

- A. Prepare a representative surface 36 inch by 36 inch (0.91 m by 0.91 m) in size using specified materials and preparation and application methods on surfaces identical to those to be coated; approved mock-up constitutes standard for workmanship.
- B. Locate where directed.
- C. Mock-up may remain as part of the Work.

1.5 FIELD CONDITIONS

1.6 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

1.7 PART 2 PRODUCTS

1.8 MANUFACTURERS

- A. Silane, Siloxane, Silane-Siloxane Blend, and Siliconate Water Repellents:
 - 1. BASF Construction Chemicals; : www.buildingsystems.basf.com/#sle.
 - 2. Pecora Corporation; : www.pecora.com/#sle.
 - 3. PROSOCO, Inc; Siloxane WB, Basis of Design product: www.prosoco.com/#sle.
 - 4. Sherwin-Williams Company; : www.sherwin-williams.com/#sle.
 - 5. Tnemec Company, Inc; : www.tnemec.com/#sle.

1.9 MATERIALS

- A. Water Repellent: Non-glossy, colorless, penetrating, water-vapor-permeable, non-yellowing sealer, that dries invisibly leaving appearance of substrate unchanged.
 - 1. Applications: Vertical surfaces and non-traffic horizontal surfaces.
 - 2. Number of Coats: Two.
 - 3. Silane, siloxane, silane-siloxane blend, or siliconate that reacts chemically with concrete and masonry.

PART 3 EXECUTION

2.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify joint sealants are installed and cured.
- C. Verify surfaces to be coated are dry, clean, and free of efflorescence, oil, or other matter detrimental to application of water repellent.

2.2 PREPARATION

- A. Protection of Adjacent Work:
 - 1. Protect adjacent landscaping, property, and vehicles from drips and overspray.
 - 2. Protect adjacent surfaces not intended to receive water repellent.
- B. Prepare surfaces to be coated as recommended by water repellent manufacturer for best results.

2.3 APPLICATION

- A. Apply water repellent in accordance with manufacturer's instructions, using procedures and application methods recommended as producing the best results.
- B. Apply two coats, minimum.
- C. Remove water repellent from unintended surfaces immediately by a method instructed by water repellent manufacturer.
- D. Provide manufacturer's field service representative to inspect preparation and application work for at least 3 hours on first day to ensure that manufacturer's "best practices" for preparation and application are being followed.

END OF SECTION

SECTION 07 2100

INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Board insulation at cavity wall construction and at curtain walls.
- B. Batt insulation in exterior wall and soffit construction.
- C. Batt insulation for filling perimeter window and door shim spaces.
- D. Spray foam insulation for closing space between metal roof deck and top of CMU wall at locations indicated on drawings.

1.2 RELATED REQUIREMENTS

- A. Section 07 2123 - Loose-Fill Insulation: Granular and bead insulation.
- B. Section 07 2216 - Roof Insulation: Insulation specified for roofing system.
- C. Section 07 2500 - Weather Barriers: Separate air barrier materials.
- D. Section 07 4213 - Metal Wall Panels: Continuous insulation behind metal wall panels.
- E. Section 07 5400 - Thermoplastic Membrane Roofing: Insulation specified as part of roofing system.
- F. Section 07 5400 - Thermoplastic Membrane Roofing: Installation requirements for board insulation over low slope roof deck specified in this section.
- G. Section 07 8400 - Firestopping: Insulation as part of fire-rated through-penetration assemblies and as part of sealing top-of-wall conditions at exterior walls for locations indicated on drawings.

1.3 REFERENCE STANDARDS

- A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2010.
- B. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013.
- C. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014.
- D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- F. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 2012.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

1.5 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.1 APPLICATIONS

- A. Insulation Inside Masonry Cavity Walls: Mineral wool board.
- B. Insulation Over Metal Stud Framed Walls, Continuous: Mineral wool board.
- C. Insulation in exterior Metal Framed Walls and soffits: Batt insulation with no vapor retarder.
- D. Insulation in interior Metal Framed Walls: Acoustic batt insulation.
- E. Insulation to close space between metal roof deck and top of CMU wall: Spray foam insulation.

2.2 FIBERBOARD INSULATION MATERIALS

- A. Mineral Fiberboard Insulation: Rigid or semi-rigid mineral fiber, ASTM C612 or ASTM C553; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
 - 1. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 - 2. Board Thickness: 2 inches (50 mm).
 - 3. Thermal Resistance: R-value (RSI-value) of 4.2 degrees F hr sq ft/Btu (0.74 K sq m/W) per inch at 75 degrees F (24 C), minimum, when tested according to ASTM C518.
 - 4. Manufacturers:
 - a. Thermafiber, Inc; RainBarrier: www.thermafiber.com/#sle.
 - b. ROCKWOOL (ROXUL, Inc); CAVITYROCK: www.rockwool.com/#sle.
 - c. Owens Corning; ThermaFiber Rainbarrier HD: www.thermafiber.com.
 - d. Substitutions: See Section 01 6000 - Product Requirements.

2.3 BATT INSULATION MATERIALS

- A. Where batt insulation is indicated, either glass fiber or mineral fiber batt insulation may be used, at Contractor's option.
- B. Glass Fiber Batt Insulation: Friction fit, flexible preformed batt or blanket, complying with ASTM C665; friction fit.
 - 1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 - 3. Combustibility: Non-combustible, when tested in accordance with ASTM E136.
 - 4. Formaldehyde Content: Zero.
 - 5. Thickness: To match thickness of metal wall framing, R19 minimum.
 - 6. Manufacturers:
 - a. CertainTeed Corporation; : www.certainteed.com/#sle.
 - b. Johns Manville; : www.jm.com/#sle.
 - c. Owens Corning Corporation: www.ocbuildingspec.com.
 - 7. Substitutions: See Section 01 6000 - Product Requirements.

C. Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.

1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
2. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
3. Thickness: To match thickness of metal wall framing, R19 minimum when used at exterior walls.
4. Manufacturers:
 - a. Johns Manville; MinWool Sound Attenuation Fire Batts: www.jm.com/#sle.
 - b. ROCKWOOL (ROXUL, Inc); COMFORTBATT: www.rockwool.com/#sle.
 - c. ROCKWOOL (ROXUL, Inc); AFB evo™: www.rockwool.com/#sle.
 - d. Substitutions: See Section 01 6000 - Product Requirements.

2.4 SPRAY FOAM INSULATION

A. Insulating Spray Foam: Two-component closed-cell polyurethane foam, rated as an Alternative Thermal Barrier Assembly when installed exposed, without thermal barriers or ignition barriers.

1. Basis of Design Product: Preferred Solutions, Inc.; Staycell One Step 255: www.stayflex.com.
2. Manufacturers:
 - a. Substitutions: See Section 01 6000 - Product Requirements.

2.5 ACCESSORIES

- A. Insulation Fasteners: Manufacturer's recommended product for purpose intended.
- B. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
- B. Verify substrate surfaces are flat, free of irregularities or materials or substances that may impede adhesive bond.

3.2 BOARD INSTALLATION AT EXTERIOR WALLS

- A. Install boards horizontally on walls.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.3 BOARD INSTALLATION AT CAVITY WALLS

- A. Secure impale fasteners to substrate at following frequency:
 1. Six (6) per insulation board or as recommended in Manufacturer's installation instructions.
- B. Install boards to fit snugly between wall ties.
- C. Install boards horizontally on walls.

1. Butt edges and ends tightly to adjacent boards and to protrusions.
2. Place impale fastener locking discs.

D. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.4 BATT INSTALLATION

- A. Install insulation in accordance with manufacturer's instructions.
- B. Install in exterior wall spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

E. SPRAY FOAM INSTALLATION

1. Install insulation in accordance with manufacturer's instructions.
2. Schedule installation to allow required ventilation procedures without disruption of school schedule.
3. Install between roof deck at top of CMU wall without gaps.

3.5 PROTECTION

- A. Do not permit installed insulation to be wet or damaged prior to its concealment. Replace wet or damaged insulation.

END OF SECTION

SECTION 07 2123

LOOSE-FILL INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Loose-fill insulation in cells of new concrete masonry unit (CMU) walls.

1.2 RELATED REQUIREMENTS

- A. Section 04 2000 - Unit Masonry: Masonry wall system to receive loose-fill insulation.

1.3 REFERENCE STANDARDS

- A. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; 2013, Including All Amendments and Errata.
- B. ASTM C516 - Standard Specification for Vermiculite Loose Fill Thermal Insulation; 2008 (Reapproved 2013).
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- C. Certificates: Certify that products of this section meet or exceed specified requirements.
- D. Manufacturer's Installation Instructions: Indicate procedures for preparation and installation.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Vermiculite Loose-Fill Insulation: ASTM C516, vermiculite type, water repellent, fire resistant; flame spread/smoke developed index of 0/0, when tested in accordance with ASTM E84.
- B. Thermal Resistance [R-value (RSI-value)]: Provided minimum values in accordance with applicable edition of ASHRAE Std 90.1 I-P for envelope requirements of building location and climate zone.

2.2 APPLICATIONS

- A. Provide loose-fill insulation in the following application(s) as indicated on drawings:

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate and adjacent materials are dry and ready to receive insulation.
- B. Verify wall spaces are free of mortar blockage allowing for free flow of insulation.

3.2 PREPARATION

- A. Verify holes and openings have been sealed to prevent escape of insulation.

3.3 INSTALLATION

- A. Install loose-fill insulation in accordance with manufacturer's instructions.

- B. Deposit loose-fill insulation after masonry wall has sufficiently dried to manufacturer's suggested optimum moisture content prior to covering cores with bond beams or lintels.
- C. Deposit loose-fill insulation as wall is erected and completely fill spaces.

3.4 PROTECTION

- A. Place temporary signs warning workers in areas that contain loose-fill insulated walls to use caution and to prevent loss of insulation when cutting into walls.

END OF SECTION

SECTION 07 22 16

ROOF INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Mechanically fastening a ¼" gypsum cover board to the existing roof system. Installation of tapered edge strips to coping to create slope.

1.02 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section, including but not limited to:
 - 1. Summary of Work Section 00 11 00
 - 2. Thermoplastic Single Ply Roofing Section 07 54 00

1.03 REFERENCES

- A. Refer to the following references for specification compliance:
 - 1. NC State Building Code
 - 2. National Roofing Contractors Association – NRCA
 - 3. FM Global
 - 4. Underwriters Laboratories, Inc. – UL
 - 5. ASHRAE Standard 90.1

1.04 DESCRIPTION

- A. Install new rigid polyisocyanurate insulation and or cover board as shown on drawing details.

1.05 SUBMITTALS

- A. Refer to Section 01 33 00-Submittal Procedures for requirements.
- B. Manufacturer's Product Data Sheets for all materials specified certifying material complies with all specified requirements.
- C. Latest edition of the Manufacturer's current material specifications and installation instructions.

1.06 QUALITY ASSURANCE

- A. Insulation to be installed in accordance with their respective manufacturer's requirements.
- B. Insulation(s) not bearing UL label at point of delivery shall be rejected.
- C. Insulation damaged or wetted before, during, or after installation shall be removed from the job site no later than the next working day from the day such damage or moisture contamination is noted.

- D. Wind Design: Install insulation system to meet the required wind uplift pressures as specified in Section 07 54 00.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Material shall be delivered in the manufacturer's original sealed and labeled shrouds and in quantities to allow continuity application.
- B. Storage: Materials shall be stored out of direct exposure to the elements on pallets or dunnage at least 4 inches above ground level at site location acceptable to Owner.
 - 1. Utilize tarps that will completely cover materials to prevent moisture contamination. Remove or slit factory shrouds and/or visqueen; do not use these materials as tarps.
 - 2. Install vapor retarders under material storage areas located on the ground.
 - 3. Remove damaged or deteriorated materials from the job site.
- C. Handling: Material shall be handled in such a manner to preclude damage and contamination with moisture or foreign matter.

1.08 PROJECT CONDITIONS

- A. Insulation shall not be applied during precipitation. Contractor assumes all responsibility for starting installation in the event there is a probability of precipitation occurring during application.
- B. Contractor will take necessary action to restrict dust, asphalt, and debris from entering the structure.
- C. No more roofing will be removed than can be replaced with insulation, membrane and base flashings in the same day to create a watertight installation.

PART 2 PRODUCTS

2.01 MATERIALS

- 1. Gypsum Substrate/Thermal Retarder:
 - a. Shall be nonstructural, fiberglass faced, 5/8" thick, Type X, moisture resistant gypsum board, meeting the requirements of ASTM C 1396, ASTM D 3273, and ASTM C 473.
 - b. Shall be nonstructural, glass mat faced gypsum panel with 500 psi moisture resistant treated core, non-asphaltic primer surfacing, and tested in accordance with ASTM E 84 and ASTM E 136. Board Size shall be 4' by 8' and thickness shall be 5/8". Acceptable manufacturers include:
 - i. GP Gypsum DensDeck
 - ii. USG Secureck
 - iii. DEXcell Glass Mat Roof Board
- 2. Roof Insulation:
 - a. Shall be rigid polyisocyanurate roof insulation board with factory applied coated polymer bonded glass fiber mat facers on the top and bottom.

Boards to comply with ASTM C1289 Type II, Class 2, Grade 2 and meet the following requirements:

- b. Curing time shall be 24 hours minimum, plus an additional 24 hours minimum per inch thickness, at a minimum of 60 degrees F before shipment from the manufacturer.
- c. Dimensional stability shall be 2 percent maximum linear change when conditioned at 158 degrees F and 97 percent relative humidity for seven days.
- d. Maximum permissible insulation board size for mechanical attachment is 4' x 8' and for foam adhesive and hot asphalt attachment is 4' x 4'. Field cutting of larger boards is not acceptable.
- e. Thickness shall be as shown on drawings.

3. Tapered Insulation System:

- a. Shall be rigid polyisocyanurate roof insulation board with factory applied coated polymer bonded glass fiber mat facers on the top and bottom. Boards to comply with ASTM C1289 Type II, Class 2, Grade 2, and meet the following requirements:
- b. Curing time shall be 24 hours minimum, plus an additional 24 hours minimum per inch thickness, at a minimum of 60 degrees F before shipment from the manufacturer.
- c. Dimensional stability shall be 2 percent maximum linear change when conditioned at 158 degrees F and 97 percent relative humidity for seven days.
- d. Board size shall be 4 foot by 4 foot.
- e. Slope shall be as shown on drawing details.
- f. Fill Insulation: Shall be rigid polyisocyanurate meeting the above requirements with board size of 4 foot by 4 foot and thickness of 2".
- g. Crickets and Saddles: Shall be rigid polyisocyanurate meeting the above requirements with a board size of 4 foot by 4 foot and 1/2" per foot slope.

4. Cover Board: Shall be cover board approved by roof system manufacturer. Board Size shall be 4' by 8' and minimum thickness shall be as listed below or as required by roof system manufacturer. Acceptable products include:

- a. Georgia Pacific 1/2" DensDeck Roof Board
- b. Georgia Pacific 1/2" DensDeck Prime Roof Board (Vertical substrates)
- c. USG 1/2" Securock Glass-Mat Roof Board
- d. DEXcell 1/2" Glass Mat Roof Board

B. Insulation Accessories

1. Tapered Edge Strip: Shall be a closed-cell polyisocyanurate foam core integrally bonded to non-asphaltic, fiber-reinforced organic felt or inorganic coated-glass facers. Fabricated with "zero edge" to provide transitions as required by field conditions:

- a. Shall be installed at edges to make transitions as detailed in Contract Drawings.
- b. Use 2" by 24" tapered edge strips to form crickets in front of curbs wider than 12" and to provide slope transition at the outside of drainage sumps.
- c. Use 1.5" x 12".

C. Insulation Attachment Materials:

1. Steel Deck Mechanical Fasteners and Stress Plates:

Induction Fastening System:

- a. Non-membrane penetrating fastening system for installing roof insulation and thermoplastic membrane roofing.
- b. Fastening system uses same plates and fasteners to secure roof insulation and membrane roofing to roof deck or purlins without penetrating roof materials.
- c. Electromagnetic induction welding process bonds underside of membrane roofing to top of coated plates.
- d. FM Rating for Wind Uplift: Specified in thermoplastic membrane roofing section.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Contractor to inspect substrate for soundness and notify Engineer in writing of any deficiencies.
- B. Commencement of work signifies Contractor's acceptance of substrate. Any defects in roofing work resulting from such accepted substrates shall be corrected to Owner's satisfaction at no additional expense.

3.02 PREPARATION

- A. General
 1. Roof deck to be dry and broomed clean of debris and foreign matter prior to installation of insulation system.

3.03 APPLICATION

- A. General
 1. Application shall be in accordance with the insulation/membrane manufacturer's instructions and these specifications.
 2. All cover boards to be in full sheets, carefully fitted and pushed against adjoining sheets to form tight joints, unless manufacturer requires gapping. As such gaps shall be according to manufacturers requirements.
 3. Overlayment boards that must be cut to fit shall be saw cut or knife-cut in a straight line, not broken. Chalk lines shall be used to cut insulation. Uneven or broken edges are not acceptable.
 4. Remove insulation dust and debris that develops during insulation cutting operations.
 5. On steel decks, apply overlayment boards with long dimension of units across deck ribs.
 6. Crickets, saddles and tapered edge strips shall be installed before the overlayment insulation.

7. Provide necessary modifications to insulation system or nailers at roof edges as required to ensure a flush and smooth transition is provided for the roof membrane and flashing.
8. Field modifications of insulation, tapered insulation, tapered edge strips and cants shall be made by the Contractor where required to accommodate roof and flashing conditions, prevent water dams and ponding water. Ponding water at scuppers and cricket valleys shall not be accepted.
9. Provide necessary modifications to prevent standing water which is defined as 1/4" of water in a 4-square foot or larger area 24 hours or more after precipitation. See roof plan for known areas of existing poor drainage and additional cricket installation.
10. Insulation boards may require mechanical fasteners and stress plates at slope transition of crickets to minimize bridging.

B. Roof Drainage:

1. Drainage sumps shall be installed as detailed. Cut existing built up roof to accommodate sump.
2. The Contractor shall be responsible for carefully laying out the tapered insulation, sumps, drain bowls and scuppers to ensure the finished roof provides complete drainage with no standing water.
3. Contractor shall fabricate miter-cut sumps at scuppers to provide smooth transitions between the insulation system and the drains/scuppers.
4. Sumps shall ensure complete roof drainage and prevent water dams.
5. Contractor shall adjust insulation, drains and scuppers to ensure complete roof drainage and satisfactory substrates for membrane and flashings.
6. Drain sump components shall be fastened to the deck using specified insulation fasteners or adhesives.
7. Circular sumps and sumps that do not provide smooth transition or that create standing water at the drains shall be rejected and shall require removal and replacement.

C. Insulation Mechanical Attachment

1. Induction fastener quantity and spacing shall be as indicated in the Contract Drawings.
2. Induction fasteners shall be installed using manufacturer's recommended equipment and in accordance with the manufacturer's requirements.
3. Induction fasteners and stress plates shall be set secure and tight against the insulation surface, and shall not be over-driven.

END OF SECTION 07 22 16

SECTION 07 2500

WEATHER BARRIERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Air Barriers: Materials that form a system to stop passage of air through exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Vapor retarder under concrete slabs on grade.
- B. Section 07 6200 - Sheet Metal Flashing and Trim: Metal flashings installed in conjunction with weather barriers.
- C. Section 07 9200 - Joint Sealants: Sealing building expansion joints.

1.3 DEFINITIONS

- A. Weather Barrier: Assemblies that form either water-resistive barriers, air barriers, or vapor retarders.
- B. Air Barrier: Air tight barrier made of material that is relatively air impermeable but water vapor permeable, both to the degree specified, with sealed seams and with sealed joints to adjacent surfaces. Note: For the purposes of this specification, vapor impermeable air barriers are classified as vapor retarders.

1.4 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- B. ICC-ES AC148 - Acceptance Criteria for Flexible Flashing Materials; ICC Evaluation Service, Inc; 2011.
- C. ICC-ES AC212 - Acceptance Criteria for Water-Resistive Coatings Used as Water-Resistive Barriers over Exterior Sheathing; ICC Evaluation Service, Inc; 2015.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on material characteristics, performance criteria, and limitations.
- C. Shop Drawings: Provide drawings of special joint conditions.

1.6 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.

PART 2 PRODUCTS

2.1 WEATHER BARRIER ASSEMBLIES

- A. Air Barrier:
 - 1. On outside surface of inside wythe of exterior masonry cavity walls use air barrier coating.
 - 2. On outside surface of single wythe masonry and concrete exterior walls use air barrier coating.

3. On outside surface of sheathing of exterior walls use air barrier coating.

2.2 AIR BARRIER MATERIALS (WATER VAPOR PERMEABLE AND WATER-RESISTIVE)

- A. Air Barrier, Fluid Applied: Vapor permeable, elastomeric waterproofing.
 1. Air Barrier Coating:
 - a. Material: Acrylic.
 - b. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 - c. Code Acceptance: Comply with applicable requirements of ICC-ES AC212.
 - d. Sealants, Tapes and Accessories: As recommended by coating manufacturer.
 - e. Manufacturers:
 - 1) Henry Company; Air-Bloc 17MR: www.henry.com/#sle.
 - 2) Master Wall, Inc; Rollershield LAB System: www.masterwall.com/#sle.
 - 3) Parex USA, Inc; Parex USA WeatherSeal Spray & Roll-on: www.parexusa.com/#sle.
 - 4) Sto Corp; StoGuard Sto Airseal: www.stocorp.com/#sle.
 - 5) Substitutions: See Section 01 6000 - Product Requirements.

2.3 ACCESSORIES

- A. Sealants, Tapes, and Accessories for Sealing Weather Barrier and Sealing Weather Barrier to Adjacent Substrates: As specified or as recommended by weather barrier manufacturer.
- B. Flexible Flashing: Sheathing fabric saturated with air barrier coating and complying with the applicable requirements of ICC-ES AC148.
- C. Liquid Flashing: One part, fast curing, non-sag, elastomeric, gun grade, trowelable liquid flashing.
- D. Thinners and Cleaners: As recommended by material manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces and conditions are ready to accept the work of this section.

3.2 PREPARATION

- A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.
- B. Clean and prime substrate surfaces to receive adhesives and sealants in accordance with manufacturer's instructions.

3.3 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Air Barriers: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.
- C. Apply sealants and adhesives within recommended application temperature ranges. Consult manufacturer if temperature is out of this range.
- D. Coatings:

1. Prepare substrate in manner recommended by coating manufacturer; treat joints in substrate and between dissimilar materials as recommended by manufacturer.
2. Where exterior masonry veneer is to be installed, install masonry anchors before installing weather barrier over masonry; seal around anchors air tight.
3. Mastic Coating: Install by trowel or roller to manufacturer's recommended minimum thickness; use sheet seal to join to adjacent construction, seal air tight with sealant.
4. Use flashing to seal to adjacent construction and to bridge joints.

E. Openings and Penetrations in Exterior Weather Barriers:

1. Install flashing over sills, covering entire sill frame member, extending at least 5 inches (125 mm) onto weather barrier and at least 6 inches (150 mm) up jambs; mechanically fasten stretched edges.
2. At openings to be filled with non-flanged frames, seal weather barrier to each side of opening framing, using flashing at least 9 inches (230 mm) wide, covering entire depth of framing or as indicated on drawings.
3. At head of openings, install flashing under weather barrier extending at least 2 inches (50 mm) beyond face of jambs; seal weather barrier to flashing.
4. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.
5. Service and Other Penetrations: Form flashing around penetrating item and seal to weather barrier surface using manufacturer's recommended details.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.

3.5 PROTECTION

- A. Do not leave materials exposed to weather longer than recommended by manufacturer.

END OF SECTION

SECTION 07 4213

METAL WALL PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Manufactured metal panels for walls and soffits, with insulation, related flashings, and accessory components.

1.2 RELATED REQUIREMENTS

- A. Section 05 4000 - Cold-Formed Metal Framing: Wall panel substrate.
- B. Section 07 2100 - INSULATION: Product information for continuous insulation to be provided as part of metal wall panel work specified in this section.
- C. Section 07 2500 - Weather Barriers: Weather barrier under wall panels.
- D. Section 07 9200 - Joint Sealants: Sealing joints between metal wall panel system and adjacent construction.

1.3 REFERENCE STANDARDS

- A. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2010 (Reapproved 2015).

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate dimensions, layout, joints, construction details, and methods of anchorage. Work to include two colors, indicate extents of panel colors, coordinated with architectural drawings. Document compliance with design loads.
- C. Samples: Submit two samples of wall panel and soffit panel, 12 inch (305 mm) by 12 inch (305 mm) in size illustrating finish colors, sheen, and texture.
- D. Manufacturer's Qualification Statement.
- E. Installer's Qualification Statement.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in installing products of the type specified in this section with minimum three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.
- B. Store prefabricated material off the ground and protected from weather; prevent twisting, bending, or abrasion; provide ventilation; slope metal sheets to ensure proper drainage.
- C. Prevent contact with materials that may cause discoloration or staining of products.

1.7 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

- B. Correct defective work within a 20 year period after the Date of Substantial Completion for degradation of panel finish, including color fading caused by exposure to weather.
- C. Correct defective work within a five year period after Date of Substantial Completion, including defects in water tightness and integrity of seals.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:

1. AEP Span; Wall Panel: TW-12; Soffit Panel: Flush Panel: www.aepspan.com.
2. Centria; Wall Panel: CS-260; Soffit Panel: IW-10A: www.centria.com.
3. Firestone; Wall Panel: Delta CFP-12F; Soffit Panel: UC Flush: www.firestonebpc.com.
4. Morin; Wall Panel: X-12; Soffit Panel: F-12-S: www.morincorp.com.
5. Petersen Aluminum Corporation; Wall Panel: PAC Precision Series HWP; Soffit Panel: Flush: www.pac-clad.com.

2.2 MANUFACTURED METAL PANELS

A. Wall Panel System: Factory fabricated prefinished metal panel system, site assembled.

1. Provide exterior panels, soffit panels, and subgirt framing assembly.
2. Design and size components to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of wall.
3. Design Pressure: In accordance with project structural drawings.
4. Maximum Allowable Deflection of Panel: 1/180 of span.
5. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing.
6. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
7. Fabrication: Formed true to shape, accurate in size, square, and free from distortion or defects; pieces of longest practical lengths.

B. Exterior Wall Panels:

1. Profile: Horizontal; style as indicated.
2. Side Seams: Batten-covered, sealed with continuous gaskets.
3. Material: Precoated steel sheet, 22 gage, 0.0299 inch (0.76 mm) minimum thickness.
4. Panel Width: 12 inches (305 mm).
5. Panel Length: As indicated on drawings.
6. Color: Two colors, as indicated on drawings, and as selected by Architect from manufacturer's full line of solid colors.

C. Soffit Panels:

1. Profile: Flush.
2. Material: Precoated steel sheet, 22 gage, 0.0299 inch (0.76 mm) minimum thickness.

- 3. Color: Two colors, as indicated on drawings, and as selected by Architect from manufacturer's full line.
- D. Subgirt Framing Assembly:
 - 1. Hat or Zee profile, 7/8 to 1 inch thick, galvanized, to attach panel system to building.
- E. Trim, Closure Pieces, Caps, Flashings, and Infills: Same material, thickness and finish as exterior sheets; brake formed to required profiles.
- F. Anchors: Galvanized steel or Stainless steel.

2.3 MATERIALS

- A. Precoated Steel Sheet: Aluminum-zinc alloy-coated steel sheet, ASTM A792/A792M, Commercial Steel (CS)) or Forming Steel (FS), with AZ50/AZM150 coating; continuous-coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating.
- B. Insulation: Mineral Fiber type specified in Section 07 2100.

2.4 FINISHES

- A. Exposed Surface Finish: Panel manufacturer's standard polyvinylidene fluoride (PVDF) coating, top coat over epoxy primer.
- B. Panel Backside Finish: Panel manufacturer's standard siliconized polyester wash coat.

2.5 ACCESSORIES

- A. Gaskets: Manufacturer's standard type suitable for use with system, permanently resilient; ultraviolet and ozone resistant.
- B. Fasteners: Manufacturer's standard type to suit application; stainless steel or hot dip galvanized.
 - 1. Metal-to-Metal Fasteners: Self-drilling, self-tapping screws.
- C. Field Touch-up Paint: As recommended by panel manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that building framing members are ready to receive panels.
- B. Verify that weather barrier has been installed over substrate completely and correctly.

3.2 INSTALLATION

- A. Install panels on walls and soffits in accordance with manufacturer's instructions.
- B. Fasten panels to structural supports; aligned, level, and plumb.
- C. Use concealed fasteners unless otherwise approved by Architect.
- D. Seal and place gaskets to prevent weather penetration. Maintain neat appearance.

3.3 TOLERANCES

- A. Maximum Offset From True Alignment Between Adjacent Members Butting or In Line: 1/16 inch (1.6 mm).
- B. Maximum Variation from Plane or Location Indicated on Drawings: 1/4 inch (6.4 mm).

3.4 CLEANING

- A. Remove site cuttings from finish surfaces.
- B. Remove protective material from wall panel surfaces.

END OF SECTION

SECTION 07 4646

FIBER-CEMENT SIDING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fiber-cement soffit panels.

1.2 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Soffit substrate.
- B. Section 07 2500 - Weather Barriers: Weather barrier under siding.
- C. Section 07 9200 - Joint Sealants: Sealing joints between siding and adjacent construction and fixtures.
- D. Section 09 9113 - Exterior Painting: Field painting.

1.3 REFERENCE STANDARDS

- A. ASTM C1186 - Standard Specification for Flat Fiber Cement Sheets; 2008 (Reapproved 2012).

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturer's data sheets on each product to be used, including:
 - 1. Manufacturer's requirements for related materials to be installed by others.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Installation methods, including nail patterns.
- C. Warranty: Submit copy of manufacturer's warranty, made out in Owner's name, showing that it has been registered with manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store products under waterproof cover and elevated above grade, on a flat surface.

PART 2 PRODUCTS

2.1 FIBER-CEMENT SIDING

- A. Soffit Panels: Panels made of cement and cellulose fiber formed under high pressure with integral surface texture, complying with ASTM C1186, Type A, Grade II; with machined edges, for nail attachment.
 - 1. Texture: Smooth.
 - 2. Length: 96 inches (2400 mm), nominal.
 - 3. Width: 48 inches (1220 mm).
 - 4. Thickness: 5/16 inch (8 mm), nominal.
 - 5. Finish: Unfinished.
 - 6. Manufacturer: Same as siding.
 - a. Allura, a division of Plycem USA, Inc; Smooth Soffit: www.allurausa.com/#sle.
 - b. James Hardie Building Products, Inc; HardieSoffit: www.jameshardie.com/#sle.

- c. Nichiha USA, Inc; NichiSoffit: www.nichiha.com/#sle.
- d. Substitutions: See Section 01 6000 - Product Requirements.

2.2 ACCESSORIES

- A. Battens and Trim: Same material and texture as soffit, 3/4 inch by 2-1/2 inch nominal.
- B. Fasteners: Galvanized or corrosion resistant; length as required to penetrate minimum 1-1/4 inch (32 mm).

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrate, clean and repair as required to eliminate conditions that would be detrimental to proper installation.
- B. Do not begin until unacceptable conditions have been corrected.
- C. If substrate preparation is responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions and recommendations.
 - 1. Read warranty and comply with terms necessary to maintain warranty coverage.
 - 2. Use trim details indicated on drawings.
 - 3. Touch up field cut edges before installing.
 - 4. Pre-drill nail holes if necessary to prevent breakage.
- B. Allow space for thermal movement between both ends of siding panels that butt against trim; seal joint between panel and trim with specified sealant.
- C. After installation, seal joints except lap joints of lap siding; seal around penetrations, and paint exposed cut edges.
- D. Finish Painting: Refer to Section 09 9113.

3.3 PROTECTION

- A. Protect installed products until Date of Substantial Completion.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 07 54 00

THERMOPLASTIC SINGLE-PLY ROOFING

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Install a mechanically attached through induction welding, thermoplastic membrane and flashings to provide a permanently watertight system.

1.02 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section, including but not limited to:
 - 1. Rough Carpentry Section 06 10 00
 - 2. Preparation for Reroofing Section 07 01 50
 - 3. Roof Insulation Section 07 22 16
 - 4. Sheet Metal Flashing and Trim Section 07 62 00

1.03 REFERENCES

- A. Refer to the following references, current edition for specification compliance:
 - 1. NC State Building Code
 - 2. ASTM International
 - 3. National Roofing Contractors Association (NRCA)
 - 4. Underwriters Laboratory (UL)
 - 5. FM Global
 - 6. Single Ply Roofing Institute

1.04 SUBMITTALS

- A. Refer to Section 01 33 00-Submittal Procedures for Submittals.
- B. Latest edition of the Manufacturer's current material specifications and installation instructions.
- C. Manufacturer's Product Data Sheets for all materials specified certifying material complies with all specified requirements.
- D. Submit documentation of approved, tested roof system to meet the specified requirements for the following:
 - 1. Wind uplift pressures
 - 2. UL Fire Resistance Rating

1.05 DELIVERY, STORAGE AND HANDLING

- A. All products delivered to the job site shall be in the original unopened containers or wrappings bearing all seals and approvals.
- B. Handle all materials to prevent damage. Place all materials on pallets and fully protect from moisture.

- C. Membrane rolls shall be stored lying down on pallets and fully protected from the weather with clean canvas tarpaulins. Unvented polyethylene tarpaulins are not accepted due to the accumulation of moisture beneath the tarpaulin in certain weather conditions that may affect the ease of membrane weldability.
- D. All adhesives shall be stored at temperatures approved for the product.
- E. All flammable materials shall be stored in a cool, dry area away from sparks and open flames. Follow precautions outlined on containers or supplied by material manufacturer/supplier.
- F. All materials which are determined to be damaged by the Engineer or membrane manufacturer are to be removed from the job site and replaced at no cost to the Owner.

1.06 PROJECT CONDITIONS

- A. Roofing shall not be applied during precipitation. Contractor assumes all responsibility for starting installation in the event there is a probability of precipitation occurring during application.
- B. Only as much of the new roofing as can be made weathertight each day, including all flashing and detail work, shall be installed. All seams shall be cleaned and heat welded before leaving the job site that day.
- C. All work shall be scheduled and executed without exposing the interior building areas to the effects of inclement weather. The existing building and its contents shall be protected against all risks.
- D. All surfaces to receive new insulation, membrane or flashings shall be dry. Should surface moisture occur, the Applicator shall provide the necessary equipment to dry the surface prior to application.
- E. All new and temporary construction, including equipment and accessories, shall be secured in such a manner as to preclude wind blow-off and subsequent roof or equipment damage.
- F. Uninterrupted waterstops shall be installed at the end of each day's work and shall be completely removed before proceeding with the next day's work. Waterstops shall not emit dangerous or unsafe fumes and shall not remain in contact with the finished roof as the installation progresses. Contaminated membrane shall be replaced at no cost to the Owner.
- G. Arrange work sequence to avoid use of newly constructed roofing as a walking surface or for equipment movement and storage. Where such access is absolutely required, the Applicator shall provide all necessary protection and barriers to segregate the work area and to prevent damage to adjacent areas. A protection layer of plywood over insulation board shall be provided for all new and existing roof areas that receive rooftop traffic during construction.
- H. Prior to and during application, all dirt, debris and dust shall be removed from surfaces, either by vacuuming, sweeping, blowing with compressed air and/or similar methods.
- I. Contaminants, such as grease, fats, oils, and solvents, shall not be allowed to come into contact with the roofing membrane. All rooftop contamination that is anticipated or that is occurring shall be reported to the Engineer and membrane manufacturer to determine the corrective steps to be taken.

- J. If any unusual or concealed condition is discovered, the contractor shall stop work, notify Owner of such condition immediately, and in writing within 24 hours.
- K. The roofing membrane shall not be installed under the following conditions without consulting the membrane manufacturer's technical department for precautionary steps:
 - 1. The roof assembly permits interior air to pressurize the membrane underside.
 - 2. Any exterior wall has 10% or more of the surface area comprised of opening doors or windows.
 - 3. The wall/deck intersection permits air entry into the wall flashing area.
- L. Precautions shall be taken when using membrane adhesives at or near rooftop vents or air intakes. Adhesive odors could enter the building. Coordinate the operation of vents and air intakes in such a manner as to avoid the intake of adhesive odor while ventilating the building. Keep lids on unused cans at all times.

1.07 QUALITY ASSURANCE

- A. Manufacturer Requirements:
 - 1. Manufacturer must have written contractor/installer approval program.
 - 2. Products manufactured by other manufacturers and private labeled are not acceptable.
 - 3. See materials section for general product description and specified requirements.
- B. Contractor Requirements:
 - 1. This roofing system shall be applied only by a Contractor authorized by the membrane manufacturer prior to bid.
 - 2. Application of the roofing system shall be accomplished by a primary roofing contractor, his roofing foreman, and sufficient applicator technicians who all have been trained and approved by the manufacturer of the single ply roofing system. Contractor to submit evidence of qualification from the manufacturer.
- C. Upon completion of the installation an inspection shall be made by a representative of the membrane manufacturer to review the installed roof system and list all deficiencies.
- D. There shall be no deviation made from the Contract Documents or the approved shop drawings without prior written approval by the Engineer.
- E. All work shall be completed by personnel trained and authorized by the membrane manufacturer.
- F. Contractor to provide manufacturer written verification indicating all seams have been probed and are watertight.
- G. Install roofing system to meet UL 790 Class A Fire Rating.
- H. Wind Design:
 - 1. Install roofing system to meet or exceed the requirements of the current adopted version of ASCE-7, and shall be an approved assembly tested to the wind uplift pressures listed below:
 - a. Field of Roof: - 41 psf.

- b. Perimeter of Roof: - 69 psf.
- c. Corner of Roof: - 104 psf.

1.08 WARRANTIES

- A. Manufacturer's Guarantee: Manufacturer's standard form, non pro-rated, without monetary limitation or deductibles, in which manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period. Failure includes roof leaks or breaches in the primary roof membrane causing moisture to enter the substrate below (even if visible leaks are not observed inside the facility). Warranty to remain in effect for wind speeds up to 72 mph. Warranties requiring the Owner's signature will not be acceptable.
 - 1. Warranty to include but not be limited to membrane, insulation, adhesives, fasteners, sealants, flashings, polymer clad sheet metal, etc.
 - 2. Warranty Period: Twenty years from date of Substantial Completion.
 - 3. Manufacturer's Representative shall attend two post construction field inspections: the first no earlier than twenty -three (23) months and no later than twenty-four (24) months after the date of Substantial Completion and the second no earlier than fifty-nine (59) months and no later than sixty (60) months. Submit a written report within seven (7) days of the site visits to the Engineer listing observations, conditions and any recommended repairs or remedial action.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Membrane materials shall be manufactured by the following:
 - 1. Soprema
 - 2. Fibertite
 - 3. Carlisle Syntec

2.02 MEMBRANE MATERIALS

- A. Mechanically Attached Membrane and Components:
 - 1. Membrane
 - a. Soprema, Sentinel P150 60 mil
 - b. Fibertite 45 mil SM
 - c. Carlisle Sure-Flex PVC 60 mil Membrane
- B. Mechanically Attached Membrane and Components:
 - 1. Coverstrip: Shall be 8" wide pre-cut polyester reinforced flashing strip.
 - 2. Plates: Specifically designed for induction welding process
 - a. Secures roof insulation and PVC membrane roofing.
 - b. Type:
 - i. PVC-Type Plates:
 - (a) Coated with adhesive formulated for PVC membrane roofing.
 - (b) Color: Black.
 - c. Diameter: 3 inches.

- d. Thickness: 22 gauge.
 - e. Material: Coated Galvalume.
 - f. Coating Corrosion Resistance: Meets FM Approval Standard 4470 criteria.
 - g. Profile: Recessed center and raised flat bonding surface.
3. Fasteners: #15 HD Fastener:
- i. Secures roof materials to 22-gauge minimum steel deck.
 - ii. Head:
 - (a) #3 Phillips truss head.
 - (b) Diameter: 0.435 inch.
 - iii. Thread Diameter: 0.275 inch.
 - iv. Shank Diameter: 0.202 inch.
 - v. Length: Sufficient length to penetrate steel deck at top flute a minimum of 1 inch.
 - vi. Drill point.
 - vii. Heat treated.
 - viii. Coating: OMG Roofing Products "CR-10" corrosion-resistant coating.
 - ix. Coating Corrosion Resistance: Meets FM Approval Standard 4470 criteria.
 - x. FM approved.

2.03 RELATED MATERIALS

- A. Flashing/Stripping Membrane: Shall be a non fleeceback, thermoplastic membrane reinforced with fiberglass. Utilize asphalt resistant flashing membrane where in contact with residual asphaltic materials or as required by the manufacturer.
- 1. Soprema 60 mil P150
 - 2. Fibertite 45 mil SM
 - 3. Carlisle Sure-Flex KEE HP 60 mil Membrane
- B. Flashing Adhesive: Shall be membrane manufacturer's solvent based adhesive.
- 1. Soprema Sentinal S Bonding Adhesive
 - 2. Fibertite FTR 190e
 - 3. Carlisle Sure-Flex PVC Low VOC Bonding Adhesive
- C. T-joint Patch: Shall be membrane manufacturer's circular patch welded over T-joints formed by overlapping thick membranes.
- D. Corner Flashing: Shall be membrane manufacturer's pre-formed inside and outside flashing corners that are heat-welded to membrane or polymer clad metal base flashings.
- E. Pipe Flashing: Shall be membrane manufacturer's pre-formed pipe boot flashing that is heat-welded to membrane and secured with a stainless steel draw band and sealant.
- F. Termination Bar: Shall be manufacturer's 1/8" by 1" mill finish extruded aluminum bar with pre-punched slotted holes.
- G. Counterflashing Bar: Shall be a prefabricated extruded aluminum metal counterflashing and termination bar. 0.10"-0.12" thick bar with 2-1/4" profile, pre-drilled holes 8" on center and sealant kick out at top edge.
- H. Sealant: Shall be manufacturer's multi-purpose sealant.

- I. Fasteners:
 - 1. Flashing Membrane Termination Screws: #12 stainless steel hex or pan head screws with length to penetrate substrate a minimum of 1-1/2".
 - 2. Concrete and Masonry Flashing Membrane Termination Anchors:
 - a. 1/4" diameter metal based expansion anchor with stainless steel pin of length to penetrate substrate a minimum of 1-1/2".
 - b. Masonry screws, approved by membrane manufacturer, 1/4 inch minimum diameter, corrosion resistant, with Phillips flat head. Length to provide minimum 1-1/2" embedment into substrate.
- J. Primary Membrane Cleaner: Shall be a high quality solvent cleaner provided by membrane manufacturer and approved by engineer for use as a general membrane cleaner.
- K. Pre-weld Cleaner: Shall be a high quality solvent based seam cleaner with moderate evaporation rate provided by membrane manufacturer.
- L. Walkway Pad: Shall be walkway pad by manufacturer of membrane.
- M. Pre-Fabricated Expansion Joint: Shall be manufacturer's approved pre-fabricated expansion joint made with polyester reinforced membrane, neoprene foam and galvanized metal.
- N. Polymer Clad Metal: Refer to Section 07 62 00-Sheet Metal Flashing and Trim

PART 3 EXECUTION

3.01 SUBSTRATE PREPARATION

- A. Verify that the substrate is dry, clean, smooth, and free of loose material, oil, grease, or other foreign matter. Sharp ridges and other projections and accumulations of bitumen shall be removed to ensure a smooth surface before roofing. Slit all existing mole runs and blisters and hot air weld cap sheet to base ply.
- B. Asphalt roofing substrates shall be removed, covered, or flashed using compatible, approved materials. PVC shall not come in contact with substrates containing asphalt materials.
- C. Any deteriorated substrate shall be repaired.
- D. Beginning installation means acceptance of prepared substrate.
- E. Provide necessary protection from adhesive vapors to prevent interaction with foamed plastic insulation.

3.02 MEMBRANE INSTALLATION (SCREWS AND INDUCTION PLATES)

- A. Lay roof cover board/insulation over roof deck in accordance with roof insulation section 07 22 16.
- B. Plates:
 - 1. Place plates in grid pattern on roof insulation in accordance with thermoplastic membrane roofing section.

2. Install required number of plates and fasteners per 4-foot by 8-foot insulation/cover board or over purlins to achieve membrane roofing manufacturer's required FM rating.
 3. Install plates in straight rows in at least 1 direction in accordance with membrane roofing manufacturer's prescriptive fastening patterns for roof field, perimeter, and corners. Plates may need to be adjusted slightly in order to hit top flutes of roof deck.
 4. Secure plates in accordance with membrane roofing manufacturer's instructions using specified fasteners and in accordance to roofing manufacturer's prescriptive fastening patterns for roof field, perimeter, and corners.
 5. Do not overdrive fasteners on plates.
 6. Install plates and fasteners tight and flat to roof insulation with no dimpling of insulation board, or cover board surface.
- C. Lay membrane roofing over roof insulation and fastened plates in accordance with thermoplastic membrane roofing section.
- D. Overlap adjoining sheets of membrane roofing and join together by heat welding in accordance with thermoplastic membrane roofing section.
- E. Calibration of Induction Welding Tools:
1. Calibrate each induction welding tool in accordance with membrane roofing manufacturer's instructions to appropriate level for site conditions.
 2. Adjust induction welding tools to achieve maximum bond strength based on ambient temperature from 0 to 120 degrees F.
 3. Recalibrate induction welding tools whenever ambient temperature changes up or down by 15 degrees F.
 4. Adjust energy level of induction welding tools in accordance with membrane roofing manufacturer's instructions to produce optimal bond.
 5. Optimal Bond: 100 percent bond.
- F. Bonding Membrane Roofing:
1. Operate calibrated induction welding tools and magnetic cooling clamps in accordance with membrane roofing manufacturer's instructions. Keep bottom of magnetic cooling clamps clean from debris with a clean cotton rag.
 2. Ensure induction welding tools are centered over plates.
 3. Create 100 percent bond between underside of membrane roofing and top of plates.
 4. Ensure total, even, consistent adhesion of membrane roofing to top of plates.
 5. Partial Bond of Membrane Roofing to Plates: Not acceptable.

3.03 MEMBRANE TERMINATION

- A. Terminate membrane at all walls as shown in the contract drawings.
1. Roof Deck: Membrane shall be mechanically terminated using approved fasteners and plates six (6) inches on center.
 2. Concrete/Masonry Wall Substrate: Membrane shall be turned up wall one inch and mechanically terminated using approved anchors eight (8) inches on center with a termination bar.
- B. Terminate membrane at all penetrations as shown in the contract drawings.
1. Membrane shall be fastened six inches on center or a minimum of four (4)

fasteners per penetration into the structural deck using fasteners and plates as approved by the membrane manufacturer for the deck substrate.

- C. Membrane shall extend over roof edge a minimum of 2" below the perimeter wood blocking.

3.04 FLASHING INSTALLATION

A. General

1. All flashings shall be installed concurrently with the roof membrane as the job progresses.
2. No temporary flashings shall be allowed without the prior written approval of the Engineer and Manufacturer. Approval shall only be for specific locations on specific dates. If any water is allowed to enter under the newly completed roofing, the affected area shall be removed and replaced at the Contractor's expense.
3. Seams shall not be "taped" as temporary measure but shall be fully completed before the end of each day.
4. Flashing shall be adhered to compatible, dry, smooth, and solvent-resistant surfaces.
5. Where substrates are incompatible with adhesives and PVC materials, the Contractor shall remove the incompatible materials and replace it with a compatible substrate, or install compatible PVC flashing materials.
6. Use caution to ensure adhesive fumes are not drawn into the building.

B. Adhesive for Flashing Membrane

1. Over the properly installed and prepared flashing substrate, flashing adhesive shall be applied according to instructions found on the Product Data Sheet. The membrane adhesive shall be applied in smooth, even coats with no gaps, globs or similar inconsistencies.
2. Only an area which can be completely covered in the same day's operations shall be flashed. The bonded sheet shall be pressed firmly in place with a hand roller.
3. No adhesive shall be applied in seam areas that are to be welded.

- C. All flashings shall mechanically terminated a minimum of 8 inches above the finished roofing surface using approved fasteners and counterflashing bar unless otherwise indicated in the Contract Drawings. Flashing heights less than 8" shall be accepted in writing by the Manufacturer's Technical Department.

- D. All flashing membranes shall be consistently adhered to substrates. All interior and exterior corners and miters shall be cut and hot-air welded into place. No bitumen shall be in contact with the (roof) membrane.

- E. All flashings shall be hot-air welded at their joints and at their connections with the (roof) membrane.

- F. All flashings that exceed 30 inches (0.75 m) in height shall receive additional securement. Consult Manufacturer's Technical Department for securement methods.

- G. Corners shall be flashed using the membrane manufacturer's pre-formed corners.

- H. Polymer Clad sheet metal incorporated into the roofing system shall be sealed off with a heat welded stripping ply. The stripping ply shall extend four inches beyond sheet metal

onto roof membrane and fit closely to edge of sheet metal.

I. Roof Drain:

1. Mechanically attach membrane 6" on center into structural deck around drain sump. Fully adhere flashing membrane and hot-air weld to membrane a minimum of 4 inches.
2. Flashing membrane shall be set in a full bed of sealant under the clamping ring.
3. Provide new cast iron strainer dome and clamping ring and provide new stainless steel clamping ring bolts.
4. Clamping rings shall be secured in place with all bolts at the end of each work day. Contractor shall water test roof drains after every instance the clamping ring is removed and reinstalled. The Contractor shall notify the Engineer and Owner of the water test schedule.

J. Soil Pipe/Pipe Penetration:

1. Provide field wrapped pipe penetration flashing or manufacturer's pre-fabricated pipe boot as shown in detail drawing.
2. Apply aluminum tape to penetration if asphalt contamination is present.
3. Extend existing pipe to obtain a minimum 8" finished flashing height.
4. Cut existing pipe to obtain a maximum 12" finished flashing height.
5. Horizontal flashing membrane shall be hot-air welded a minimum of four inches onto the membrane.
6. Vertical flashing membrane shall be fully adhered to pipe penetration and extend a minimum of 1.5" horizontal at the base of penetration. Hot-air weld vertical flashing membrane to horizontal flashing membrane.
7. Install stainless steel draw band and sealant or hot-air weld flashing cap to terminate top edge of pipe flashing.

3.05 HOT-AIR WELDING OF SEAM OVERLAPS

A. General

1. All seams shall be hot-air welded. Seam overlaps should be 3 inches (75 mm) wide when automatic machine-welding and 4 inches (100 mm) wide when hand-welding, except for certain details.
2. Welding equipment shall be provided by or approved by the membrane manufacturer. All mechanics intending to use the equipment shall have successfully completed a training course provided by a membrane manufacturer's technical representative prior to welding.
3. All membrane to be welded shall be clean and dry.

B. Hand-Welding

1. Hand-welded seams shall be completed in two stages. Hot-air welding equipment shall be allowed to warm up for at least one minute prior to welding.
2. The back edge of the seam shall be welded with a narrow but continuous weld to prevent loss of hot air during the final welding.
3. The nozzle shall be inserted into the seam at a 45 degree angle to the edge of the membrane. Once the proper welding temperature has been reached and the membrane begins to "flow," the hand roller is positioned perpendicular to the nozzle and pressed lightly. For straight seams, the 1½ inch (40 mm) wide nozzle is recommended for use. For corners and compound connections, the ¾ inch (20

mm) wide nozzle shall be used.

C. Machine Welding

1. Machine welded seams are achieved by the use of automatic welding equipment. When using this equipment, instructions from the manufacturer shall be followed and local codes for electric supply, grounding and over current protection observed. Dedicated circuit house power or a dedicated portable generator is recommended. No other equipment shall be operated off the generator.
2. Metal tracks may be used over the deck membrane and under the machine welder to minimize or eliminate wrinkles.

D. Quality Control of Welded Seams

1. The Applicator shall check all welded seams for continuity using a rounded screwdriver. Visible evidence that welding is proceeding correctly is smoke during the welding operation, shiny membrane surfaces, and an uninterrupted flow of dark grey material from the underside of the top membrane. On-site evaluation of welded seams shall be made daily by the Applicator to locations as directed by the Engineer or membrane manufacturer's representative. One inch (25 mm) wide cross-section samples of welded seams shall be taken at least three times a day. Correct welds display failure from shearing of the membrane prior to separation of the weld. Each test cut shall be patched by the Applicator at no extra cost to the Owner.

3.06 WALKWAY PAD INSTALLATION

- A. Roofing membrane to receive walkway pad shall be clean and dry.
- B. Place chalk lines on sheet to indicate location of Walkway.
- C. Apply a continuous coat of membrane adhesive to the sheet and the back of walkway pad in accordance with membrane manufacturer's technical requirements and press walkway pad into place with a water-filled, foam-covered lawn roller.
- D. Clean the membrane in areas to be welded. Hot-air weld the entire perimeter of the walkway to the roofing membrane.
- E. Check all welds with a rounded screwdriver. Re-weld any inconsistencies.
- F. Important: Check all existing membrane seams that are to be covered by walkway with rounded screwdriver and re-weld any inconsistencies before walkway installation.
- G. Provide walk pads where indicated in Contract Drawings and at the following locations:
 1. Around roof hatches.
 2. At base and top of fixed wall access ladders.
 3. Around HVAC units.
 4. At door access to roof areas.

3.07 TEMPORARY CUT-OFF

- A. All flashings shall be installed concurrently, with the membrane in order to maintain a watertight condition as the work progresses.

- B. When a break in the day's work occurs in the central area of the project install a temporary watertight seal. An 8" strip of flashing membrane shall be welded 4" to the new field membrane. The remaining 4" of flashing membrane shall be sealed to the deck and/or the substrate so that water will not be allowed to travel under the new or existing membrane. The edge of the membrane shall be sealed in a continuous heavy application of pourable sealer of 6 inch width. When work resumes, the contaminated membrane shall be removed and disposed of. None of these materials shall be reused in the new work.
- C. If inclement weather occurs while a temporary water stop is in place, the Contractor shall provide the labor necessary to monitor the situation to maintain a watertight condition.
- D. If any water is allowed to enter under the newly-completed system, the affected area shall be removed and replaced at the Contractor's expense.

3.08 CLEANING AND PROTECTION

- A. The Contractor shall be responsible for protecting the roof from construction related damages during the Work.
- B. The Contractor shall ensure trash and debris is removed from the roof daily.
- C. Metal scraps, nails, screws and other sharp damaging debris shall be kept off of the roof membrane surface during construction.
- D. The Contractor shall clean off/remove excess adhesive, sealant, stains and residue on the membrane and flashing surfaces.
- E. The Contractor shall repair or remove and replace damaged membrane, flashings and other membrane components. Repairs shall be approved by the Engineer and be in accordance with the membrane manufacturers repair instruction to comply with the specified warranty.
- F. The Contractor shall remove temporary coverings and masking protection from adjacent work areas upon completion.

END OF SECTION 07 54 00

SECTION 07 62 00

SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Fabrication and installation of new sheet metal flashings and trim to provide a permanently watertight condition.

1.02 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section, including but not limited to:
 - 1. Rough Carpentry Section 06 10 00
 - 2. Thermoplastic Single Ply Roofing Section 07 54 00

1.03 REFERENCES

- A. Refer to the following references for specification compliance:
 - 1. NC State Building Code
 - 2. ASTM International
 - 3. National Roofing Contractors Association (NRCA)
 - 4. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
 - a. Architectural Sheet Metal Manual, Seventh Edition – January, 2012
 - 5. ANSI/SPRI ES-1

1.04 SUBMITTALS

- A. Refer to Section 01 33 00-Product Submittals for Submittals.
- B. Manufacturer's Product Data Sheets for all materials specified certifying material complies with all specified requirements.
- C. Pre-finished sheet metal and sealant color chart.
- D. Shop Drawings for any transitions and/or terminations not depicted in Contract Drawings.

1.05 QUALITY ASSURANCE

- A. Installation shall comply with the Contract Drawings. References to figures are from SMACNA Architectural Sheet Metal Manual, Seventh Edition – January, 2012.
- B. Ensure work is free of leaks in all weather conditions.
- C. Fabricate metal edge (where no gutter is present) in accordance with ANSI/SPRI ES-1 requirements.

- D. Workmanship shall be first-class in every respect. The sheet metal work shall be assembled and secured in accordance with these specifications, the manufacturer's requirements and referenced standards.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Delivery: Deliver materials in the manufacturer's original sealed and labeled containers and in quantities required to allow continuity of application.
- B. Storage: Store materials within areas designated or approved by the Owner. Ensure materials remain dry, covered and not in contact with the ground.
- C. Handling: Handle material in such manner as to preclude damage and contamination with moisture or foreign matter.

1.07 PROJECT CONDITIONS

- A. Environmental: Protect building and its components from the elements at all times during the project.
- B. Coordination and Scheduling: Coordinate all phases of work to allow continuity of work without delays.

1.08 WARRANTY

- A. Contractor to provide the pre-finished sheet metal manufacturer's thirty (30) year finish warranty from the date of substantial completion.
- B. Provide certification of air-dried kynar paint or powder coating for specified materials.

PART 2 PRODUCTS

2.01 PRE-FINISHED ALUMINUM

- A. ASTM B209 Aluminum Alloy Sheet and Plate, alloy and temper 3003-H14, primed and finished on one side with Kynar/Hylar based fluoropolymer coating of 1.0 mil total dry film thickness, and on the reverse side, with a wash coat of 0.3 to 0.4 mil dry film thickness. A strippable plastic film should protect the finish during fabrication and installation. Manufacturer's standard color to be selected by Owner.

- 1. 040 inch (40-mil)
 - a. Fascia Cover (If required)
 - b. Prefabricated Metal Edge
 - i. Pac Snap Edge, FA
 - ii. Anchor Tite Standard for FA membrane
 - iii. Engineers accepted equivalent
 - c. Gutter
 - d. Collector Head
 - e. Scupper Face Plate
 - f. Downspouts

2.02 MILL FINISHED ALUMINUM

- A. ASTM B209 Aluminum Alloy Sheet and Plate, alloy and temper 3003-H14.
 - 1. 040 inch (40-mil)
 - a. Slip Flashing
 - b. Counterflashing
 - c. Termination Bar

2.03 STAINLESS STEEL

- A. 26 gauge, Type 304 as tested in accordance with ASTM A 167.
 - 1. Watertight Umbrella
 - 2. Counterflashing w/Existing Receiver (if unable to reuse existing)
 - 3. Multiple Pipe Enclosure Components
 - a. Pipe Enclosure Flashing
 - b. Closure Cap
 - 4. Pitch Pan
 - 5. Splash Pan

2.04 POLYMER CLAD METAL (PVC)

- A. Polymer Clad Metal – Heat-weldable, 24 gauge, AISI G90 galvanized steel sheet with a 20-mil unsupported thermoplastic membrane coating to match the flashing membrane composition laminated on one side. Polymer-Clad metal shall be manufactured by, and included in the warranty of, the single-ply membrane Manufacturer. Color shall be selected by Owner.
 - 1. Flange/Sleeve
 - 2. Metal Edge
 - 3. Scupper Liner
 - 4. Drip Edge

2.05 FASTENERS

- A. Roofing Nails: 11 or 12 gauge stainless steel ring shank roofing nails with diamond point, minimum 3/8" diameter head and length as required to penetrate substrate a minimum of 1-1/4".
- B. Screws:
 - 1. Sheet metal to wood attachment (exposed): #12 stainless steel, 5/16 HWH with length to penetrate substrate a minimum of 1-1/2". Provide with bonded EPDM washer or washer specified below.
 - 2. Sheet metal to wood attachment (concealed): #10 stainless steel, low profile pancake head with length to penetrate substrate a minimum of 1-1/2".
 - 3. Sheet metal to light gauge steel attachment: #14-13 DP1 stainless steel low profile pancake head of length as required for three threads to penetrate metal substrate or min. 1" penetration though wood substrates.

4. Sheet metal to sheet metal attachment (exposed): 1/4" x 7/8" carbon steel, self-drilling point, self-tapping, zinc alloy hex head screws with bonded EPDM tubular washer under head of fastener; screw heads to match color of wall panel by means of factory applied coating.
- C. Concrete and Masonry Anchors: 1/4" diameter metal based expansion anchor with stainless steel pin of length to penetrate substrate a minimum of 1-1/2".
- D. Washers: Shall be stainless steel with neoprene gasket backing. Shall be 9/16" diameter for use with #12 screws and 5/8" diameter for use with 1/4" diameter concrete and masonry anchors.
- E. Rivets: #44 stainless steel rivets with stainless steel mandrel. Length of rivet to properly fasten particular sheet metal components. Rivets shall be factory painted to match adjacent sheet metal.

2.06 RELATED MATERIALS

- A. Compressible Insulation: Un-faced friction-fit fiberglass building insulation, cut to fit from 3-1/2"x 15"x48" batts.
- B. Polyurethane Sealant: One-component elastomeric gun grade polyurethane sealant conforming to ASTM C 920, Type S, Grade NS, Class 25, and use NT, M, A, G, or O as required by substrate conditions. Color to match adjacent materials.
- C. Silicone Sealant: Shall be a one-component, non-sag, neutral cure, low-modulus, UV resistant, high performance silicone sealant. Shall meet ASTM C 920, Type S, Grade NS, Class 100, Use M, G, A or O. Color to match adjacent materials.
- D. Sealant Tape: Minimum 1/2" wide non-skinning butyl sealant tape.
- E. Butyl Sealant: Shall be gun grade, non-skinning, non-hardening, flexible blend of butyl rubber and polyisobutylene sealant.
- F. Aluminum Tape: Pressure-sensitive, 2" wide aluminum tape used as a separation layer between small areas of asphalt contamination and the membrane and as bond breaker under the metal edge cover plates.
- G. Backer Rod: Closed-cell polyethylene or polyurethane rods sized approximately 25% larger than joint opening.
- H. Pourable Sealer: Two part pourable polyurethane sealant conforming to ASTM D 429, and designed to seal around penetrations.
- I. Prefabricated Pipe Penetration Flashings: Two-piece, non-insulated, stainless steel STACK JACK Flashings as manufactured by Thaler Metal Industries Ltd. (www.thalermetal.com, or 800-576-1200) or Engineer accepted equivalent.
- J. Prefabricated Flexible Conduit Penetration Flashings: One-piece non insulated Aluminum Liquid Tight Flexible Conduit Flashings; MEF-2A standard 12" (305 mm) high flashing; 0.109" (2.7mm) mill finish 6061-T4 aluminum; to CSA B272-93; with EPDM End Cap as manufactured by Thaler Metal Industries Ltd. (www.thalermetal.com, or 800-576-1200) or Engineer accepted equivalent.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Coordinate with other work for correct sequencing of items which make up the entire system.
- B. Ensure substrates are installed, secured and modified to accommodate sheet metal flashings.
- C. Deficiencies associated with the sheet metal substrates shall be reported to Engineer before beginning sheet metal work. All such deficiencies shall be corrected before installing sheet metal flashings.

3.02 INSTALLATION

- A. General:
 - 1. All joints to be locked and sealed or soldered.
 - 2. Provide for thermal movement (expansion and contraction) of all exposed sheet metal.
 - 3. Where dissimilar metals contact, galvanic action shall be prevented by means of heavy coat of asphalt paint.
 - 4. All metal flanges shall be installed on top of membrane and adhered as indicated in detail drawings. Metal flanges connected to the roof shall be installed per membrane manufacturer's specifications and the requirements herein.
 - 5. Various sheet metal sections shall be uniform with corners, joints and angles mitered, sealed and secured.
 - 6. Exposed edges shall be returned (hemmed); both for strength and appearance, and sheet metal shall be fitted closely and neatly.
 - 7. Provide cleats or stiffeners and other reinforcements to make all sections rigid and substantial.
 - 8. Sheet metal shall be fabricated, supported, cleated, fastened and joined to prevent warping, "oil canning", and buckling.
 - 9. All sheet metal details shall provide for redundancy including but not limited to sheet metal underlayment and/or sealants. This secondary protection shall be installed, sealed and lapped to ensure a redundant layer of protection will shed moisture infiltration in the sheet metal fails.
- B. Fasteners: Shall be size and type required.
 - 1. All fasteners to be rust resistant and compatible with materials to be joined.
 - 2. All exposed fasteners shall be stainless steel screws with washers fastened through 5/16" predrilled oversized holes.
 - 3. All exposed fasteners into concrete or masonry shall be metal based expansion anchor with stainless steel pin with washers fastened through 11/32" predrilled oversized holes.
 - 4. All exposed fasteners shall have factory painted heads to match the sheet metal color.
 - 5. Exposed horizontal surface fasteners are not acceptable.
- C. Soil Pipe

1. Provide Prefabricated Pipe Penetration Flashing as shown in detail drawing with a 4" minimum flange.
2. Set flange in a full bed of roofing cement over base ply and strip in as specified.
3. Provide separate flashing cap extending a minimum of 1" down inside pipe, and a minimum of 3" down outside the pipe.
4. Clean and solder all seams.

D. Pipe Penetration

1. Fabricate flange/sleeve and umbrellas as shown in detail drawings. Refer to SMACNA Architectural Sheet Metal Manual Figure 8-9C.
2. Provide a 4" minimum flange attached and stripped in as indicated in the Contract Drawings.
3. Install watertight umbrella with stainless steel draw band and sealant properly tooled to ensure adhesion and slope to shed water.
4. Vertical leg of umbrella flashing shall extend a minimum of 2" below the sleeve top and be positioned as low as possible on the sleeve.
5. Clean and solder all seams.

E. Slip Flashing for Curbs

1. Fabricate slip flashing at curbs as shown in detail drawings in 10' lengths.
2. Slip flashing shall extend a minimum of 2 inches below base flashing termination and shall fit tightly against curb.
3. Secure slip flashing 12" on center of a minimum of two fasteners per side of the curb.
4. Notch and lap ends of adjoining sections not less than 4"; apply sealant tape between sections.
5. Lap miters at corners a minimum of 1 inch and apply sealant between laps. Rivet at 2" on center.

F. Reglet Mounted Two-Piece Receiver and Counterflashing

1. Fabricate receiver and counterflashing as shown in detail drawings in 10' lengths.
2. Install receiver flashing into saw-cut reglet and secure with soft metal wedges at 18" on center set deep into joint or surface mount at 12" on center.
3. Install sealant properly tooled to ensure adhesion and slope to shed water in saw-cut reglet. Sealant shall completely cover soft metal wedges.
4. Install counterflashing as indicated in detail drawings and secure to receiver flashing 12 inches on center. Stagger receiver anchors/wedges with counterflashing fasteners.
5. Counterflashing shall extend a minimum of 1.5 inches below base flashing termination.
6. Notch and lap ends of adjoining sheet metal sections not less than 4"; apply sealant tape between sections.
7. Lap miters at corners a minimum of 1 inch and apply sealant between laps. Rivet at 2" on center.

G. Surface Mounted Two-Piece Receiver and Counterflashing

1. Fabricate receiver and counterflashing as shown in detail drawings in 10' lengths.
2. Install receiver flashing surface mounted at 12" on center.
3. Install sealant in kick-out and manually tool concave to ensure proper adhesion and slope to shed water as indicated in detail drawings.

4. Install counterflashing as indicated in detail drawings and secure to receiver flashing 12 inches on center. Stagger receiver anchors with counter flashing fasteners.
5. Counterflashing shall extend a minimum of 1.5 inches below base flashing termination.
6. Notch and lap ends of adjoining sheet metal sections not less than 4"; apply sealant between sections.
7. Lap miters at corners a minimum of 1 inch and apply sealant between laps. Rivet at 2" on center.

H. Fascia Cover

1. Provide fascia cover secured to wood blocking 12" on center where indicated in detail drawings.
2. Notch and lap ends of adjoining fascia cover sheet metal sections not less than 4"; apply sealant tape or two beads of butyl sealant between sections.

I. Parapet Wall

1. Provide prefabricated snap lock metal fascia edge as shown on drawings.
 - a. Metal Era
 - b. OMG
 - c. ATAS
 - d. PAC CLAD
2. Install tapered edge strip mechanically attached or set in foam adhesive to top of wood blocking.
3. Install flashing membrane up and over parapet extending a minimum of 1" below wood blocking.
4. Provide one piece coping section at four way and tee intersections.
5. Turn coping ends up a minimum of 2" at elevation walls and cover termination with surface mounted counterflashing.

J. Overflow Scupper

1. Fabricate thru-wall scupper flange, liner, and faceplate as shown in detail drawings. Scuppers dimensions shall be as indicated in the Contract Drawings.
2. Clean and solder all seams of the flange and liner.
3. Hot-air weld stripping membrane at seams of the flange and liner.
4. Install flashing membrane through scupper opening prior to installing new scupper to seal wall cavity.
5. Provide flange which extends a minimum of 4" on top and sides of scupper, and extends a minimum of 4" out onto the horizontal membrane. Set all flanges in a full bead of urethane sealant.
6. Strip-in flange as specified in Contract Drawings.
7. Provide faceplate which extends 1.5" around the entire scupper and secure to wall substrate with four fasteners. Set faceplate in a bead of sealant.
8. Scupper Liner shall extend 1" beyond the exterior wall face and lock onto faceplate.

K. Metal Edge (Thermoplastic)

1. Fabricate metal edge as shown in detail drawings in 10' lengths. Refer to SMACNA Architectural Sheet Metal Manual Figure 2-1 except for continuous cleat dimensions which shall be as shown in Contract Drawings.
 - a. Fabricate without vertical gravel stop at drainage edges and $\frac{3}{4}$ inch vertical gravel stop at non-drainage edges.
2. Terminate membrane at roof edge and hot-air weld flashing membrane strip to extend down the outside vertical face over the wall.
3. Provide sealant tape at base of flashing membrane on outside of wall to prevent moisture infiltration.
4. Install a continuous cleat over fascia cover as indicated in detail drawings fastened to substrate 6" on center. Locate fasteners no greater than 2" from the bottom hem.
5. Lock metal edge onto continuous cleat and secure flange of metal edge to wood blocking 3" on center staggered and not within $\frac{1}{2}$ " from inside edge and $\frac{3}{4}$ " from outside edge.
6. Strip flange of metal edge with hot-air welded stripping membrane as specified in the Contract Drawings.
7. Hand tong all of metal edge onto continuous cleat.
8. Metal Edge Joints:
 - a. Leave a $\frac{1}{4}$ " opening between metal edge sections. Install two roofing nails in the end of the flange, and one roofing nail in the end of the vertical face of each metal edge section.
 - b. Center aluminum tape over entire joint opening (flange and face).
 - c. Hot-air weld 4" wide strip of stripping membrane over entire joint.
 - d. Strip in flange of metal edge as described above.
 - e. Center 6" wide cover plate over joint locking onto notched drip edges of metal edge sections. Refer to SMACNA Architectural Sheet Metal Manual Figure 2-5A, and Figure 2-5, Detail 1.
 - f. Strip flange of cover plate with hot-air welded flashing membrane. Flashing membrane shall extend 2" beyond the cover plate flange on 3 interior sides.

L. Gutters

1. Fabricate to profile shown in Contract Drawings. Refer to SMACNA Architectural Sheet Metal Manual Figure 1.2 Style D.
2. Gutters shall be continuous, roll formed from coil stock on site or formed in 10' lengths.
 - a. Joints in gutters must be lapped a minimum of 1 inch, riveted 1 inch on center. Install sealant tape between gutter sections and sealant at exposed inside edge and on rivets. Lap joints in the direction of water flow.
3. Terminate membrane at roof edge and hot-air weld flashing membrane strip to extend down the outside vertical face of wall.
4. Provide downspout outlet tubes in downspout locations. Refer to SMACNA Architectural Sheet Metal Manual Figure 1-33B and Detail 1. Gutter outlet tubes to be tabbed a minimum of 1", set in a full bead of sealant and secured to gutter with a minimum of two rivets per tab.

5. Provide primed and painted brackets and spacers as shown in detail drawings. Evenly stagger the placement of brackets and spacers. Spacing shall be 36" on center for both brackets and spacers.
6. Spacers shall be riveted to both sides of the gutter only.
7. Brackets shall be secured with two stainless steel fasteners to the wood blocking.
8. Leading edge of gutter to be a minimum of 1" below the back edge as shown in detail drawing.
9. Hang gutters level.
10. Metal Edge: Refer to Metal Edge installation indicated above.

M. Downspouts:

1. Fabricate downspouts in 10' lengths. Refer to SMACNA Architectural Sheet Metal Manual Figure 1-32B.
2. Downspouts shall tie into existing below grade storm drainage system or if no below grade system is applicable downspouts shall kick-out above grade onto concrete splash blocks.
3. Each downspout shall be secured to the structure with two-piece hangers spaced no more than 8' apart with a minimum of two hangers per downspout with a hanger located within 12" from bottom. Hangers shall be primed and painted to match downspouts. Refer to SMACNA Architectural Sheet Metal Manual Figure 1-35H.
4. Downspouts are to be fashioned to run back to (at overhangs) and parallel to the facility walls.
5. Provide discharge elbow at the base of downspout where it kicks out onto splash pan or splash block.
6. Where downspouts discharge onto lower adjacent roof areas, provide splash pans at discharge as specified below.

N. Splash Pans

1. Where downspouts discharge onto adjacent roof; provide splash pans on 18" by 30" walk pads.
2. Splash pan shall be fabricated to meet SMACNA Architectural Sheet Metal Manual Figure 1-36, Alternate Section with 2 v-grooves.

O. Multiple Pipe Penetration

1. Fabricate pitch pan, pipe enclosure flashing, and closure cap as shown in detail drawings. Refer to SMACNA Architectural Sheet Metal Manual Figure 8-8B or 8-9A depending upon direction of pipes.
2. Size pitch pan minimum 2" larger than the penetration on all sides. Provide a 4" minimum flange and double walls with minimum depth of 6".
3. Strip-in flange of pitch pan as indicated in the Contract Drawings.
4. Install 2" wide aluminum tape around all sides of pitch pan extending 1/2" above top edge.
5. Fill pitch pan with non-shrink grout to a depth of 2" from the top of the tape.
6. Fill pitch pan with pourable sealer to the top of the tape. Slope to shed water.
7. Secure pipe enclosure flashing and cap as indicated in detail drawings.
8. Clean and solder all seams.

P. Polymer Clad Base Flashing

1. Fabricate as shown in detail drawings in 10' lengths.

2. Leave a 1/4" opening between sheet metal sections.
3. Center aluminum tape over entire joint opening.
4. Hot-air weld 4" wide strip of stripping membrane over entire joint.
5. Strip flange of base flashing as indicated in the Contract Drawings.

3.03 CLEANING AND PROTECTION

- A. All sheet metal work shall be thoroughly cleaned of all asphalt, flux, scrapes and dust.
- B. Scratches through the metal finish shall be replaced to the Owner's satisfaction.

END OF SECTION 07 62 00

SECTION 07 8400

FIRESTOPPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Firestopping of all joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not.

1.2 REFERENCE STANDARDS

- A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2015.
- B. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops; 2013a.
- C. ASTM E1966 - Standard Test Method for Fire Resistive Joint Systems; 2007 (Reapproved 2011).
- D. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies; 2013.
- E. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015.
- F. ITS (DIR) - Directory of Listed Products; current edition.
- G. FM (AG) - FM Approval Guide; current edition.
- H. UL 1479 - Standard for Fire Tests of Penetration Firestops; Current Edition, Including All Revisions.
- I. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.
- J. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
- K. UL (FRD) - Fire Resistance Directory; current edition.

1.3 SUBMITTALS

- A. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
- B. Product Data: Provide data on product characteristics, performance ratings, and limitations.

1.4 MOCK-UP

- A. Install one firestopping assembly representative of each fire rating design required on project.
 - 1. Where one design may be used for different penetrating items or in different wall constructions, install one assembly for each different combination.
 - 2. Where firestopping is intended to fill a linear opening, install minimum of 1 linear ft (1/3 linear m).
- B. Obtain approval of authorities having jurisdiction (AHJ) before proceeding.
- C. If accepted, mock-up will represent minimum standard for the Work.
- D. If accepted, mock-up may remain as part of the Work. Remove and replace mock-ups not accepted.

1.5 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.
- B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Firestopping Manufacturers:
 - 1. 3M Fire Protection Products; : www.3m.com/firestop/#sle.
 - 2. A/D Fire Protection Systems Inc; : www.adfire.com/#sle.
 - 3. Hilti, Inc; : www.us.hilti.com/#sle.
 - 4. Nelson FireStop Products; : www.nelsonfirestop.com/#sle.
 - 5. Tremco Commercial Sealants & Waterproofing; TREMstop Acrylic: www.tremcosealants.com/#sle.
 - 6. Substitutions: See Section 01 6000 - Product Requirements.

2.2 MATERIALS

- A. Firestopping Materials: Any materials meeting requirements.
- B. Mold and Mildew Resistance: Provide firestopping materials with mold and mildew resistance rating of zero(0) in accordance with ASTM G21.
- C. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.
- D. Fire Ratings: Refer to drawings for required systems and ratings.

2.3 FIRESTOPPING ASSEMBLY REQUIREMENTS

- A. Head-of-Wall Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of floor or wall, whichever is greater.
- B. Floor-to-Floor, Wall-to-Wall, and Wall-to-Floor Joints, Except Perimeter, Where Both Are Fire-Rated: Use system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
 - 1. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.
- C. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.
 - 1. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.

2.4 FIRESTOPPING SYSTEMS

- A. Firestopping: Any material meeting requirements.
 - 1. Fire Ratings: Use system that is listed by FM (AG), ITS (DIR), or UL (FRD) and tested in accordance with ASTM E814, ASTM E119, or UL 1479 with F Rating equal to fire

rating of penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify openings are ready to receive the work of this section.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.

3.3 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by authorities having jurisdiction.
- C. Install labeling required by code.

3.4 FIELD QUALITY CONTROL

- A. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

3.5 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.6 PROTECTION

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 07 9200

JOINT SEALANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nonsag gunnable joint sealants.
- B. Self-leveling pourable joint sealants.
- C. Joint backings and accessories.

1.2 RELATED REQUIREMENTS

- A. Section 08 8000 - Glazing: Glazing sealants and accessories.
- B. Section 09 2116 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.
- C. Section 09 3000 - Tiling: Sealant between tile and plumbing fixtures and at junctions with other materials and changes in plane.
- D. Section 23 3100 - HVAC Ducts and Casings: Duct sealants.

1.3 REFERENCE STANDARDS

- A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2006 (Reapproved 2011).
- B. ASTM C834 - Standard Specification for Latex Sealants; 2014.
- C. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2012.
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.
- E. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2013.
- F. ASTM C1311 - Standard Specification for Solvent Release Sealants; 2014.
- G. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2002 (Reapproved 2013).

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
 - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
 - 2. List of backing materials approved for use with the specific product.
 - 3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
 - 4. Substrates the product should not be used on.
 - 5. Substrates for which use of primer is required.
 - 6. Installation instructions, including precautions, limitations, and recommended backing materials and tools.

- C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.
- D. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

PART 2 PRODUCTS

2.1 JOINT SEALANT APPLICATIONS

A. Scope:

1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
 - a. Wall expansion and control joints.
 - b. Joints between door, window, and other frames and adjacent construction.
 - c. Joints between different exposed materials.
 - d. Openings below ledge angles in masonry.
 - e. Other joints indicated below.
2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
 - a. Joints between door, window, and other frames and adjacent construction.
 - b. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.
 - 1) Exception: Such gaps and openings in gypsum board finished stud walls and suspended ceilings.
 - 2) Exception: Through-penetrations in sound-rated assemblies that are also fire-rated assemblies.
 - c. Other joints indicated below.
3. Do not seal the following types of joints.
 - a. Intentional weepholes in masonry.
 - b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
 - c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
 - d. Joints where installation of sealant is specified in another section.
 - e. Joints between suspended panel ceilings/grid and walls.

B. Exterior Joints: Use nonsag silyl-terminated polyether/polyurethane sealant, unless otherwise indicated.

1. Lap Joints between Manufactured Metal Panels, and Lap Joints in Sheet Metal Fabrications: Butyl rubber, non-curing.

C. Interior Joints: Use nonsag polyurethane sealant, unless otherwise indicated.

1. Wall and Ceiling Joints in Non-Wet Areas: Acrylic emulsion latex sealant.

2. Wall and Ceiling Joints in Wet Areas: Nonsag polyurethane sealant for continuous liquid immersion.
 3. Floor Joints in Wet Areas: Nonsag polyurethane "traffic-grade" sealant suitable for continuous liquid immersion.
 4. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.
 5. In Sound-Rated Assemblies: Acrylic emulsion latex sealant.
 6. Narrow Control Joints in Interior Concrete Slabs: Self-leveling polyurethane sealant.
 7. Other Floor Joints: Self-leveling polyurethane "traffic-grade" sealant.
- D. Interior Wet Areas: Bathrooms, restrooms, and food service areas; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.
- E. Sound-Rated Assemblies: Walls and ceilings identified as "STC-rated", "sound-rated", or "acoustical".

2.2 NONSAG JOINT SEALANTS

- A. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
1. Color: White.
- B. Silyl-Terminated Polyether (STPE) and Polyurethane (STPU) Sealant: ASTM C920, Grade NS, Uses M and A; single component; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus 35 percent, minimum.
 2. Color: To be selected by Architect from manufacturer's standard range.
- C. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multicomponent; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus 25 percent, minimum.
 2. Color: To be selected by Architect from manufacturer's standard range.
- D. Non-Sag "Traffic-Grade" Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; explicitly approved by manufacturer for continuous water immersion and traffic without the necessity to recess sealant below traffic surface.
1. Movement Capability: Plus and minus 25 percent, minimum.
 2. Hardness Range: 40 to 50, Shore A, when tested in accordance with ASTM C661.
- E. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.
1. Color: Standard colors matching finished surfaces, Type OP (opaque).
- F. Non-Curing Butyl Sealant: Solvent-based; ASTM C1311; single component, nonsag, non-skinning, non-hardening, non-bleeding; vapor-impermeable; intended for fully concealed applications.

2.3 SELF-LEVELING SEALANTS

- A. Self-Leveling Polyurethane Sealant for Continuous Water Immersion: Polyurethane; ASTM C920, Grade P, Uses M and A; single or multicomponent; explicitly approved by manufacturer for traffic exposure and continuous water immersion.
 - 1. Movement Capability: Plus and minus 25 percent, minimum.
- B. - Rigid Self-Leveling Polyurethane Joint Filler: Two part, low viscosity, fast setting; intended for cracks and control joints not subject to significant movement.
 - 1. Hardness Range: Greater than 100, Shore A, and 50 to 80, Shore D, when tested in accordance with ASTM C661.

2.4 ACCESSORIES

- A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
 - 1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type C - Closed Cell Polyethylene.
 - 2. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.
- B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
- C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.
- D. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.
- C. Verify that backer rods are of the correct size.

3.2 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.3 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Perform acoustical sealant application work in accordance with ASTM C919.
- D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.

- E. Install bond breaker backing tape where backer rod cannot be used.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.
- I. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

3.4 POST-OCCUPANCY

- A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width; i.e. at low temperature in thermal cycle. Report failures immediately and repair.

END OF SECTION

SECTION 08 1213

HOLLOW METAL FRAMES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Non-fire-rated hollow metal frames for non-hollow metal doors.
- B. Fire-rated hollow metal frames for non-hollow metal doors.
- C. Interior glazed borrowed lite frames.

1.2 RELATED REQUIREMENTS

- A. Section 04 2000 - Unit Masonry: Masonry grout fill of hollow metal frames.
- B. Section 08 1416 - Flush Wood Doors: Non-hollow metal door for hollow metal frames.
- C. Section 08 7100 - Door Hardware: Hardware, silencers, and weatherstripping.
- D. Section 08 8000 - Glazing: Glazed borrowed lites.
- E. Section 09 9123 - Interior Painting: Field painting.

1.3 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2011.
- C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2014.
- D. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.
- E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2015.
- G. 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; 2014.
- H. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2014.
- I. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2009.
- J. ITS (DIR) - Directory of Listed Products; current edition.
- K. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
- L. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.
- M. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.
- N. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

- O. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Hollow Metal Frames with Integral Casings:
 - 1. Ceco Door, an Assa Abloy Group company; : www.assaabloydss.com/#sle.
 - 2. Curries, an Assa Abloy Group company; : www.assaabloydss.com/#sle.
 - 3. Republic Doors, an Allegion brand; : www.republicdoor.com/#sle.
 - 4. Steelcraft, an Allegion brand; : www.allegion.com/#sle.

2.2 PERFORMANCE REQUIREMENTS

- A. Refer to Door and Frame Schedule on the drawings for frame sizes, fire ratings, sound ratings, finishing, and other variations.
- B. Door Frame Type: Provide hollow metal door frames with integral casings.
- C. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
- D. Accessibility: Comply with ICC A117.1 and ADA Standards.
- E. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturers standard.
- F. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior frame that is also indicated as being sound-rated must comply with the requirements specified for exterior frames and for sound-rated frames; where two requirements conflict, comply with the most stringent.
- G. Hardware Preparations, Selections and Locations: Comply with BHMA A156.115, NAAMM HMMA 830, NAAMM HMMA 831 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- H. Zinc Coating for Units in Wet Locations (Kitchens, Janitor Closets, Restrooms, Shower Rooms): Components zinc-iron alloy-coated (galvanized) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise.
- I. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
- J. Frame Head Members: See door frame elevations on drawings for door head member heights.

- K. Frames Wider than 48 Inch (1219 mm): Reinforce with steel channel fitted tightly into head of frame, flush with top.

2.3 HOLLOW METAL DOOR FRAMES WITH INTEGRAL CASINGS

- A. Frame Finish: Factory primed and field finished.
- B. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 3 - Extra Heavy-duty.
 - b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Frame Metal Thickness: 16 gage, 0.053 inch (1.3 mm), minimum.
 - d. Zinc Coating: A60/ZF180 galvanized coating; ASTM A653/A653M. See door schedule for locations.
- C. Fire-Rated Door Frames: Full profile/continuously welded type.
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 3 - Extra Heavy-duty.
 - b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Frame Metal Thickness: 16 gage, 0.053 inch (1.3 mm), minimum.
 - d. Zinc Coating: A60/ZF180 galvanized coating; ASTM A653/A653M. See door schedule for locations.
 - 2. Fire Rating: As indicated on Door and Frame Schedule, tested in accordance with UL 10C or NFPA 252 ("positive pressure fire tests").
 - 3. Provide units listed and labeled by ITS (DIR) or UL (DIR).
 - a. Attach fire rating label to each fire rated unit.

2.4 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.5 ACCESSORIES

- A. Silencers: Resilient rubber, fitted into drilled hole; 3 on strike side of single door, 3 on center mullion of pairs, and 2 on head of pairs without center mullions.
- B. Grout for Frames: Portland cement grout with maximum 4 inch (102 mm) slump for hand troweling; thinner pumpable grout is prohibited.
- C. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

3.2 PREPARATION

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.3 INSTALLATION

- A. Install frames in accordance with manufacturer's instructions and related requirements of specified frame standards or custom guidelines indicated.
- B. Install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
- D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
- E. Comply with glazing installation requirements of Section 08 8000.
- F. Install door hardware as specified in Section 08 7100.
- G. Touch up damaged factory finishes.

3.4 TOLERANCES

- A. Maximum Diagonal Distortion: 1/16 inch (1.6 mm) measured with straight edges, crossed corner to corner.

3.5 SCHEDULE

- A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION

SECTION 08 1416

FLUSH WOOD DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Flush wood doors; flush and flush glazed configuration; fire rated and non-rated.

1.2 RELATED REQUIREMENTS

- A. Section 08 1213 - Hollow Metal Frames.
- B. Section 08 7100 - Door Hardware.
- C. Section 08 8000 - Glazing.

1.3 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.
- B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.
- C. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.
- D. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- E. WDMA I.S. 1A - Interior Architectural Wood Flush Doors; 2013.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C. Shop Drawings and schedules: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
 - 1. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
- D. Samples: Submit two samples of door veneer, 2 by 3 inch (50 by 75 mm) in size illustrating wood grain, stain color, and sheen.
- E. Warranty, executed in Owner's name.

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.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging. Inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

1.7 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Interior Doors: Provide manufacturer's warranty for the life of the installation.
- C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Wood Veneer Faced Doors:
 - 1. Graham Wood Doors; Supreme Door (GSD): www.grahamdoors.com.
 - 2. Marshfield DoorSystems, Inc; Signature Series: www.marshfielddoors.com.
 - 3. VT Industries, Inc; Heritage Collection: www.vtindustries.com.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.

2.2 DOORS

- A. Doors: Refer to drawings for locations and additional requirements.
 - 1. Quality Level: Custom Grade, Extra Heavy Duty performance, in accordance with WDMA I.S. 1A.
 - 2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
- B. Interior Doors: 1-3/4 inches (44 mm) thick unless otherwise indicated; flush construction.
 - 1. Provide solid core doors at all locations.
 - 2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.

2.3 DOOR AND PANEL CORES

- A. All doors: Provide doors with no added urea formaldehyde including, but not limited to, adhesives, cores, cross bands, stiles and rails.
- B. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.
- C. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

2.4 DOOR FACINGS

- A. Veneer Facing for Transparent Finish: White birch, HPVA Grade A, plain sliced (flat cut), with slip match between leaves of veneer, balance match of spliced veneer leaves assembled on door or panel face.
 - 1. Vertical Edges: Same species as face veneer.
 - 2. "Pair Match" each pair of doors.

2.5 DOOR CONSTRUCTION

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
 - 1. Provide solid blocks at lock edge for hardware reinforcement.

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- 2. Provide solid blocking for other throughbolt hardware.
 - C. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
 - D. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
 - E. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
 - F. Provide edge clearances in accordance with the quality standard specified.
- 2.6 FACTORY FINISHING - WOOD VENEER DOORS
- A. Finish work in accordance with WDMA I.S. 1A for grade specified and as follows:
 - 1. Transparent:
 - a. System - TR-8, UV Cured Acrylated Polyester/Urethane.
 - b. Stain: As selected by Architect to match existing doors. If standard range of stain colors does not provide an acceptable color match, custom mix stain to match.
 - c. Sheen: Flat.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.2 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
 - 1. Install fire-rated doors in accordance with NFPA 80 requirements.
- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- C. Use machine tools to cut or drill for hardware.
- D. Coordinate installation of doors with installation of frames and hardware.
- E. Coordinate installation of glazing.

3.3 TOLERANCES

- A. Comply with specified quality standard for fit and clearance tolerances.
- B. Comply with specified quality standard for telegraphing, warp, and squareness.

3.4 ADJUSTING

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.

3.5 SCHEDULE

- A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION

SECTION 08 4313

ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Aluminum-framed storefront, with vision glass.
- B. Insulated infill panels of metal.
- C. Aluminum doors and frames.
- D. Aluminum light shelves.
- E. Flashing where storefront abutts masonry.
- F. Weatherstripping.

1.2 RELATED REQUIREMENTS

- A. Section 07 2100 - Thermal Insulation: Insulating between storefront and adjacent construction.
- B. Section 07 4213 - Metal Wall Panels: Flashing where storefront abutts metal panels.
- C. Section 07 9200 - Joint Sealants: Sealing joints between frames and adjacent construction.
- D. Section 08 7100 - Door Hardware: Hardware items other than specified in this section.
- E. Section 08 8000 - Glazing: Glass and glazing accessories.

1.3 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.
- B. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.
- C. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2012.
- D. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- E. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2014.
- F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, insulated metal infill panels, door hardware, internal drainage details.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, fastener types and spacing, expansion and contraction joint location and details, and field welding required.

1. Include design engineer's stamp or seal on shop drawings for attachments, anchors, and resistance to wind loads.
 - D. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
 - E. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.
 - F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- 1.6 QUALITY ASSURANCE
- A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in North Carolina .
 - B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Handle products of this section in accordance with AAMA CW-10.
 - B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.
- 1.8 FIELD CONDITIONS
- A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C). Maintain this minimum temperature during and 48 hours after installation.
- 1.9 WARRANTY
- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
 - B. Correct defective Work within a ten year period after the Date of Substantial Completion.
 - C. Provide ten year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
 - D. Provide 20 year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.1 BASIS OF DESIGN -- FRAMING FOR MONOLITHIC & INSULATING GLAZING

- A. Center-Set Style, Thermally-Broken:
 1. Basis of Design: Kawneer Trifab 451T.
 2. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep (51 mm wide by 114 mm deep).
- B. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below:
 1. Trulite Glass and Aluminum Solutions, LLC; CS451: www.trulite.com.
 2. YKK AP America Inc; YES 45 ST: www.ykkap.com/#sle.
- C. Substitutions: See Section 01 6000 - Product Requirements.
 1. For any product not identified as "Basis of Design", submit information as specified for substitutions.

2.2 BASIS OF DESIGN -- SWINGING DOORS

A. Wide Stile, Insulating and Monolithic Glazing:

1. Basis of Design: Kawneer 500 Heavy Wall Entrances.
2. Thickness: 2 inches (50 mm).
3. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below:
 - a. Trulite Glass and Aluminum Solutions, LLC; Magnum Entrances: www.trulite.com.
 - b. YKK AP America Inc; 50M Monumental Commercial Entrances: www.ykkap.com.
 - c. Substitutions: See Section 01 6000 - Product Requirements.
 - 1) For any product not identified as "Basis of Design", submit information as specified for substitutions.

B. Flush, aluminum skinned, Not Thermally-Broken:

1. Basis of Design: Kawneer Flushline Series, embossed aluminum face sheets..
2. Thickness: 1-3/4 inches (43 mm).
3. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below:
 - a. Trulite Glass and Aluminum Solutions, LLC: www.trulite.com.
 - b. YKK AP America Inc: www.ykkap.com.
 - c. Substitutions: See Section 01 6000 - Product Requirements.
 - 1) For any product not identified as "Basis of Design", submit information as specified for substitutions.

2.3 STOREFRONT

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.

1. Unitized, shop assembly.
2. Glazing Rabbet: For 1 inch (25 mm) insulating glazing.
3. Finish: Class I natural anodized.
 - a. Factory finish all surfaces that will be exposed in completed assemblies.
 - b. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
4. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
5. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
6. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.

7. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F (95 degrees C) over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
 8. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
 9. Perimeter Clearance: Maintain nominal 3/8" clearance between framing members and adjacent construction while allowing expected movement.
- B. Performance Requirements:
1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
 - a. Positive/Negative Design Wind Loads: See structural drawings for lbf/sf ft.
 - b. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.

2.4 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
1. Framing members for interior applications need not be thermally broken.
 2. Glazing Stops: Flush.
- B. Glazing: As specified in Section 08 8000. 1" insulating glazing at exterior storefront, 1/4" monolithic glazing at interior storefront.
- C. Infill Panels: Insulated, aluminum sheet face and back, with edges formed to fit glazing channel and sealed. Basis of Design, Mapes-R or similar.
1. Face Sheet: 0.032 inch (0.8 mm) thick.
 2. Back Sheet: 0.025 inch (0.63 mm) thick.
 3. Exterior Finish: Panel manufacturer's standard polyvinylidene fluoride (PVDF) coating, top coat over epoxy primer. Color to be selected from manufacturer's full range of solid colors.
 4. Interior Finish: Clear anodized.
 5. Substrate: Hardboard or cement board.
 6. Insulation: Mineral fiber board, Class A, Micore or similar.
- D. Swing Doors: Flush or with aluminum framed vision lites - See Schedules on drawings..
1. Bottom Rail: Minimum 10 inches (254 mm) high.
 2. Glazing Infill:
 - a. Exterior Doors: 1" Insulating glazing.
 - b. Interior Doors: 1/4" Monolithic glazing.
 3. Glazing Stops: Square.
 4. Finish: Same as storefront.
- E. Accessories:

1. Light Shelves: Aluminum extrusion perimeter shapes with composite panel infill, tiltable for cleaning. Finish on bottom surface of infill panel to match adjacent storefront framing, top surface to be painted white. Basis of Design product - Kawneer InLighten.
 - a. Other Manufacturers:
 - 1) C.R. Laurence Compant, Inc; 7100 Series Aluminum Interior Light Shelf System: www.crlaurence.com.
 - 2) Trulite Glass and Aluminum Solutions, LLC: www.trulite.com.
 - 3) YKK AP America Inc; Luminance Light Shelf System: www.ykkap.com.
 - 4) Substitutions: See Section 01 6000 - Product Requirements.
2. At perimeter storefront framing, provide plastic/vinyl non-structural flat fillers (Shim backers) to support backer rods.

2.5 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Sheet Aluminum: ASTM B209 (ASTM B209M).
- C. Fasteners: Stainless steel.
- D. Exposed Flashings: Aluminum sheet, 0.040 inch (1.0 mm) minimum thickness or as indicated on drawings; finish to match framing members.
- E. Sill Flashing Sealant: Elastomeric, silicone or polyurethane, compatible with flashing material.
- F. Sealant for Setting Thresholds: Non-curing butyl type.
- G. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
- H. Glazing Accessories: As specified in Section 08 8000.

2.6 FINISHES

- A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils (0.018 mm) thick.

2.7 HARDWARE

- A. For each door, include weatherstripping.
- B. Other Door Hardware: As specified in Section 08 7100.
- C. Weatherstripping: Bulb type, continuous and replaceable; provide on all doors.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

3.2 INSTALLATION

- A. Coordinate sequence of work with other trades; flashing provided by metal wall panel installer where storefront abutts metal wall panels.
- B. Install wall system in accordance with manufacturer's instructions.

- C. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- D. Provide alignment attachments and shims to permanently fasten system to building structure.
- E. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- F. Provide thermal isolation where components penetrate or disrupt building insulation.
- G. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- H. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- I. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- J. Install glass and infill panels in accordance with Section 08 8000, using exterior wet/dry glazing method.
- K. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.3 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inch per 3 feet (1.5 mm per m) non-cumulative or 0.06 inch per 10 feet (1.5 mm per 3 m), whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.8 mm).

3.4 ADJUSTING

- A. Adjust operating hardware for smooth operation.

3.5 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.6 PROTECTION

- A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 08 4435

PROTECTIVE FRAMED GLAZING ASSEMBLIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Interior protective framed glazing assembly.

1.2 RELATED REQUIREMENTS

- A. Section 04 2000 - Unit Masonry: Rough openings to receive window assemblies.

1.3 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.
- B. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2012.
- C. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- D. ITS (DIR) - Directory of Listed Products; current edition.
- E. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by each affected installer.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide evidence of compliance with fire performance criteria and manufacturer's published product data on framing components, glazing, anchorage and fasteners.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
- D. Samples: Submit samples as follows illustrating each exposed metal finish of interior project-specific applications.
- E. Warranty Documentation: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with at least five years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to substrate when exposed to sunlight or weather.

1.8 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C), and maintain above this minimum temperature during and for 48 hours after installation.

1.9 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.1 INTERIOR PROTECTIVE FRAMED GLAZING ASSEMBLIES

- A. Manufacturers:
 - 1. Curries, an Assa Abloy Company: Fire Window Frame; www.curries.com.
 - 2. SAFTIFIRST, a division of O'Keeffe's Inc; GPX Architectural Series with fire resistive walls/windows: www.safti.com/#sle.
 - 3. Technical Glass Products; Fireframes Aluminum Series: www.fireglass.com.
 - 4. Vetrotech Saint-Gobain USA; VDS 120: www.vetrotechusa.com.
 - 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Provide factory fabricated, factory finished framing members with glazing and related anchorage and attachment devices.
 - 1. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing room for tested assembly's required sealant joints and connection details.
- C. Fire Performance: Hourly rating as indicated on drawings; tested as an assembly including glazing.
 - 1. Acceptable evidence of compliance includes listing by UL (DIR), ITS (DIR), or testing agency acceptable to authorities having jurisdiction.

2.2 COMPONENTS

- A. Framing Members: Formed steel structural members with aluminum cladding and non-combustible thermally-resistive material as required for fire rating.
 - 1. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.

2.3 MATERIALS

- A. Sealants Within Fire-Rated Assembly: As required by fire-rating and manufacturer's assembly.
- B. Refer to Section 07 9200 for additional information on sealant requirements.
- C. Glazing Gaskets: Type to suit application to achieve fire-rating requirements.

2.4 FINISHES

- A. Finishing: Apply factory finish to surfaces that will be exposed in completed assemblies.
 - 1. Touch-up surfaces cut during fabrication so that no natural metal surfaces are visible in completed assemblies, including joint edges.
- B. Aluminum Finish: Class II natural anodized.
 - 1. Apply factory finish to surfaces that will be exposed in completed assemblies.

2. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
- C. Class II Natural Anodized Finish: AAMA 611 AA-M12C22A31 Clear anodic coating not less than 0.4 mils (0.01 mm) thick.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that wall openings are ready to receive work of this section.
- C. Verify that anchorage devices have been properly installed and located.

3.2 INSTALLATION

- A. Install wall system in accordance with limitations of fire rating and with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.3 TOLERANCES

- A. Maximum Variation from Plumb: 1/16 inch every 3 feet (1.6 mm every 0.914 m) non-cumulative or 1/2 inch per 100 ft (12.7 mm per 30.5 m), whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.8 mm).
- C. Sealant Space Between Mullions and Adjacent Construction: Maximum of 3/4 inch (19 mm) and minimum of 1/4 inch (6.4 mm).

3.4 FIELD QUALITY CONTROL

- A. Provide services of manufacturer's field representative to observe installation and submit report.
- B. Replace components that have failed field testing and retest until performance is satisfactory.

3.5 CLEANING

- A. Remove protective material from pre-finished surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

3.6 PROTECTION

- A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Work under this section includes furnishing and the installation of finish hardware specified herein and noted on drawings for a complete and operational system, including any electrified door hardware components and low-speed auto operators.
- B. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. Definition: "Finish Hardware" includes items known commercially as finish / security hardware and systems which are required for swing, sliding and folding doors, except special types of unique and non-matching hardware specified in the same section as the door and door frame.
- B. Extent of finish / security hardware required is indicated on drawings and in Part 3: Hardware Sets. Provide items, articles, materials, operations and methods listed, mentioned or scheduled herein or on the drawings, in quantities as required to complete the project. Provide hardware that functions properly and compliant with required Codes: Fire/Life Safety/ADA. Prior to furnishing the hardware, advise the architect of items that will not operate properly, are improper for conditions, or will not remain permanently anchored.
- C. Types of finish hardware required include, but are not limited to, the following:
 - 1. Butt Hinges
 - 2. Continuous Hinges
 - 3. Lock cylinders and keys
 - 4. Lock and latch sets
 - 5. Exit devices
 - 6. Door Pulls
 - 7. Closers
 - 8. Door trim units
 - 9. Weatherstripping for exterior doors
 - 10. Protection plates
 - 11. Thresholds, Gaskets, and Door Bottoms
 - 12. Key Cabinet
 - 13. Electrified Hardware
 - 14. Coat Hooks at office doors
- D. References
 - 1. NFPA-80- as adopted - Standard for Fire Doors and Windows
 - 2. NFPA-101-as adopted - Life Safety Code
 - 3. NFPA - 70 - National Electric Code
 - 4. ADA - The Americans with Disabilities Act - Title III - Public Accommodations
 - 5. ANSI-A 117.1-American National Standards Institute - Accessible and Usable Buildings and Facilities
 - 6. ANSI-A156.5-American National Standards Institute - Auxiliary Locks and Associated Products
 - 7. NC Building Code as Adopted.
 - 8. Positive Pressure Testing UL10C & UBC7.2
 - 9. UL - Underwriters Laboratories
 - 10. WHI - Warnock Hersey International, Division of Intertek Testing Services
 - 11. State, Local and Federal Codes, National Electrical Building Codes, including the Authority Having Jurisdiction.

1.3 QUALITY ASSURANCE

- A. Manufacturer: Obtain each type of hardware (ie., lock sets / security equipment) from a single manufacturer, although several may be indicated as offering products complying with requirements.
- B. Supplier: A recognized architectural finish hardware supplier, with warehousing facilities, who has been furnishing hardware and installation in the project's vicinity for a period of not less than 5 years. The supplier shall be, or shall employ, an Architectural Hardware Consultant (AHC) who is available, at reasonable times during the course of the work, for consultation about project's hardware requirements, to the Owner, Architect and the Contractor. The architectural hardware consultant (AHC) shall prepare all hardware and wiring diagrams. This Supplier is responsible for proper coordination of all finished hardware with related sections to insure compatibility of products. The Hardware Supplier shall attend all coordination meetings regarding hardware applications with related trades.
- C. Fire-Rated Openings: Provide hardware for fire-rated openings in compliance with NFPA Standard No. 80 and local building code requirements. Provide only hardware, which has been tested and listed by UL / WHI or FM for types and sizes of doors required and complies with requirements of door and door frame labels. Provide door seals to meet Positive Pressure Testing UL10C and UBC7 - 2 as required.
- D. Where emergency exit devices are required on fire-rated doors (with supplementary marking on doors' UL or FM labels indicating "Fire Door to be Equipped with Fire Exit Hardware") provide UL / WHI or FM label on exit devices indicating "Fire Exit Hardware".
- E. Thru bolt door closers at all doors and exit devices – except at FRP doors. The Hardware Supplier shall verify and coordinate proper blocking if provided from the door manufacturer for hardware attachment on doors.
- F. Unless otherwise specified, provide lever handle locksets ADA compliant.
- G. Pre-Installation Meeting: The GC /CM shall initiate and conduct a jobsite meeting with the hardware supplier and the Installer, and all related trades for mechanical and electrical hardware. This meeting shall convene at least one month prior to commencement of the related work, specifically, the electrical rough-in for coordination of electrified hardware applications. All approved shop drawings, wiring diagrams, and schedules shall be made available to all related trades as required for work to be performed. The Owner's representative shall attend all pre-install meetings. One month prior to the installation of the hardware, the hardware supplier shall, with the assistance of the manufacturer's representative, provide review/training to the Installers of the following products: closers, exit devices, locks, and electrified hardware.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data for each item of hardware in accordance with Division-1 section "Submittals". Include whatever information may be necessary to show compliance with requirements, and include instructions for installation and for maintenance of operating parts and finish.
- B. Hardware Schedule: Submit copies of the schedule in accordance with Division 1 - "Submittals", General Requirements. Schedule shall be in vertical format, listing each door opening, including: handing, all hardware scheduled for the opening or otherwise required to allow for proper function of door openings as intended, and the finish of the hardware. At doors with door closers or door controls, include degree of door opening. If requested, all submittals (schedules, cut sheets, diagrams) shall be reviewed by the Owner's representative prior to ordering the material. Furnish wiring diagrams for all electrified hardware.
 - 1. Final Hardware Schedule Content: Based on finish hardware indicated, organize hardware schedule into a vertical format with "hardware sets" indicating complete designations of every item required for each door or opening. Include the following information:
 - a. Type, style, function, size and finish of each hardware item.
 - b. Name and manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Maintain the same Set/Heading numbering from Part 3 of this section, or reference to the

- Spec Set number in the Heading.
 - e. Reference door numbers from the door/frame schedule in the plan set.
 - f. Explanation of all abbreviations, symbols, codes, etc., contained in schedule.
 - g. Mounting locations for hardware.
 - h. Door and frame sizes and materials.
 - i. Keying information as available.
 - j. One Heading/Set per page
 - k. Operational Description for all specified electrical hardware shall be included with each Heading/Set.
 - C. Submittal Sequence: Submit hardware schedule and wiring diagrams according to the GC's established project schedule, particularly where acceptance of hardware schedule must precede fabrication of other work (e.g., hollow metal frames), and electrical rough-in, which is critical in the project construction schedule. Include with schedule the product data, catalog cuts, samples, templates, shop drawings of other work affected by finish hardware, and other information essential to the coordinated review of hardware schedule.
 - D. Keying Schedule: Coordinate, and prepare as required, the keying schedule after meeting with the Owner to determine the Owner's instructions for keying.
 - E. Samples if Requested: Prior to submittal of the final hardware schedule and prior to final ordering of finish hardware, submit any requested samples of type of exposed hardware unit, finished as required, and tagged with full description for coordination with schedule.
 - F. Templates: Furnish hardware templates to each fabricator of doors, frames and other work to be factory-prepared for the installation of hardware. Upon request, check shop drawings of such other work, to confirm that adequate provisions are made for proper location, coordination and installation of hardware.
 - G. Manufacturer's Catalog Cuts: Submit manufacturer's cut/catalog sheets on all hardware items and any required special mounting instructions with the hardware schedule.
 - H. Wiring Diagrams: Provide complete wiring diagrams for each opening requiring electrified hardware. Provide an elevation drawing, with each electrified hardware set. Provide a point-to-point diagram prior to the delivery of hardware to job site and another copy to the Owner at time of job completion. All electrical components shall be listed by opening in the hardware submittals. Include an operational description with each diagram.
 - I. Operational Descriptions: Provide a complete operational description of the specified electrified hardware components for each opening, and include the description under the hardware set/heading in the hardware submittal. Operational descriptions shall detail how each electrified component functions within the opening, incorporating all conditions of ingress and egress. Review these descriptions with all related trades at the Pre-Install meetings.
 - J. Elevation Drawings: Provide elevation drawings of electronic hardware and systems identifying locations of the system components with respect to their placement in the door opening. Include the number of wires, with the gauge included, needed at the specific locations. Provide a copy with each hardware schedule submitted for approval. Supply another copy to the Owner upon project completion. Include an operational description with each drawing.
- 1.5 PRODUCT HANDLING
- A. Tag each item or package separately, with identification related to final hardware schedule, and include basic installation instructions with each item or package.
 - B. Inventory hardware jointly with the General Contractor, representatives of hardware supplier / hardware installer until each is satisfied that count is correct.
 - C. Deliver individually packaged hardware items at the proper times to the proper locations (shop or project site) for installation.

- D. The General Contractor shall provide secure lock-up for hardware and security equipment delivered to the project, but not yet installed. Control handling and installation of hardware items, which are not immediately replaceable, so that completion of the work will not be delayed by hardware losses, both before and after installation.

1.6 SEQUENCING AND SCHEDULING

- A. Deliver all finish hardware to the job site in a timely manner so not to delay progress of other trades.

1.7 WARRANTY

- A. Door closers shall include a thirty (30) year manufacturers' warranty against defects in materials and workmanship.
- B. Exit Devices shall include a three (3) year warranty.
- C. Hinges: Life of Building.
- D. Electrified Hardware shall include a one (1) year warranty.
- E. Other Hardware shall include a three (3) year warranty.

PART 2 - PRODUCTS

2.1 SCHEDULED HARDWARE

- A. Requirements for design, grade, function, finish, size and other distinctive qualities of each type of finish hardware are indicated in the Finish Hardware Data Sheet and Hardware Schedule at the end of this section. Products are identified by using hardware designation numbers of the following:

- B. Manufacturers:

	Hardware Item:	Specified Manufacturer	Designation
1.	Butt Hinges:	Ives	IVE
2.	Continuous Hinges	Ives	IVE
3.	Locksets:	Yale	YAL
4.	Cylinders/Cores	Yale	YAL
5.	Silencers:	Ives	IVE
6.	Stops:	Ives	IVE
7.	Overhead Stops	Glynn-Johnson	GLY
8.	Closers:	LCN	LCN
9.	Thresholds:	Zero	ZER
10.	Gasket/Door Bottoms:	Zero	ZER
11.	Kickplates:	Ives	IVE
12.	Pull/Push Plates:	Ives	IVE
13.	Exit Devices:	Von Duprin	VON
14.	Flush Bolts:	Ives	IVE
15.	Automatic Flush Bolts:	Ives	IVE
16.	Miscellaneous Hardware:	Ives, Glynn-Johnson	IVE/GLY
17.	Key Cabinet	See Spec	
18.	Network Locksets	Schlage Electronics	SCE
19.	Power Supplies Power Transfers	Von Duprin	VON

- C. Provide products as hereafter specified. Substitutions other than those manufacturers listed, must be approved, in writing, via addenda, prior to bid. Procedure for substitutions shall be as outlined in Division 1. No substitutions will be considered after award of contract.

2.2 MATERIALS AND FABRICATION

A. General:

1. Hand of Door: Drawings show direction of slide, swing or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.
2. Coordinate door pulls with cylinder lock location to confirm pulls do not interfere with access to lock. Provide offset pulls if required.
3. Manufacturer's Name Plate: Do not use manufacturer's products which have manufacturer's name or trade name displayed in a visible location (omit removable nameplates), except in conjunction with required UL labels and as otherwise acceptable to Architect.
4. Manufacturer's identification will be permitted on rim of lock cylinders only.
5. Finishes:
 - a. 626/652 for all finished metal hardware items except as 630 is otherwise indicated. Door closers to be powder coated to match 652/626. Exit devices shall be US26D with stainless steel touchbars.
6. Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware, which has been prepared for self-tapping sheet metal screws, except, as specifically indicated.
7. Furnish screws for installation, with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of such other work as closely as possible, including "prepared for paint" in surfaces to receive painted finish.
8. Provide concealed fasteners for hardware units which are exposed when door is closed, except to extent no standard units of type specified are available with concealed fasteners. Use thru-bolts for closer and exit devices. Coordinate wood door blocking at all wood doors and all fire-rated wood doors. Provide sleeves for each thru-bolt or use sex screw fasteners.
9. Tools and Maintenance Instructions for Maintenance: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of finish hardware.

2.3 HINGES AND BUTTS

- A. Templates: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.
- B. Screws: Furnish Phillips flat-head or machine screws for installation of units, except furnish Phillips flat-head or wood screws for installation of units into wood. Finish screw heads to match surface of hinges or pivots.
- C. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
 1. Steel Hinges: Steel pins.
 2. Non-ferrous Hinges: Stainless steel pins.
 3. Exterior Doors: Non-removable pins.
 4. Out-swing Corridor Doors: Non-removable pins.
 5. Interior Doors: Non-rising pins.
 6. Tips: Flat button and matching plug, finished to match leaves.
 7. Number of hinges: Provide number of hinges indicated but not less than 3 hinges for door leaf for doors 90" or less in height and one additional hinge for each 30" of additional height.
 8. **Owner Preferred:**
 - a. **Ives: 5BB1/5BB1HW**
 9. Acceptable Manufacturers:
 - b. McKinney: TB2714/TB2314/TB3786/TB3386

- c. Stanley: FBB179/199/168/191
- D. Continuous Hinges: Provide concealed, non-handed, full height hinges with interlocking cover and symmetrically template hole pattern made from extruded aluminum. Finish shall be BHMA 628. Field modifications for cutting shall be permitted up to 6" from the bottom.
 - 1. **Owner Preferred**
 - a. **Ives: 112HD**
 - 2. Acceptable Manufacturers:
 - b. Select: SL11HD
 - c. Stanley: 661HD

2.4 CYLINDERS AND KEYING

- A. General: The Hardware Supplier shall furnish the keyed permanent cores and keys for the project. All locks/cylinders shall be furnished with keyed temporary construction cores. The construction cores shall utilize a color-coded construction cores system which is not part of the Owner's existing permanent key system. The Hardware Supplier shall be responsible for furnishing/invoicing the GC for the construction cores. The General Contractor, under the supervision of the Owner, shall install permanent cores and return the construction cores to the Hardware Supplier for credit to the GC. The Owner shall assume no responsibility for construction cores, and the construction cores shall not be part of the Owner's material list from the GC. All permanent keyed cores shall be furnished as Yale. Provide permanent keys and cores stamped with the applicable key mark for identifications. These visual key control marks or codes shall not include the actual key cuts: VKC.
- B. The NHCS existing key system is a Yale restricted (patented) grandmaster system which shall be utilized for all project keying requirements. Equip locks and cylinders with Yale factory-keyed cores as specified. All cylinder housings shall accept Yale keyed permanent cores. The Hardware Supplier shall confirm all keying and core requirements with the Owner's representative prior to ordering the cores.
- C. Provide permanent keys and cores stamped with the applicable key mark for identifications. These visual key control marks or codes shall not include the actual key cuts: VKC. All cylinders/locksets shall be furnished with temporary construction keyed cores for the construction period of the project. Furnish five (5) Construction Keys and one (1) control key for the General Contractor's use during project construction. Furnish five (5) each Grandmaster keys. Furnish five (5) each Master keys (per master group). Furnish a total of three (3) change keys per cylinder or keyed alike group. Actual cut keys to be determined by the school district. All keys shall be stamped with key symbols and "Do Not Duplicate".
- D. DO NOT provide any permanent control keys.
- E. Provide one (1) each bitting list to the Owner by registered mail.
- F. **Owner Preferred:**
 - 1. **Yale**

2.5 MORTISE LOCKS

- A. Locksets shall be as specified: Mortise lockset shall be Series 1000, Grade 1 Operational and Security, UL Listed for 3-hour fire door. Strikes: Provide manufacturer's standard wrought box strike for each latch or lock bolt, with ANSI curved lip extended to protect frame, finished to match hardware set. Where specified, provide a replaceable breakaway spindle mechanism residing inside the lock chassis. The lock case shall be full wrapped heavy gauge steel with all metal zinc dichromate plated working parts. Lock case shall be universal function type and allow for field reversible handing without opening the lock case. Lever rotation shall be in both directions for ease of use, and allow for independent lever rotation. All locks except Yale shall be furnished as "less cylinder". Add Yale cylinders with keyed permanent cores.

- B. Lock Throw: Provide solid stainless steel 1-1/2" deadbolt with 1" minimum throw. Comply with UL requirements for throw of bolts and latch bolts on rated fire openings.
- C. Provide 3/4" minimum throw on latch bolts.
- D. **Owner Preferred:**
 - 1. **Yale AU5400 x LN**
- E. Acceptable Manufacturers:
 - 1. Schlage ND Series
 - 2. Corbin-Russwin CL3100 Series

2.6 PULLS/ PUSH PLATES

- A. Exposed Fasteners: Provide manufacturer's standard exposed fasteners for installation; through-bolted for matched pairs, but not for single units. Furnish type and size as specified in Hardware Sets.
- B. Acceptable Manufacturers:
 - 1. Ives
 - 2. Burns
 - 3. Trimco

2.7 CLOSERS AND DOOR CONTROL DEVICES

- A. Size of Units: Except as otherwise specifically indicated, comply with the manufacturer's recommendations for size of door control unit, depending upon size of door, exposure to weather and anticipated frequency of use.
- B. Closers: All door closers shall be of one manufacturer to provide for proper installation and servicing after installation. All closers shall use high strength cast iron cylinders, forged main arms, and one-piece forged steel pistons. All closers shall be inspected after installation by a factory representative to ensure proper adjustment and operation. A report shall be filed with the architect after said visit has been made. Closer shall carry a manufacturer's minimum 20-year warranty for hydraulic units and 2-year warranty for electrical and/or handicap power assist door closers against manufacturing defects and workmanship. PRV [pressure relief valves] are not acceptable.
- C. Parallel Arm Closers: Shall incorporate one piece solid forged steel arms steel stud shoulder bolts, shall be incorporated in regular arms, hold open arms, arms with stop built in, arms with hold open and stop built in. All other closers to have forged steel main arms for strength, and durability. Unless otherwise specified, mount all closers parallel arm.
- D. Built-In Stops: Where closers with built-in positive stops are used, the stops shall be of one piece cast malleable iron material with built in springs. Where required, the hold-open assembly handle for these stops shall rotate on ball bearings.
- E. All door closers shall pass UL10C positive pressure fire test.
- F. Provide closers with adjustable spring power. Size closers to ensure exterior and fire rated doors will consistently close and latch. Size all other door closer to allow for reduced opening force not to exceed 5 lbs.
- G. Hydraulic Fluid: All closers, with the exception of interior electronic closers, shall utilize temperature stable fluid capable of withstanding temperature ranges of 120 degrees F. to -30F. without requiring seasonal adjustment of closer speed to properly close the door. Fluid shall be nonflammable.

- H. All closers shall have a powder coat finish on closer body, arm, cover and adapter plate. Furnish special rust inhibiting pretreat coating, as specified, for closer body, arm, cover and plates before the powder coat finish.
- I. All door closers shall have full covers and separate adjusting valves for sweep, latch and back-check. Provide all drop plates, shoe supports, templates, etc. to properly mount closers according to manufacturers' recommendations.
- J. **Owner Preferred:**
 - 1. **LCN 4040XP/4040XP SCUSH**
- K. Acceptable Manufacturers:
 - 1. Corbin-Russwin DC8200 A11
 - 2. Sargent 281 x EDA/ 281CS
- L. Through bolts shall be used for attachment of closers at all doors.

2.8 EXIT DEVICES

- A. General: All devices shall be of one manufacturer to provide for proper installation and servicing. Devices shall be furnished non-handed and capable of direct field conversion for all available trim functions. All devices shall carry a minimum three-year warranty against manufacturing defects and workmanship. All devices shall be push-through touch pad design as specified. No exposed touch bar fasteners, no exposed cavities when operated.
- B. Furnish all touch-pad type devices with stainless steel touch bars. Plastic parts are not acceptable. Dogging mechanism shall be mechanical hook type with no plastic dogging cams.
- C. Furnish all touch-pad type exit devices with deadlocking latch bolts. Latchbolts shall be moly-coated to reduce friction against the strike.
- D. Furnish all touch-pad exit devices with flush end caps. End caps shall be flush with device housing with no raised edges.
- E. Furnish roller strikes with all rim exit devices.
- F. All removable mullions shall be furnished with key function for removal. Furnish stabilizers similar to Von Duprin 154 with all removable mullions.
- G. Outside Trim: Shall be heavy duty type and fastened by means of concealed welded lugs and thru-bolts from the inside. Trim shall be forged brass with a minimum average thickness on the escutcheon of .130. Plate with trim shall be brass with minimum average thickness of .090 and have forged pulls. Where Lever Handles are specified provide 996 type Break Away Trim. Where outside trim is specified, furnish trim that thru-bolts directly to the exit device center case.
- H. Furnish cylinders with all lockable exit devices.
- I. Furnish required filler plates and shim kits for flush mounting of exit devices on all doors requiring same. Exit devices to be mounted on full-glass doors, shall not have exposed fasteners on the mechanism case.
- J. Springs: Compression type only. Torsion springs are not acceptable.
- K. Electrified Functions: Electric Latch Retraction shall be provided with a continuous duty solenoid, retracting the latch bolt for momentary latch retraction, or may be held retracted for extended periods of time. Electric operated trim device shall be furnished as Fail-Safe. When the power is off, the trim is unlocked for free entry. The trim may then be relocked electrically by applying power.

- L. Exit Device Dogging: Except on fire-rated doors, wherever closers are provided on doors equipped with exit devices, equip the units with keyed dogging device to hold the push bar down and the latch bolt in the open position, or as Less Dogging (LD) as specified.

M. Owner Preferred:

- 1. Von Duprin 99 Series, 996 Series lever trim, 990 Series pull trim

N. Acceptable Manufacturers:

- 1. Precision 2100 series, 4900 series lever trim, 1700A series pull trim
- 2. Sargent 80 series, 700 ET series lever trim, 800 MAL pull trim

2.9 DOOR TRIM UNITS

- A. Fasteners: Provide manufacturer's standard exposed fasteners for door trim units (kick plates, edge trim, viewers, knockers, mail drops and similar units); either machine screws or self-tapping screws.
- B. Fabricate edge trim of stainless steel, not more than 1/2" nor less than 1/16" smaller in length than door dimension.
- C. Fabricate protection plates (armor, kick or mop) not more than 2" less than door width on stop side and not more than 1" less than door width on pull side, x the height indicated.
- D. Metal Plates: Stainless steel, .050" (U.S. 18 ga), bevel 3 edges: top and both sides.
- E. Acceptable Manufacturers:
 - 1. Ives
 - 2. Trimco
 - 3. Burns

2.10 GASKETS, DOOR BOTTOMS

- A. General: Except as otherwise indicated, provide continuous weatherstripping at each edge of every exterior door leaf, except where stated the door manufacturer will provide the weatherstripping. Provide type, sizes and profiles shown or scheduled. Provide non-corrosive fasteners as recommended by manufacturer for application indicated. All gaskets for fire label doors shall comply the door manufacturers label approvals. Fire-label wood doors shall be furnished as "Category A" type with the intumescent seal, integral to the door construction.
- B. Sound seal: Provide types as indicated for sound isolation. As indicated in the Door Schedule each door shall receive an automatic door bottom and double row of bulb-type adhesive gasket.
- C. Acceptable Manufacturers:
 - 1. National Guard 5050
 - 2. Reese F-797B
 - 3. Zero 188S

2.11 THRESHOLDS

- A. General: Except as otherwise indicated provide standard aluminum threshold unit of type, size and profile as shown or scheduled.
- B. Provide thresholds that are 1" wider than depth of frame.
- C. Provide gasketed threshold for all exterior doors.

- D. The hardware supplier shall verify all sill conditions and finish floor conditions and coordinate proper threshold as required to insure a smooth transition between threshold and the interior floor.

- E. Acceptable Manufacturers:

- 1. National Guard 950
- 2. Zero 566
- 3. Hager 577

2.12 DOOR SILENCERS

- A. All hollow metal frames shall have gray resilient type silencers. Quantity (3) on single doors and quantity (2) on pair of doors.

2.13 COORDINATORS

- A. Furnish type specified in hardware sets.

- B. Acceptable Manufacturers:

- 1. Ives: COR x FL
- 2. DCI: 600 x filler
- 3. Burns: 7600 series x Filler

2.14 FLUSHBOLTS

- A. Furnish type specified in hardware sets.

- B. Flush Bolt Heads: Minimum of 1/2" diameter rods of brass, bronze or stainless steel, with minimum 12" long rod for doors up to 7'-0" in height. Provide longer rods as necessary for doors exceeding 7'-0" in height.

- C. Provide dust-proof strikes for foot bolts, except where special threshold construction provides non-recessed strike for bolt.

- D. Acceptable Manufacturers:

- 1. Ives: FB31P/FB41P/ FB458
- 2. DCI: 842/962/780F
- 3. Trimco: 3810/3815/3917

2.15 OVERHEAD STOPS

- A. Furnish type specified in hardware sets. Through-bolts shall be used for attachment of overhead holders.

- B. Acceptable Manufacturers:

- 1. Glynn Johnson: 90 series
- 2. Sargent: 1790 series.
- 3. Rixson: 10 series

2.16 WALL STOPS

- A. Furnish a stop or holder for all doors. Furnish floor stops only where specifically indicated. Where wall stops are not applicable, furnish overhead stops. Holder shall not be furnished at fire-rated doors.

- B. Acceptable Manufacturers:

1. Ives: WS406/407CCV
2. Trimco: 1270WXCP
3. DCI: 3211

2.17 KEY CABINET

- A. Furnish one each wall-mount cabinet with a capacity of 1.5 times the number of key sets. Provide the cabinet with at least one hook for each key set, plus additional hooks for 50% expansion. Furnish the cabinet complete with a cam lock, permanent key tags, and change key cards. The Hardware Supplier shall prepare all change key index records, tag all keys and place permanent file keys in the cabinet. Review with the Owner.
- B. Acceptable Manufacturers:
 1. Lund Deluxe Series 1200
 2. MMF
 3. Telkey

2.18 KEY KEEPER

- A. Furnish one each secure storage box for two each building keys for emergency personnel use. This box shall be located per the architect and fire marshal at the exterior of the building. This box shall be approved by the City of Wilmington and by New Hanover County.
- B. Dual Lock Model, Recessed Mount, 1/4" plate steel housing, 5/8" thick steel door with interior gasket seal. Vault and Lock UL listed. Lock has 1/8" dust cover with tamper seal mounting capability. Vault has anti-theft re-locking mechanism with drill resistant hard-plate lock protector.
- C. UL Listed. Double-action rotating tumblers and hardened steel pins accessed by a biased cut key.
- D. **Owner Preferred:**
 1. **Knox Vault 4400 Series**
- E. Acceptable Manufacturers:
 1. Eagle
 2. Ramset

2.19 ELECTRONIC NETWORK LOCKSETS/READERS

- A. Network Locksets, network exit trim, wall-mount readers, and all necessary components shall be programmed by the Owner's network/client-software and provided by security. All readers shall include the capability to be configured as stand-alone and as networked. All lock readers, exit readers, and wall readers shall include a multi-technology reader which may be changed out without removing the lock/trim from the door. All network locksets/ exit trim shall accept the Yale keyed permanent core.
- B. All readers shall be compatible with the Owner's existing access control system and cards.
- C. Panel Interface Module (PIM) shall be provided by security.
- D. **Owner Preferred:**
 1. **Schlage Electronics AD400 / MT Series**
- E. Acceptable Manufacturers:
 1. Sargent Persona / 4300 Series

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mount hardware units at heights indicated in "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute, except as specifically indicated or required to comply with governing regulations, and except as may be otherwise directed by Architect.
- B. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Wherever cutting and fitting is required to install hardware onto or into surfaces, which are later to be painted or finished in another way, coordinate removal, storage and reinstallation or application of surface protections with finishing work specified in the Division 09 sections. Do not install surface-mounted items until finishes have been completed on the substrate.
- C. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- D. Drill and countersink units, which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- E. Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant.
- F. Adjust and reinforce attachment substrate for proper installation and operation:
 - 1. Gaskets: Install jamb-applied gaskets before closers, overhead stops, rim strikes, etc.
- G. Locate floor stops not more than 4 inches from the wall.
- H. Verify actual locations of wiring connections before electrified door hardware is installed.
- I. Examine doors and frames with the hardware installer for compliance with requirements for installation tolerances, labeled fire door assembly, wall and floor construction, and other conditions affecting door performance.
- J. Existing door/frame conditions: The GC and all related trades shall review the existing conditions prior to ordering and installing any new hardware. Notify the architect of any exceptions. All existing doors scheduled to be re-worked and re-used shall be reviewed with the Finish Hardware Submittal and templates before the doors are prepped for the new hardware and re-hung in the door opening.
- K. The Hardware Installer shall be responsible for installation of all mechanical and electromechanical hardware items specified in the Hardware Sets, at the end of the section, in accordance with the manufacturer's technical installation guidance, and in addition to all applicable code requirements. Electromechanical hardware items include: electrified hinges, power transfers, network locksets, network exit trim, electrified panic devices.
- L. The Division 26 Electrical sub-contractor shall make all wiring connections from the electrified hardware to the power source wiring. The Electrical sub-contractor shall install and connect all power supplies to the electrified hardware items. The Electrical sub-contractor shall provide and install all (120VAC) power source wiring as required for the electrified locking and access control hardware, equipment, accessories, and power supplies.

3.2 ADJUST AND CLEAN

- A. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Replace units, which cannot be adjusted to operate freely and smoothly as intended for the application made.
- B. Clean adjacent surfaces soiled by hardware installation.

- C. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy, and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.
- D. Instruct Owner's Personnel in proper adjustment and maintenance of hardware and hardware finishes, during the final adjustment of hardware.
- E. Continued Maintenance Service: Approximately six months after the acceptance of hardware in each area, the Installer, accompanied by the representative[s] of the Finish Hardware manufacturer[s], shall return to the project and re-adjust every item of hardware to restore proper function of doors and hardware. Consult with and instruct Owner's personnel in recommended additions to the maintenance procedures. Replace hardware items, which have deteriorated or failed due to faulty design, materials or installation of hardware units. Prepare a written report of any current or predictable problems (of substantial nature) in the performance of the hardware and furnish copy to Owners Agent / Representative.

3.3 HARDWARE SETS

HARDWARE GROUP NO. 01

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112HD EPT	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	SD-RX-QEL-99-EO-24VDC	626	VON
1	EA	WIRELESS EXIT DEVICE TRIM	AD-400-993R-70-MT-RHO-JDYA6 (BY SECURITY) (REUSE EXISTING)	626	SCE
2	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
1	EA	MORTISE CYLINDER	AS REQUIRED	626	YAL
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30	689	LCN
1	EA	MOUNTING PLATE	4040XP-18	689	LCN
1	EA	WEATHER STRIPPING	BY DOOR/FRAME SUPPLIER		
1	EA	THRESHOLD	566A-223	A	ZER
1	EA	DOOR CONTACT	679-05HM (BY SECURITY)	BLK	SCE
1	EA	POWER SUPPLY	PS902 120/240 VAC	LGR	SCE

DOOR CONTACT TIED TO ACCESS CONTROL SYSTEM FOR MONITORING.

CYLINDER DOGGING AVAILABLE. PUSHBUTTON/AIPHONE TO RETRACT LATCHBOLT ON PANIC
HARDWARE TO ALLOW ENTRY. DOOR IS ALWAYS AVAILABLE FOR FREE EGRESS.

HARDWARE GROUP NO. 02

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112HD	628	IVE
1	EA	PANIC HARDWARE	CD-99-L-DT-06	626	VON
1	EA	MORTISE CYLINDER	AS REQUIRED	626	YAL
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30	689	LCN
1	EA	MOUNTING PLATE	4040XP-18	689	LCN
1	EA	WEATHER STRIPPING	BY DOOR/FRAME SUPPLIER		
1	EA	THRESHOLD	566A-223	A	ZER
1	EA	DOOR CONTACT	679-05HM (BY SECURITY)	BLK	SCE

DOOR CONTACT TIED TO ACCESS CONTROL SYSTEM FOR MONITORING.

HARDWARE GROUP NO. 03

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112HD	628	IVE
1	EA	WIRELESS LOCK	AD-400-MS-70-MT-RHO-JDYA6 (BY SECURITY)	626	SCE
1	EA	ELEC PANIC HARDWARE	CD-RX-LC-99-EO	626	VON
2	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
1	EA	MORTISE CYLINDER	AS REQUIRED	626	YAL
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30	689	LCN
1	EA	MOUNTING PLATE	4040XP-18	689	LCN

DOOR CONTACT TIED TO ACCESS CONTROL SYSTEM FOR MONITORING.

PRESENTING VALID CREDENTIAL TO READER WILL UNLOCK EXIT TRIM AND ALLOW ENTRY.
DOOR IS ALWAYS AVAILABLE FOR FREE EGRESS.

HARDWARE GROUP NO. 04

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112HD	628	IVE
1	EA	PANIC HARDWARE	CD-99-L-DT-06	626	VON
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
1	EA	MORTISE CYLINDER	AS REQUIRED	626	YAL
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30	689	LCN
1	EA	MOUNTING PLATE	4040XP-18	689	LCN

HARDWARE GROUP NO. 05

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112HD	628	IVE
1	EA	STOREROOM LOCK	AU 5405 LN	626	YAL
3	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
1	EA	DOUBLE CYLINDER DEADBOLT	D121	626	YAL
1	EA	ELECTRIC STRIKE	6400 FSE 12/24 VAC/VDC	US32D	VON
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	MOUNTING PLATE	4040XP-18	689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30	689	LCN
1	EA	POWER SUPPLY	PS902 120/240 VAC	LGR	SCE

PUSHBUTTON AT RECEPTION TO RELEASE ELECTRIC STRIKE TO ALLOW ENTRY FROM RECEPTION TO CORRIDOR. DEADBOLT FOR USE AFTER HOURS TO LOCK RECEPTION FROM CORRIDOR. DOOR IS NOT AN EXIT.

HARDWARE GROUP NO. 06

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112HD	628	IVE
1	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	AU 5405 LN	626	YAL
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
1	EA	SURFACE CLOSER	4040XP EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FIRE/LIFE WALL MAG	SEM7850	689	LCN
1	EA	GASKETING	188SBK PSA	BK	ZER

DOORS NORMALLY HELD OPEN BY MAGNETS. UPON LOSS OF POWER OR FIRE ALARM, MAGNETS TO RELEASE.

HARDWARE GROUP NO. 07

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	AU 5407 LN	626	YAL
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 08

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	AU 5407 LN	626	YAL
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 09

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	AU 5405 LN	626	YAL
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
1	EA	OH STOP	90S	630	GLY
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 10

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	WIRELESS LOCK	AD-400-MS-70-MT-RHO-JDYA6 (BY SECURITY)	626	SCE
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
1	EA	SURFACE CLOSER	4040XP REG	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER

DOOR CONTACT TIED TO ACCESS CONTROL SYSTEM FOR MONITORING.

PRESENTING VALID CREDENTIAL TO CARD READER LOCK WILL MOMENTARILY UNLOCK LOCK AND ALLOW ENTRY.

UPON LOSS OF POWER DOOR IS LOCKED.

DOOR IS ALWAYS AVAILABLE FOR FREE EGRESS.

HARDWARE GROUP NO. 11

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	AU 5407 LN	626	YAL
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
1	EA	SURFACE CLOSER	4040XP REG	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER

HARDWARE GROUP NO. 12

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK	AU 5402 LN	626	YAL
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
1	EA	SURFACE CLOSER	4040XP REG	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	COAT AND HAT HOOK	572	626	IVE

HARDWARE GROUP NO. 13

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK	AU 5402 LN	626	YAL
1	EA	MOP PLATE	8400 4" X 1" LDW B-CS	630	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	COAT AND HAT HOOK	572	626	IVE

HARDWARE GROUP NO. 14

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PUSH PLATE	8200 4" X 16"	630	IVE
1	EA	DOOR PULL, 3/4" RND	8102HD 10" I	630	IVE
1	EA	SURFACE CLOSER	4040XP REG	689	LCN
1	EA	MOP PLATE	8400 4" X 1" LDW B-CS	630	IVE
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. 15

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	AU 5407 LN	626	YAL
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
1	EA	OH STOP	90S	630	GLY
1	EA	SURFACE CLOSER	4040XP REG	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER

HARDWARE GROUP NO. 17

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
1	EA	CLASSROOM DEADBOLT	D161	626	YAL
1	EA	DOOR PULL, 3/4" RND	8102HD 10" I	630	IVE
1	EA	PUSH PLATE	8200 4" X 16"	630	IVE
1	EA	SURFACE CLOSER	4040XP REG	689	LCN
1	EA	MOP PLATE	8400 4" X 1" LDW B-CS	630	IVE
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP/HOLDER	FS495	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 18

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	FIRE EXIT HARDWARE	9927-EO-F-LBR-499F	626	VON
1	EA	FIRE EXIT HARDWARE	9927-L-F-LBR-03-499F	626	VON
1	EA	RIM CYLINDER	AS REQUIRED	626	YAL
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
2	EA	SURFACE CLOSER	4040XP EDA	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
2	EA	FIRE/LIFE WALL MAG	SEM7850	689	LCN
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER

DOORS NORMALLY HELD OPEN BY MAGNETS. UPON LOSS OF POWER OR FIRE ALARM, MAGNETS TO RELEASE.

HARDWARE GROUP NO. 19

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	FIRE EXIT HARDWARE	99-L-F-2SI-03	626	VON
2	EA	RIM CYLINDER	AS REQUIRED	626	YAL
1	EA	RIM CYL THUMBTURN	XB11-979	626	SCH
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER

HARDWARE GROUP NO. 20

Provide each 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	AS REQUIRED	626	YAL
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	WEATHER STRIPPING	BY DOOR/FRAME SUPPLIER		
1	EA	THRESHOLD	566A-223	A	ZER

HARDWARE GROUP NO. 21

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112HD	628	IVE
1	EA	ELEC PANIC	CD-RX-LC-99-EO	626	VON
		HARDWARE			
1	EA	WIRELESS EXIT DEVICE	AD-400-993R-70-MT-RHO-JDYA6 (BY	626	SCE
		TRIM	SECURITY) (REUSE EXISTING)		
2	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
1	EA	MORTISE CYLINDER	AS REQUIRED	626	YAL
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	MOUNTING PLATE	4040XP-18	689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30	689	LCN
1	EA	WEATHER STRIPPING	BY DOOR/FRAME SUPPLIER		
1	EA	THRESHOLD	566A-223	A	ZER

DOOR CONTACT TIED TO ACCESS CONTROL SYSTEM FOR MONITORING.

PRESENTING VALID CREDENTIAL TO READER WILL UNLOCK EXIT TRIM AND ALLOW ENTRY.

DOOR IS ALWAYS AVAILABLE FOR FREE EGRESS.

HARDWARE GROUP NO. 22

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112HD	628	IVE
1	EA	PANIC HARDWARE	CD-99-L-DT-06	626	VON
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
1	EA	MORTISE CYLINDER	AS REQUIRED	626	YAL
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	MOUNTING PLATE	4040XP-18	689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30	689	LCN
1	EA	WEATHER STRIPPING	BY DOOR/FRAME SUPPLIER		
1	EA	THRESHOLD	566A-223	A	ZER
1	EA	DOOR CONTACT	679-05HM (BY SECURITY)	BLK	SCE

DOOR CONTACT TIED TO ACCESS CONTROL SYSTEM FOR MONITORING.

HARDWARE GROUP NO. 23

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112HD	628	IVE
1	EA	STOREROOM LOCK	AU 5405 LN	626	YAL
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	WEATHER STRIPPING	BY DOOR/FRAME SUPPLIER		
1	EA	THRESHOLD	566A-223	A	ZER
1	EA	DOOR CONTACT	679-05HM (BY SECURITY)	BLK	SCE

DOOR CONTACT TIED TO ACCESS CONTROL SYSTEM FOR MONITORING.

HARDWARE GROUP NO. 24

Provide each 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-L-F-LBR-03-499F	626	VON
1	EA	FIRE EXIT HARDWARE	9927-EO-F-LBR-499F	626	VON
1	EA	RIM CYLINDER	AS REQUIRED	626	YAL
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
2	EA	SURFACE CLOSER	4040XP EDA	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
2	EA	FIRE/LIFE WALL MAG	SEM7850	689	LCN
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	WEATHERSTRIPPING	8217SBK PSA	BK	ZER

DOORS NORMALLY HELD OPEN BY MAGNETS. UPON LOSS OF POWER OR FIRE ALARM, MAGNETS TO RELEASE.

HARDWARE GROUP NO. 25

Provide each 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-L-F-LBR-03-499F	626	VON
1	EA	FIRE EXIT HARDWARE	9927-EO-F	626	VON
1	EA	RIM CYLINDER	AS REQUIRED	626	YAL
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
2	EA	SURFACE CLOSER	4040XP EDA	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
2	EA	FIRE/LIFE WALL MAG	SEM7850 (EXTENSION ARM AS REQUIRED - 12" MAX)	689	LCN
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	WEATHERSTRIPPING	8217SBK PSA	BK	ZER

DOORS NORMALLY HELD OPEN BY MAGNETS. UPON LOSS OF POWER OR FIRE ALARM, MAGNETS TO RELEASE.

HARDWARE GROUP NO. 26

Provide each 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
1	EA	FIRE EXIT HARDWARE	9927-L-F-LBR-03-499F	626	VON
1	EA	RIM CYLINDER	AS REQUIRED	626	YAL
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
2	EA	SURFACE CLOSER	4040XP EDA (SWING 180 DEGREES)	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
2	EA	FIRE/LIFE WALL MAG	SEM7850 (EXTENSION ARM AS REQUIRED - 12" MAX)	689	LCN
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	WEATHERSTRIPPING	8217SBK PSA	BK	ZER

DOORS NORMALLY HELD OPEN BY MAGNETS. UPON LOSS OF POWER OR FIRE ALARM, MAGNETS TO RELEASE.

HARDWARE GROUP NO. 27

Provide each 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
1	EA	FIRE EXIT HARDWARE	9927-L-F-LBR-03-499F	626	VON
1	EA	RIM CYLINDER	AS REQUIRED	626	YAL
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
2	EA	SURFACE CLOSER	4040XP EDA	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
2	EA	FIRE/LIFE WALL MAG	SEM7850	689	LCN
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	WEATHERSTRIPPING	8217SBK PSA	BK	ZER

DOORS NORMALLY HELD OPEN BY MAGNETS. UPON LOSS OF POWER OR FIRE ALARM, MAGNETS TO RELEASE.

HARDWARE GROUP NO. 28

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	AU 5407 LN	626	YAL
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
1	EA	OH STOP	90S	630	GLY
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 29

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	CLASSROOM LOCK	AU 5407 LN	626	YAL
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
1	EA	OH STOP	90S	630	GLY
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 30

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	AU 5407 LN	626	YAL
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
1	EA	OH STOP	90S	630	GLY
1	EA	SURFACE CLOSER	4040XP REG	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER

HARDWARE GROUP NO. 31

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112HD	628	IVE
1	EA	REMOVABLE MULLION	KR4954	689	VON
1	EA	PANIC HARDWARE	LD-99-EO	626	VON
1	EA	ELEC PANIC	LD-RX-LC-99-EO	626	VON
		HARDWARE			
1	EA	WIRELESS EXIT DEVICE	AD-400-993R-70-MT-RHO-JDYA6 (BY	626	SCE
		TRIM	SECURITY) (REUSE EXISTING)		
2	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
1	EA	MORTISE CYLINDER	AS REQUIRED	626	YAL
2	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
2	EA	MOUNTING PLATE	4040XP-18	689	LCN
2	EA	CUSH SHOE SUPPORT	4040XP-30	689	LCN
1	EA	WEATHER STRIPPING	BY DOOR/FRAME SUPPLIER		
1	EA	THRESHOLD	566A-223	A	ZER

DOOR CONTACT TIED TO ACCESS CONTROL SYSTEM FOR MONITORING.

PRESENTING VALID CREDENTIAL TO CARD READER LOCK WILL MOMENTARILY UNLOCK LOCK AND ALLOW ENTRY.

UPON LOSS OF POWER DOOR IS LOCKED.

DOOR IS ALWAYS AVAILABLE FOR FREE EGRESS.

HARDWARE GROUP NO. 32

Provide each 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	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
1	EA	RIM CYLINDER	AS REQUIRED	626	YAL
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	WEATHER STRIPPING	BY DOOR/FRAME SUPPLIER		
1	EA	THRESHOLD	566A-223	A	ZER
1	EA	DOOR CONTACT	679-05HM (BY SECURITY)	BLK	SCE

DOOR CONTACT TIED TO ACCESS CONTROL SYSTEM FOR MONITORING.

HARDWARE GROUP NO. 33

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112HD	628	IVE
1	EA	PANIC HARDWARE	LD-99-EO	626	VON
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	WEATHER STRIPPING	BY DOOR/FRAME SUPPLIER		
1	EA	THRESHOLD	566A-223	A	ZER
1	EA	DOOR CONTACT	679-05HM (BY SECURITY)	BLK	SCE

DOOR CONTACT TIED TO ACCESS CONTROL SYSTEM FOR MONITORING.

HARDWARE GROUP NO. 34

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112HD	628	IVE
1	EA	REMOVABLE MULLION	KR4954	689	VON
1	EA	PANIC HARDWARE	LD-99-EO	626	VON
1	EA	PANIC HARDWARE	LD-99-NL	626	VON
1	EA	MORTISE CYLINDER	AS REQUIRED	626	YAL
1	EA	RIM CYLINDER	AS REQUIRED	626	YAL
2	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
2	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
2	EA	CUSH SHOE SUPPORT	4040XP-30	689	LCN
2	EA	MOUNTING PLATE	4040XP-18	689	LCN
1	EA	WEATHER STRIPPING	BY DOOR/FRAME SUPPLIER		
1	EA	THRESHOLD	566A-223	A	ZER
2	EA	DOOR CONTACT	679-05HM (BY SECURITY)	BLK	SCE

DOOR CONTACT TIED TO ACCESS CONTROL SYSTEM FOR MONITORING.

HARDWARE GROUP NO. 35

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	AU 5405 LN	626	YAL
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
1	EA	OH STOP	90S	630	GLY
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 36

Provide each 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
1	EA	FIRE EXIT HARDWARE	9927-L-F-LBR-03-499F	626	VON
1	EA	RIM CYLINDER	AS REQUIRED	626	YAL
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
2	EA	SURFACE CLOSER	4040XP EDA	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
2	EA	FIRE/LIFE WALL MAG	SEM7850 (EXTENSION ARM AS REQUIRED - 12" MAX)	689	LCN
1	EA	WEATHERSTRIPPING	8217SBK PSA	BK	ZER
1	EA	GASKETING	188SBK PSA	BK	ZER

DOORS NORMALLY HELD OPEN BY MAGNETS. UPON LOSS OF POWER OR FIRE ALARM, MAGNETS TO RELEASE.

HARDWARE GROUP NO. 37

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	AU 5405 LN	626	YAL
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
1	EA	OH STOP	90S	630	GLY
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 39

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112HD	628	IVE
1	EA	STOREROOM LOCK	AU 5405 LN	626	YAL
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	WEATHER STRIPPING	BY DOOR/FRAME SUPPLIER		
1	EA	THRESHOLD	566A-223	A	ZER
1	EA	DOOR CONTACT	679-05HM (BY SECURITY)	BLK	SCE

DOOR CONTACT TIED TO ACCESS CONTROL SYSTEM FOR MONITORING.

HARDWARE GROUP NO. 40

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	AU 5405 LN	626	YAL
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER

HARDWARE GROUP NO. 41

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
2	EA	MANUAL FLUSH BOLT	FB458	626	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	CLASSROOM LOCK	AU 5407 LN	626	YAL
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
1	EA	OH STOP	90S INACTIVE LEAF	630	GLY
1	EA	SURFACE CLOSER	4040XP SCUSH ACTIVE LEAF	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
2	EA	WALL STOP/HOLDER	FS495	626	IVE
2	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 42

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112HD	628	IVE
1	EA	PANIC HARDWARE	LD-99-L-2SI-03	626	VON
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
2	EA	RIM CYLINDER	AS REQUIRED	626	YAL
1	EA	RIM CYL THUMBTURN	XB11-979	626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	MOUNTING PLATE	4040XP-18	689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30	689	LCN
1	EA	WEATHER STRIPPING	BY DOOR/FRAME SUPPLIER		
1	EA	THRESHOLD	566A-223	A	ZER
1	EA	DOOR CONTACT	679-05HM (BY SECURITY)	BLK	SCE

DOOR CONTACT TIED TO ACCESS CONTROL SYSTEM FOR MONITORING.

HARDWARE GROUP NO. 43

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112HD	628	IVE
1	EA	PANIC HARDWARE	LD-99-L-03	626	VON
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
1	EA	RIM CYLINDER	AS REQUIRED	626	YAL
1	EA	SURFACE CLOSER	4040XP REG	689	LCN
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	WEATHER STRIPPING	BY DOOR/FRAME SUPPLIER		
1	EA	THRESHOLD	566A-223	A	ZER
1	EA	DOOR CONTACT	679-05HM (BY SECURITY)	BLK	SCE

DOOR CONTACT TIED TO ACCESS CONTROL SYSTEM FOR MONITORING.

HARDWARE GROUP NO. 44

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112HD	628	IVE
1	EA	STOREROOM LOCK	AU 5405 LN	626	YAL
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
1	EA	ELECTRIC STRIKE	6400 FSE 12/24 VAC/VDC	US32D	VON
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	MOUNTING PLATE	4040XP-18	689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30	689	LCN

PUSHBUTTON AT RECEPTION TO RELEASE ELECTRIC STRIKE TO ALLOW ENTRY FROM RECEPTION TO CORRIDOR.

HARDWARE GROUP NO. 45

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112HD	628	IVE
1	EA	STOREROOM LOCK	AU 5405 LN	626	YAL
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	WEATHER STRIPPING	BY DOOR/FRAME SUPPLIER		
1	EA	THRESHOLD	566A-223	A	ZER
1	EA	DOOR CONTACT	679-05HM (BY SECURITY)	BLK	SCE

DOOR CONTACT TIED TO ACCESS CONTROL SYSTEM FOR MONITORING.

HARDWARE GROUP NO. 46

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112HD	628	IVE
1	EA	REMOVABLE MULLION	KR4954	689	VON
2	EA	ELEC PANIC	LD-RX-LC-99-EO	626	VON
		HARDWARE			
1	EA	WIRELESS EXIT DEVICE	AD-400-993R-70-MT-RHO-JDYA6 (BY	626	SCE
		TRIM	SECURITY) REUSE EXISTING		
2	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL
1	EA	MORTISE CYLINDER	AS REQUIRED	626	YAL
2	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
2	EA	MOUNTING PLATE	4040XP-18	689	LCN
2	EA	CUSH SHOE SUPPORT	4040XP-30	689	LCN
1	EA	WEATHER STRIPPING	BY DOOR/FRAME SUPPLIER		
1	EA	THRESHOLD	566A-223	A	ZER

DOOR CONTACT TIED TO ACCESS CONTROL SYSTEM FOR MONITORING.

PRESENTING VALID CREDENTIAL TO CARD READER LOCK WILL MOMENTARILY UNLOCK LOCK AND ALLOW ENTRY.

UPON LOSS OF POWER DOOR IS LOCKED.

DOOR IS ALWAYS AVAILABLE FOR FREE EGRESS.

HARDWARE GROUP NO. 47

Provide each with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	ELEC PANIC HARDWARE	LD-RX-LC-99-EO	626	VON
1	EA	WIRELESS EXIT DEVICE TRIM	AD-400-993R-70-MT-RHO-JDYA6 (BY SECURITY)	626	SCE
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	YAL

DOOR CONTACT TIED TO ACCESS CONTROL SYSTEM FOR MONITORING.

PRESENTING VALID CREDENTIAL TO CARD READER LOCK WILL MOMENTARILY UNLOCK LOCK
AND ALLOW ENTRY.

UPON LOSS OF POWER DOOR IS LOCKED.

DOOR IS ALWAYS AVAILABLE FOR FREE EGRESS.

HARDWARE GROUP NO. MISC1

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	HARDWARE	4400 SERIES KNOX BOX		KNO

MOUNT ON WALL PER ARCHITECT PLANS

HARDWARE GROUP NO. MISC2

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	PIM	PIM400 (BY SECURITY)		SCE

VERIFY QUANTITY NEEDED WITH DISTRICT PRIOR TO ORDERING.

ANTENNAS TO BE PROVIDED AS NEEDED BASED ON PIM INSTALL LOCATIONS AND TIED TO
EXISTING ACCESS CONTROL SYSTEM.

END OF SECTION 087100

Door/Hardware Index

Door Numbers	HwSet#
100A	44
100B	05
100C	06
101	07
102	07
103	07
104	07
105	08
106	07
107	09
108	10
109A	07
109B	11
109C	13
110	11
111	12
112	12
113	11
200A	19
200B	19
200C	42
200D	42
200E	07
201	43
202A	14
203A	14
204	43
205A	15
205B	15
206A	15
208A	14
207A	14
300A	18
300B	18
300C	30
301A	17
301B	41
301C	17
301D	45
302C	33
307C	33
401D	33
401E	23
404C	33
500B	08
500C	33
501B	08
502B	08
502C	33
503B	08

Door Numbers	HwSet#
504B	29
504C	28
505B	28
603A	14
604A	14
713A	14
715A	14
800A	34
800B	34
800C	31
800D	34
800E	36
800F	36
801A	07
801B	29
802B	39
802C	37
803A	12
804A	40
804B	39
805B	39
805C	37
806A	07
806B	29
C4	35
E1	20
H10A	26
H11A	24
H11B	24
H12B	47
H19A	24
H19B	24
H2A	26
H3A	26
H3B	27
H5A	25
H5B	31
H7A	25
H7B	32
H8A	25
H8B	46
L1A	04
L1B	04
L1C	03
L2A	22
L2B	22
L2C	22
L2D	21
L3A	22
L3B	22

Door Numbers	HwSet#
L3C	22
L3D	21
S1	23
VA	02
VB	02
VC	01

SECTION 08 8000

GLAZING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Insulating glass units.
- B. Glazing units.
- C. Glazing compounds and accessories.

1.2 RELATED REQUIREMENTS

- A. Section 07 2500 - Weather Barriers.
- B. Section 07 9200 - Joint Sealants: Sealants for other than glazing purposes.
- C. Section 08 1113 - Hollow Metal Doors and Frames: Glazed lites in doors and borrowed lites.
- D. Section 08 1416 - Flush Wood Doors: Glazed lites in doors.
- E. Section 08 4435 - Protective Framed Glazing Assemblies: Glazing fire-tested as part of the wall assembly.
- F. Section 10 2800 - TOILET, BATH, AND LAUNDRY ACCESSORIES: Mirrors.

1.3 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.
- B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test; 2010.
- C. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2011).
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.
- E. ASTM C1036 - Standard Specification for Flat Glass; 2011.
- F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2013.
- G. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2015.
- H. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2012a.
- I. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2010.
- J. GANA (GM) - GANA Glazing Manual; 2009.
- K. GANA (SM) - GANA Sealant Manual; 2008.
- L. GANA (LGRM) - Laminated Glazing Reference Manual; 2009.
- M. ICC (IBC) - International Building Code; 2015.
- N. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use; 1990 (2004).
- O. ITS (DIR) - Directory of Listed Products; current edition.

- P. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2012.
- Q. NFPA 257 - Standard on Fire Test for Window and Glass Block Assemblies; 2012.
- R. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2014.
- S. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2014.
- T. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2014.
- U. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
- V. UL 9 - Standard for Fire Tests of Window Assemblies; Current Edition, Including All Revisions.
- W. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- X. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data on Insulating Glass Unit and Glazing Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
- C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
- D. Samples: Submit 1 samples 12 by 12 inch (305 by 305 mm) in size of glass units.
- E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA (GM), GANA (SM), GANA (LGRM), and IGMA TM-3000 for glazing installation methods. Maintain one copy on site.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

1.6 MOCK-UPS

- A. See Section 01 4000 - Quality Requirements, for additional mock-up requirements.
- B. Provide on-site glazing mock-up with the specified glazing components.
- C. Mock-ups may remain as part of the Work.

1.7 FIELD CONDITIONS

- A. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.8 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Insulating Glass Units: Provide a five (5) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Float Glass Manufacturers:

1. Cardinal Glass Industries; : www.cardinalcorp.com/#sle.
2. Guardian Glass, LLC; : www.guardianglass.com/#sle.
3. Pilkington North America Inc; : www.pilkington.com/na/#sle.
4. Vitro Architectural Glass (formerly PPG Glass); : www.vitroglazings.com/#sle.
5. Substitutions: Refer to Section 01 6000 - Product Requirements.

2.2 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.

1. Design Pressure:
 - a. Postive/Negative Design Pressure: See structural drawings for psf.
2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
3. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
4. Glass thicknesses listed are minimum.

B. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:

1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
3. Solar Optical Properties: Comply with NFRC 300 test method.

2.3 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless otherwise indicated.

1. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
2. Tinted Type: ASTM C1036, Class 2 - Tinted, Quality - Q3, with color and performance characteristics as indicated.
3. Thicknesses: As indicated; provide greater thickness as required for exterior glazing wind load design.

2.4 BASIS OF DESIGN - INSULATING GLASS UNITS

A. Insulating Glass Units: Types as indicated.

1. Durability: Certified by an independent testing agency to comply with ASTM E2190.

2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
 3. Metal Edge Spacers: Aluminum, bent and soldered corners.
 4. Spacer Color: Black.
 5. Edge Seal:
 - a. Single-Sealed System: Provide silicone, polysulfide, or polyurethane sealant as seal applied around perimeter.
 - b. Color: Black.
 6. Purge interpane space with dry air, hermetically sealed.
- B. Type IG-1 - Insulating Glass Units: Vision glass, double glazed.
1. Applications: Exterior glazing unless otherwise indicated.
 2. Space between lites filled with argon.
 3. Outboard Lite: Fully tempered float glass, 1/4 inch (6.4 mm) thick, minimum.
 - a. Tint: Vitro Optigray.
 - b. Coating: Vitro Solarban 70XL, on #2 surface.
 4. Inboard Lite: Fully tempered float glass, 1/4 inch (6.4 mm) thick, minimum.
 - a. Tint: Clear.
 5. Total Thickness: 1 inch (25.4 mm).
 6. Thermal Transmittance (U-Value), Summer - Center of Glass: 0.26, maximum.
 7. Visible Light Transmittance (VLT): 45 percent, nominal.
 8. Solar Heat Gain Coefficient (SHGC): 0.24 percent, nominal.
- C. Type IG-2 - Insulating Glass Units: Vision glass, double glazed.
1. Applications: Exterior glazing unless otherwise indicated.
 2. Space between lites filled with argon.
 3. Outboard Lite: Fully tempered float glass, 1/4 inch (6.4 mm) thick, minimum.
 - a. Tint: Clear.
 4. Inboard Lite: Fully tempered float glass, 1/4 inch (6.4 mm) thick, minimum.
 - a. Tint: Graylite II.
 - b. Coating: Vitro Solarban 70XL, on #3 surface.
 5. Total Thickness: 1 inch (25.4 mm).
 6. Thermal Transmittance (U-Value), Summer - Center of Glass: 0.24, maximum.
 7. Visible Light Transmittance (VLT): 6 percent, nominal.
 8. Solar Heat Gain Coefficient (SHGC): 0.11 percent, nominal.
- D. Type IG-3 - Insulating Glass Units: Acid etched glass, double glazed.
1. Applications: Exterior glazing unless otherwise indicated.
 2. Space between lites filled with argon.
 3. Outboard Lite: Fully tempered float glass, 1/4 inch (6.4 mm) thick, minimum.

- a. Tint: PPG Optigray.
 - b. Coating: PPG Solarban 70XL, on #2 surface.
4. Inboard Lite: Annealed float glass, 1/4 inch (6.4 mm) thick, minimum.
 - a. Tint: Clear.
 - b. Coating: Acid etched, on #3 surface.
5. Total Thickness: 1 inch (25.4 mm).
6. Glazing Method: Dry glazing method, gasket glazing.

2.5 MONOLITHIC GLAZING UNITS

A. Type G-1 - Monolithic Interior Vision Glazing:

1. Applications: Interior glazing unless otherwise indicated.
2. Glass Type: Fully tempered float glass.
3. Tint: Clear.
4. Thickness: 1/4 inch (6.4 mm), nominal.

B. Type G-2 - Fire-Protection-Rated Glazing: Type, thickness, and configuration of glazing that contains flame, smoke, and does not block radiant heat, as required to achieve fire-doors indicated fire-rating period of 90 minutes or less.

1. Applications:
 - a. Glazing in fire-rated door assembly.
 - b. Glazing in fire-rated sidelight assembly.
2. Provide products listed by ITS (DIR) or UL (DIR) and approved by authorities having jurisdiction.
3. Safety Glazing Certification: 16 CFR 1201 Category II.
4. Glazing Method: As required for fire rating.
5. Fire-Rating Period: As indicated on schedule below.
6. Markings for Fire-Protection-Rated Glazing Assemblies: As indicated on schedule below. Provide permanent markings on fire-protection-rated glazing in compliance with ICC (IBC), local building code, and authorities having jurisdiction:
 - a. "D" - meets fire door assembly criteria of NFPA 252, UL 10B, or UL 10C fire test standards.
 - b. "OH" - meets fire window assembly criteria including hose stream test of NFPA 257, or UL 9 fire test standards.
 - c. "H" - meets fire door assembly hose stream test of NFPA 252, UL 10B, or UL 10C fire tests standards.
 - d. "XXX" - placeholder that represents fire-rating period, in minutes.
7. Manufacturers:
 - a. SAFTIFIRST, a division of O-Keeffe's Inc: www.safti.com.
 - b. SCHOTT North America Inc.: www.us.schott.com.
 - c. Technical Glass Products: www.fireglass.com.

- d. Vetrotech North America: www.vetrotechusa.com.
- e. Substitutions: Refer to Section 01 6000 - Product Requirements.

2.6 GLAZING COMPOUNDS

- A. Type GC-1 - Glazing Putty: Polymer modified latex, knife grade consistency; grey color.
- B. Type GC-5 - Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; non-bleeding, non-staining; ASTM C920, Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; color as selected.

2.7 ACCESSORIES

- A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot (25 mm for each square meter) of glazing or minimum 4 inch (100 mm) by width of glazing rabbet space minus 1/16 inch (1.5 mm) by height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch (75 mm) long by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.
- C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.
 - 1. Width: As required for application.
 - 2. Thickness: As required for application.
 - 3. Spacer Rod Diameter: As required for application.
- D. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.
- E. Glazing Clips: Manufacturer's standard type.

PART 3 EXECUTION

3.1 VERIFICATION OF CONDITIONS

- A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.
- B. Verify that the minimum required face and edge clearances are being provided.
- C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.
- D. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.3 INSTALLATION, GENERAL

- A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.
- B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.
- C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.
- D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.
- E. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.
- F. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, etc.

3.4 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

- A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.
- B. Place setting blocks at 1/4 points with edge block no more than 6 inch (152 mm) from corners.
- C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
- D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.5 INSTALLATION - DRY GLAZING METHOD (TAPE AND TAPE)

- A. Application - Interior Glazed: Set glazing infills from the interior of the building.
- B. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch (1.6 mm) above sight line.
- C. Place setting blocks at 1/4 points with edge block no more than 6 inch (152 mm) from corners.
- D. Rest glazing on setting blocks and push against tape for full contact at perimeter of pane or unit.
- E. Place glazing tape on free perimeter of glazing in same manner described above.
- F. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
- G. Carefully trim protruding tape with knife.

3.6 INSTALLATION - WET GLAZING METHOD (COMPOUND AND COMPOUND)

- A. Application - Interior Glazed: Set glazing infills from the interior of the building.
- B. Install glazing resting on setting blocks. Install applied stop and center pane by use of spacer shims at 24 inch (610 mm) centers, kept 1/4 inch (6 mm) below sight line.
- C. Locate and secure glazing pane using glazers' clips.
- D. Fill gaps between glazing and stops with glazing compound until flush with sight line. Tool surface to straight line.

3.7 CLEANING

- A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
- B. Remove non-permanent labels immediately after glazing installation is complete.
- C. Clean glass and adjacent surfaces after sealants are fully cured.
- D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.8 PROTECTION

- A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.
- B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

3.9 SCHEDULES

- A. Aluminum-Framed Storefronts and Storefront Entrance Doors:
 - 1. Glass Type IG-1: Unless otherwise noted.
 - 2. Glass Type IG-2: Where window elevations indicate Tinted Glazing.
 - 3. Glass Type IG-3: Where window elevations indicate Frosted Glazing.
 - 4. Glass Type G-1: At interior locations.
 - 5. Glazing Method: Install glass using dry method, and with glass thickness as required to comply with performance requirements indicated in Section 08 4313.
- B. Holow Metal Frames:
 - 1. Glass Type G-1: Typical at unrated windows.
 - 2. Glass Type G-2: Sidelights sharing a frame with a 20 minute rated door.
 - a. Glazing Rating: 45 Minutes.
 - b. Glazing Markings: D-H-OH-45.
- C. Flush Wood Doors:
 - 1. Glass Type G-1: Typical at unrated doors.
 - 2. Glass Type G-2:
 - a. Doors scheduled to have 20 minute rating:
 - 1) Glazing Rating: 20 minutes.
 - 2) Glazing Markings: D-20.
 - b. Doors scheduled to have 90 minute rating, with lites up to 100 square inches:
 - 1) Glazing Rating: 90 minutes.
 - 2) Glazing Markings: D-H-90.
- D. Flush Aluminum Doors, Exterior Glazing: Glass Type IG-1, 1 inch (25mm).

END OF SECTION

SECTION 09 0561

COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. This section applies to floors identified in contract documents that are receiving the following types of floor coverings:
 - 1. Resilient tile and sheet.
 - 2. Carpet tile.
- B. Removal of existing floor coverings.
- C. Preparation of new and existing concrete floor slabs for installation of floor coverings.
- D. Testing of concrete floor slabs for moisture and alkalinity (pH).
- E. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
 - 1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.
- F. Patching compound.
- G. Remedial floor coatings.

1.2 RELATED REQUIREMENTS

- A. Section 01 2200 - Unit Prices: Bid pricing for remediation treatments if required.
- B. Section 03 3000 - Cast-in-Place Concrete: Limitations on curing requirements for new concrete floor slabs.
- C. 09 6813 - Tile Carpeting: Requirements for substrate chemistry and moisture content prior to installation of tile carpeting.

1.3 PRICE AND PAYMENT PROCEDURES

- A. Unit Prices: See Section 01 2200 - Unit Prices.
- B. Unit Price for Alternate Flooring Adhesive: Do not include the cost of the alternate adhesive in the base bid; state on the bid form the unit price per square foot (square meter) for using the alternate adhesive, in the event such remediation is required.
- C. Unit Price for Remedial Floor Coating or Sheet Membrane: Do not include the cost of the floor coating or underlayment in the base bid; state on the bid form the unit price per square foot (square meter) for the floor coating or underlayment, installed, in the event such remediation is required.

1.4 REFERENCE STANDARDS

- A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2013.
- B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete; 1999 (Reapproved 2014).

- C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.
- D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2011.
- E. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; Resilient Floor Covering Institute; October 2011.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.6 SUBMITTALS

- A. Visual Observation Report: For existing floor coverings to be removed.
- B. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
 - 1. Moisture and alkalinity (pH) limits and test methods.
 - 2. Manufacturer's required bond/compatibility test procedure.
- C. Testing Agency's Report:
 - 1. Description of areas tested; include floor plans and photographs if helpful.
 - 2. Summary of conditions encountered.
 - 3. Moisture and alkalinity (pH) test reports.
 - 4. Copies of specified test methods.
 - 5. Recommendations for remediation of unsatisfactory surfaces.
 - 6. Submit report to Architect.
 - 7. Submit report not more than two business days after conclusion of testing.
- D. Adhesive Bond and Compatibility Test Report.
- E. Copy of RFCI (RWP).
- F. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.
 - 1. Manufacturer's qualification statement.
 - 2. Test reports indicating compliance with specified performance requirements, performed by nationally recognized independent testing agency.
 - 3. Manufacturer's installation instructions.
 - 4. Specimen Warranty: Copy of warranty to be issued by coating manufacturer and certificate of underwriter's coverage of warranty.

1.7 QUALITY ASSURANCE

- A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.
- B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
 - 1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.

- C. Contractor's Responsibility Relating to Independent Agency Testing:
 - 1. Provide access for and cooperate with testing agency.
 - 2. Confirm date of start of testing at least 10 days prior to actual start.
 - 3. Allow at least 4 business days on site for testing agency activities.
 - 4. Achieve and maintain specified ambient conditions.
 - 5. Notify Architect when specified ambient conditions have been achieved and when testing will start.
- D. Remedial Coating Installer Qualifications: Company specializing in performing work of the type specified in this section, trained by or employed by coating manufacturer, and able to provide at least 3 project references showing at least 3 years' experience installing moisture emission coatings.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, handle, and protect products in accordance with manufacturer's instructions and recommendations.
- B. Deliver materials in manufacturer's packaging; include installation instructions.
- C. Keep materials from freezing.

1.9 FIELD CONDITIONS

- A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F (18 degrees C) or more than 85 degrees F (30 degrees C).
- B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
 - 1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
 - 2. Latex or polyvinyl acetate additions are permitted; gypsum content is prohibited.
 - 3. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
- B. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.
- C. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet

flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.

1. Thickness: As required for application and in accordance with manufacturer's installation instructions.

PART 3 EXECUTION

3.1 CONCRETE SLAB PREPARATION

A. Perform following operations in the order indicated:

1. Existing concrete slabs (on-grade and elevated) with existing floor coverings:
 - a. Visual observation of existing floor covering, for adhesion, water damage, alkaline deposits, and other defects.
 - b. Removal of existing floor covering.
2. Existing concrete slabs with coatings or penetrating sealers/hardeners/dustproofers:
 - a. Do not attempt to remove coating or penetrating material.
 - b. Do not abrade surface.
3. Preliminary cleaning.
4. Moisture vapor emission tests; 3 tests in the first 1000 square feet (100 square meters) and one test in each additional 1000 square feet (100 square meters), unless otherwise indicated or required by flooring manufacturer.
5. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
6. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
7. Specified remediation, if required.
8. Patching, smoothing, and leveling, as required.
9. Other preparation specified.
10. Adhesive bond and compatibility test.
11. Protection.

B. Remediations:

1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.
3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.2 REMOVAL OF EXISTING FLOOR COVERINGS

- A. Comply with local, State, and federal regulations and recommendations of RFCI Recommended Work Practices for Removal of Resilient Floor Coverings, as applicable to floor covering being removed.
- B. Dispose of removed materials in accordance with local, State, and federal regulations and as specified.

3.3 MOISTURE VAPOR EMISSION TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F1869 and as follows.
- D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet (1.4 kg per 93 square meters) per 24 hours.
- F. Report: Report the information required by the test method.

3.4 ALKALINITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
- C. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
- D. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch (25 mm) in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.5 ADHESIVE BOND AND COMPATIBILITY TESTING

- A. Comply with requirements and recommendations of floor covering manufacturer.

3.6 APPLICATION OF REMEDIAL FLOOR COATING

- A. Comply with requirements and recommendations of coating manufacturer.

END OF SECTION

SECTION 09 2116

GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
- B. Metal stud wall framing.
- C. Metal channel ceiling framing.
- D. Gypsum sheathing.
- E. Gypsum wallboard.
- F. Joint treatment and accessories.

1.2 RELATED REQUIREMENTS

- A. Section 07 2100 - INSULATION: Acoustic insulation.
- B. Section 07 2500 - Weather Barriers: Water-resistive barrier over sheathing.
- C. Section 07 8400 - Firestopping: Rated assemblies at fire rated walls.
- D. Section 07 9200 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.

1.3 REFERENCE STANDARDS

- A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2012.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- C. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2015.
- D. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014.
- E. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2015.
- F. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2013.
- G. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2015.
- H. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.
- I. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2014a.
- J. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.
- K. ASTM C1280 - Standard Specification for Application of Gypsum Sheathing Board; 2013.
- L. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2014.

- M. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2012.
- N. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- O. ASTM E413 - Classification for Rating Sound Insulation; 2010.
- P. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015.
- Q. GA-216 - Application and Finishing of Gypsum Board; 2013.
- R. UL (FRD) - Fire Resistance Directory; current edition.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.
- C. Product Data: Provide data on metal framing, gypsum board, accessories, joint finishing system, and sheathing.
- D. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

PART 2 PRODUCTS

2.1 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
- B. Interior Partitions: Provide completed assemblies with the following characteristics:
 - 1. Acoustic Attenuation: STC of 45-49 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- C. Fire Rated Assemblies: Provide completed assemblies with the following characteristics:
 - 1. Fire Rated Ceilings and Soffits: Provide assemblies with fire ratings indicated on drawings.
 - 2. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).

2.2 METAL FRAMING MATERIALS

- A. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf (L/120 at 240 Pa).
 - 1. Studs: "C" shaped with flat or formed webs.
 - 2. Runners: U shaped, sized to match studs.
 - 3. Ceiling Channels: C- or T-shaped.
 - 4. Furring: Hat-shaped sections, minimum depth of 7/8 inch (22 mm).
- B. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
 - 1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.

2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot dipped galvanized coating.
3. Provide components UL-listed for use in UL-listed fire-rated head of partition joint systems of fire rating and movement required.
4. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-rating of the wall assembly.

2.3 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:

1. CertainTeed Corporation; : www.certainteed.com.
2. Continental Building Products; : www.continental-bp.com/#sle.
3. Georgia-Pacific Gypsum; : www.gpgypsum.com.
4. National Gypsum Company; : www.nationalgypsum.com.
5. PABCO Gypsum; : www.pabcogypsum.com.
6. USG Corporation; : www.usg.com.
7. Substitutions: See Section 01 6000 - Product Requirements.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.

1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - a. Mold resistant board is required at all locations.
3. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
4. Thickness:
 - a. Vertical Surfaces: 5/8 inch (16 mm).
 - b. Ceilings: 1/2 inch (13 mm).
 - c. Multi-Layer Assemblies: Thicknesses as indicated on drawings.

C. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.

1. Application: Ceilings, unless otherwise indicated.
2. Thickness: 1/2 inch (13 mm).
3. Edges: Tapered.

D. Exterior Sheathing Board: Sizes to minimize joints in place; ends square cut.

1. Application: Exterior sheathing, unless otherwise indicated.
2. Fungal Resistance: No fungal growth when tested in accordance with ASTM G21.
3. Glass Mat Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C1177/C1177M.
4. Type X Thickness: 5/8 inch (16 mm).

5. Edges: Square.
6. Glass Mat Faced Products:
 - a. American Gypsum Company; M-Glass Exterior Sheathing Type X.
 - b. CertainTeed Corporation; GlasRoc Type X Exterior Sheathing.
 - c. Continental Building Products; Weather Defense Platinum Sheathing Type X.
 - d. Georgia-Pacific Gypsum; DensGlass Fireguard Sheathing.
 - e. National Gypsum Company; Gold Bond eXP Sheathing.
 - f. Substitutions: See Section 01 6000 - Product Requirements.

2.4 Gypsum Wallboard ACCESSORIES

- A. Acoustic Insulation: As specified in Section 07 2100.
- B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
- C. Water-Resistive Barrier: As specified in Section 07 2500.
- D. Finishing Accessories: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
 1. Types: As detailed or required for finished appearance.
 2. Special Shapes: In addition to conventional corner bead and control joints, provide U-bead and L-bead at exposed panel edges.
- E. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
- F. High Build Drywall Surfer: Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.
- G. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch (0.84 mm) in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.
- H. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch (0.84 to 2.84 mm) in Thickness: ASTM C954; steel drill screws, corrosion resistant.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.
- B. Prior to hanging gypsum board, gypsum board installer shall provide written acceptance of stud installation.

3.2 FRAMING INSTALLATION

- A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.
- B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
- C. Studs: Space studs at 16 inches on center (at 406 mm on center).
 1. Extend partition framing as indicated on drawings.
 2. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.

- D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
- E. Blocking: Install mechanically fastened steel channel blocking for support of:
 - 1. Framed openings.
 - 2. Wall mounted cabinets.
 - 3. Plumbing fixtures.
 - 4. Toilet accessories.
 - 5. Wall mounted door hardware.

3.3 ACOUSTIC ACCESSORIES INSTALLATION

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
 - 1. Place one bead continuously on substrate before installation of perimeter framing members.
 - 2. Place continuous bead at perimeter of each layer of gypsum board.
 - 3. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.4 BOARD INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer Non-Rated: Install gypsum board parallel to framing, with ends and edges occurring over firm bearing.
 - 1. Exception: Tapered edges to receive joint treatment at right angles to framing.
 - 2. Install boards such that the bottoms do not rest directly on concrete floor slab.
- C. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing. See Section 07 8400 - Firestopping.
- D. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.
 - 1. Paper-Faced Sheathing: Immediately after installation, protect from weather by application of water-resistive barrier.

3.5 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and as directed by Architect for visual effect.
 - 1. Not more than 30 feet (10 meters) apart on walls and ceilings over 50 feet (16 meters) long.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.6 JOINT TREATMENT

- A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
 - 1. Level 5: Walls and ceilings to receive egg-shell paint finish and other areas specifically indicated. All exposed areas within the Media Center.
 - 2. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
 - 3. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 - 1. Feather coats of joint compound so that camber is maximum 1/32 inch (0.8 mm).
- C. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

3.7 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.

3.8 PROTECTION

- A. Protect installed surfaces from damage until final completion.

END OF SECTION

SECTION 09 3000

TILING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Stone thresholds.
- D. Stone Window Stools.
- E. Non-ceramic trim.
- F. Regrouting existing tile.

1.2 RELATED REQUIREMENTS

- A. Section 07 9200 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.

1.3 REFERENCE STANDARDS

- A. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2014.
- B. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).
- C. ANSI A108.1c - Specifications for Contractors Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Bed with Dry-Set or Latex-Portland Cement; 1999 (Reaffirmed 2010).
- D. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive; 2009 (Revised).
- E. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).
- F. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy; 1999 (Reaffirmed 2010).
- G. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (Reaffirmed 2010).
- H. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 1999 (Reaffirmed 2010).
- I. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 1999 (Reaffirmed 2010).
- J. ANSI A108.12 - American National Standard for Installation of Ceramic Tile with EGP (Exterior glue plywood) Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).

- K. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2010).
- L. ANSI A118.7 - American National Standard Specifications for High Performance Cement Grouts for Tile Installation; 2010 (Revised).
- M. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes For Thin-Set Ceramic Tile And Dimension Stone Installation; 2014.
- N. ANSI A118.15 - American National Standard Specifications for Improved Modified Dry-Set Cement Mortar; 2012.
- O. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2013.1.
- P. ASTM C373 - Standard Test Method for Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Whiteware Products, Ceramic Tiles, and Glass Tiles; 2014a.
- Q. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2015.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.
- D. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Tile: 2 percent of each size, color, and surface finish combination.

1.6 FIELD CONDITIONS

- A. Maintain ambient and substrate temperature of 50 degrees F (10 degrees C) during installation of mortar materials.

PART 2 PRODUCTS

2.1 TILE

- A. Manufacturers: All products by the same manufacturer.
 - 1. American Olean Corporation: www.americanolean.com/#sle.
 - 2. Dal-Tile Corporation: www.daltile.com/#sle.
 - 3. Emser Tile, LLC: www.emser.com/#sle.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Porcelain Tile, Type PT1: ANSI A137.1, standard grade.

1. Size: 12 by 12 inch (305 by 305 mm), nominal.
2. Thickness: 5/16 inch (8 mm).
3. Edges: Cushioned.
4. Surface Finish: Matte glazed.
5. Color(s): To be selected by Architect from manufacturer's standard range. Allow two colors per room.
6. Trim Units: Matching bullnose and cove base shapes in sizes coordinated with field tile.
7. Basis of Design Product: Daltile, Reminiscent.
 - a. Substitutions: See Section 01 6000 - Product Requirements.

C. Porcelain Tile, Type PT2: ANSI A137.1, standard grade.

1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
2. Size: 2 by 2 Mosaic inch (51 by 51 mm), nominal.
3. Thickness: 1/4 inch (6 mm).
4. Edges: Cushioned.
5. Surface Finish: Unglazed.
6. Color(s): To be selected by Architect from manufacturer's full range. Allow two colors per room.
7. Trim Units: Matching bullnose and build-up base shapes in sizes coordinated with field tile.
8. Basis of Design Product: Daltile, Reminiscent.
 - a. Substitutions: See Section 01 6000 - Product Requirements.

D. Porcelain Tile, Type PT-3: ANSI A137.1, standard grade.

1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
2. Size: 12 by 24 inch (305 by 610 mm), nominal.
3. Thickness: 3/8 inch (9.5 mm).
4. Edges: Cushioned.
5. Surface Finish: Matte glazed.
6. Color(s): To be selected by Architect from manufacturer's standard range. Allow two colors per room.
7. Trim Units: Matching bullnose and cove base shapes in sizes coordinated with field tile.
8. Basis of Design Product: Daltile, Reminiscent.
 - a. Substitutions: See Section 01 6000 - Product Requirements.

2.2 TRIM AND ACCESSORIES

A. Non-Ceramic Trim: Brushed stainless steel, style and dimensions as indicated on drawings, for setting using tile mortar or adhesive.

1. Applications:
 - a. Open edges of wall tile.

- b. Wall corners, outside.
 - c. Transition between floor finishes of different heights.
 - d. Expansion and control joints, floor and wall.
- 2. Manufacturers:
 - a. Schluter-Systems: www.schluter.com/#sle.
 - b. Genesis APS International: www.genesis-aps.com/#sle.
 - c. Substitutions: See Section 01 6000 - Product Requirements.
- B. Thresholds: Marble, white or gray, honed finish; 2 inches (51 mm) wide by full width of wall or frame opening; thickness to fit application; beveled one long edge with radiused corners on top side; without holes, cracks, or open seams.
 - 1. Applications:
 - a. At doorways where tile terminates.
 - b. At open edges of floor tile where adjacent finish is a different height.
- C. Window Stools: Slate, color and finish to match existing window stools. 1 inch thick.
 - 1. Face and exposed edges: Hones with corners slightly eased.

2.3 SETTING MATERIALS

- A. Manufacturers:
 - 1. ARDEX Engineered Cements; : www.ardexamericas.com.
 - 2. Custom Building Products; : www.custombuildingproducts.com.
 - 3. LATICRETE International, Inc; : www.laticrete.com.
 - 4. Merkrete, by Parex USA, Inc; : www.merkrete.com.
 - 5. ProSpec, an Oldcastle brand; : www.prospec.com.
 - 6. Substitutions: See Section 01 6000 - Product Requirements.
- B. Improved Latex-Portland Cement Mortar Bond Coat: ANSI A118.15.
 - 1. Applications: Use this type of bond coat where indicated and where no other type of bond coat is indicated.
- C. Mortar Bed Materials: Pre-packaged mix of Portland cement, sand, latex additive, and water.
 - 1. Products:
 - a. LATICRETE International, Inc; LATICRETE 3701 Fortified Mortar Bed: www.laticrete.com/#sle.
 - b. Merkrete, by Parex USA, Inc; Merkrete Underlay C: www.merkrete.com/#sle.
 - c. Proflex Products, Inc; MSI - Mud Set Installation: www.proflex.us/#sle.
 - d. Substitutions: See Section 01 6000 - Product Requirements.

2.4 GROUTS

- A. High Performance Polymer Modified Grout: ANSI A118.7 polymer modified cement grout.
 - 1. Applications: Use this type of grout where indicated and where no other type of grout is indicated.
 - 2. Use sanded grout for joints 1/8 inch (3.2 mm) wide and larger; use unsanded grout for joints less than 1/8 inch (3.2 mm) wide.

3. Color(s): As selected by Architect from manufacturer's full line.
4. Products:
 - a. Custom Building Products; Fusion Pro Single Component Grout: www.custombuildingproducts.com/#sle.
 - b. LATICRETE International, Inc; LATICRETE PERMACOLOR Grout: www.laticrete.com/#sle.
 - c. Merkrete, by Parex USA, Inc; Merkrete Pro Grout: www.merkrete.com/#sle.
 - d. Substitutions: See Section 01 6000 - Product Requirements.

2.5 Maintenance Materials

- A. Tile Sealant: Gunnable, silicone, siliconized acrylic, or urethane sealant; moisture and mildew resistant type.
 1. Applications: Between tile and plumbing fixtures, at control joints and at inside corners of base and wall tile.
 2. Color(s): As selected by Architect from manufacturer's full line.
 3. Products:
 - a. ARDEX Engineered Cements; ARDEX SX: www.ardexamericas.com/#sle.
 - b. Custom Building Products; Commercial 100% Silicone Caulk: www.custombuildingproducts.com/#sle.
 - c. LATICRETE International, Inc; LATICRETE LATASIL: www.laticrete.com/#sle.
 - d. Merkrete, by Parex USA, Inc; Merkrete Colored Caulking: www.merkrete.com/#sle.
 - e. Substitutions: See Section 01 6000 - Product Requirements.
- B. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
 1. Composition: Water-based colorless silicone.
 2. Products:
 - a. Merkrete, by Parex USA, Inc; Merkrete Grout Sealer: www.merkrete.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
- C. Grout Release: Temporary, water-soluble pre-grout coating.
 1. Products:
 - a. Custom Building Products; Aqua Mix Grout Release: www.custombuildingproducts.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.

2.6 ACCESSORY MATERIALS

- A. Waterproofing Membrane: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
 1. Fluid or Trowel Applied Type:
 - a. Thickness: 25 mils (0.6 mm), minimum, dry film thickness.
 - b. Products:

- 1) Custom Building Products; RedGard Crack Prevention and Waterproofing Membrane: www.custombuildingproducts.com/#sle.
- 2) LATICRETE International, Inc; LATICRETE HYDRO BAN: www.laticrete.com/#sle.
- 3) Merkrete, by Parex USA, Inc; Merkrete Hydro Guard 2000: www.merkrete.com/#sle.
- 4) Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of setting materials to sub-floor surfaces.
- D. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.

3.3 INSTALLATION - GENERAL

- A. Install tile and thresholds and grout in accordance with applicable requirements of ANSI A108.1A thru A108.13, manufacturer's instructions, and TCNA (HB) recommendations.
- B. Request tile pattern. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor, base, and wall joints.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- E. Form internal angles square and external angles bullnosed.
- F. Install non-ceramic trim in accordance with manufacturer's instructions.
- G. Install thresholds where indicated.
- H. Sound tile after setting. Replace hollow sounding units.
- I. Keep control and expansion joints free of mortar, grout, and adhesive.
- J. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- K. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.
- L. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.4 INSTALLATION - FLOORS - THIN-SET METHODS

- A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113, dry-set or latex-Portland cement bond coat, with standard grout, unless otherwise indicated.

3.5 INSTALLATION - FLOORS - MORTAR BED METHODS

- A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F111, with cleavage membrane, unless otherwise indicated.
- B. Cleavage Membrane: Lap edges and ends.
- C. Mortar Bed Thickness: 5/8 inch (15.9 mm), unless otherwise indicated.

3.6 INSTALLATION - WALL TILE

- A. Over interior concrete and masonry install in accordance with TCNA (HB) Method W202, thin-set with dry-set or latex-Portland cement bond coat.

3.7 INSTALLATION - REGROUTING EXISTING TILE

- A. Remove grout from existing tile in kitchen area.
- B. Reset set loose tiles using thin-set method.
- C. Remove damaged tiles and replace with matching units.
- D. Provide grout release on existing tiles, re-grout tiles, and remove grout release product.

3.8 CLEANING

- A. Clean tile and grout surfaces.

3.9 PROTECTION

- A. Do not permit traffic over finished floor surface for 4 days after installation. Cover tile flooring until final inspection with heavy Kraft paper or other heavy protective covering to prevent surface damage.

3.10 MAINTENANCE

- A. Provide 2% of each tile type and color to the Owner at project completion.

3.11 SCHEDULE

- A. Teacher Restrooms & Clinic:
 - 1. Tile: Porcelain PT-1.
 - 2. Base: Coved, 6 inches (51 mm) high, bullnosed top edge.
 - 3. Installation Method: Thinset.
 - 4. Grout: Polymer modified.
- B. Gang Restrooms:
 - 1. Tile: Porcelain Mosaic PT-2.
 - 2. Base: Coved, 6 inches (51 mm) high, bullnosed top edge.
 - 3. Installation Method, Floors: Mortar bed; Shower walls: Thin-set.
 - 4. Grout: Polymer modified.
- C. Media Center:
 - 1. Tile: Porcelain PT-3.

2. Base: Coved, 6 inches (51 mm) high, bullnosed top edge.
3. Installation Method: Thin-set.
4. Grout: Polymer modified.

D. Kitchen Areas:

1. Tile: Existing to remain.
2. Base: Existing to remain.
3. Grout: Polymer modified.

END OF SECTION

SECTION 09 5100

ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.

1.2 RELATED REQUIREMENTS

- A. Section 21 1313 - Wet Pipe Sprinkler System: Sprinkler heads in ceiling system.
- B. Section 23 0500 - Heating and Air Conditioning: Air diffusion devices in ceiling.
- C. Section 26 5100 - Interior Lighting: Light fixtures in ceiling system.
- D. Section 28 3111 - Digital Addressable Fire-Alarm System: Fire alarm components in ceiling system.

1.3 REFERENCE STANDARDS

- A. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2013a.
- B. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2013.
- C. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2014.
- D. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2014.
- E. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2015.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on suspension system components.
- C. Samples: Submit two samples 3 by 3 inch (75 by 75 mm) in size illustrating material and finish of acoustical units.
- D. Samples: Submit two samples each, minimum 6 inches (150 mm) long, of suspension system main runner.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

1.6 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F (16 degrees C), and maximum humidity of 60 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Suspension Systems:
 - 1. Same as for acoustical units.

2.2 ACOUSTICAL UNITS

- A. Acoustical Panels: Painted mineral fiber, ASTM E1264 Type III, Class A, with the following characteristics:
 - 1. Size: 24 by 24 inches (600 by 600 mm).
 - 2. Composition: Wet felted.
 - 3. Edge: Reveal edge.
 - 4. Surface Color: White.
 - 5. Surface Pattern: Fine textured.
 - 6. Suspension System: Exposed 15/16" grid Type 1.
 - 7. Products:
 - a. Armstrong; Ultima 1941 Beveled Tegular; www.armstrong.com.
 - b. Certainteed; CertaSize Symphony m, Tapered Reveal Edge: www.certainteed.com.
 - c. USG; Mars, Shadowline Tapered (SLT): www.usg.com.
 - d. Substitutions: See Section 01 6000 - Product Requirements.
- B. Washable Lay-in Ceiling Panels, ASTM E 1264, Type IX, Class A, with the following characteristics:
 - 1. Size: 24 by 24 inches (600 by 600 mm).
 - 2. Surface Texture: Medium texture, unperforated.
 - 3. Panel Edge: Square.
 - 4. Color: White.
 - 5. Suspension System: Exposed grid Type 2.
 - 6. Products:
 - a. Armstrong; Kitchen Zone 673: www.armstrong.com.
 - b. Certainteed; VinylShield A 1100-CRF-1: www.certainteed.com.
 - c. USG; Kitchen Lay-In Panel 3210: www.usg.com.
 - d. Substitutions: See Section 01 6000 - Product Requirements.

2.3 SUSPENSION SYSTEM(S)

- A. Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.
- B. Exposed Steel Suspension System Type 1: Formed steel, commercial quality cold rolled; intermediate-duty.

1. Profile: Tee; 15/16 inch (24 mm) wide face.
 2. Construction: Double web.
 3. Finish: White painted.
- C. Exposed Aluminum Suspension System Type 2: Extruded aluminum; intermediate-duty.
1. Profile: Tee; 15/16 inch (24 mm) wide face.
 2. Finish: Painted white.

2.4 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Radius inside corner closers where abutting a radius corner of CMU.
- C. Perimeter Moldings: Same material and finish as grid.
1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.
- D. Gasket For Perimeter Moldings: Closed cell rubber sponge tape.
- E. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

3.2 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Locate system on room axis according to reflected plan.
- D. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.
- E. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.
- F. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- G. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- H. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- I. Support fixture loads using supplementary hangers located within 6 inches (150 mm) of each corner, or support components independently.
- J. Do not eccentrically load system or induce rotation of runners.

- K. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 - 1. Install with continuous gasket.
 - 2. Use longest practical lengths.
 - 3. Overlap and rivet corners.

3.3 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install units after above-ceiling work is complete.
- E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- F. Cutting Acoustical Units:
 - 1. Cut to fit irregular grid and perimeter edge trim.
 - 2. Make field cut edges of same profile as factory edges.
 - 3. Double cut and field paint exposed reveal edges.
- G. Where round obstructions and bullnose concrete block corners occur, provide preformed closures to match perimeter molding.
- H. Install hold-down clips on panels at exterior locations and within 20 ft (6 m) of an exterior door.

3.4 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.5 SCHEDULE

- A. Typical Lay-In Ceiling, Unless Noted Otherwise: Acoustical Panels, Type 1 interlocking suspension grid.
- B. Kitchen Areas: Washable Lay-In Ceiling Panels, Type 2 interlocking suspension grid.

END OF SECTION

SECTION 09 6500

RESILIENT FLOORING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Resilient tile flooring.
- B. Resilient base.
- C. Resilient stair accessories.
- D. Installation accessories.

1.2 RELATED REQUIREMENTS

- A. Section 09 0561 - Common Work Results for Flooring Preparation: Independent agency testing of concrete slabs, removal of existing floor coverings, cleaning, and preparation.

1.3 REFERENCE STANDARDS

- A. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile; 2004 (Reapproved 2014).
- B. ASTM F1861 - Standard Specification for Resilient Wall Base; 2008 (Reapproved 2012).

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.
- D. Verification Samples: Submit two samples, 12 by 12 inch (305 by 305 mm) in size illustrating color and pattern for each resilient flooring product specified.
- E. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of sub-floor is acceptable.
- F. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Flooring and Base Materials: Quantity equivalent to 2 percent of each type and color.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Do not double stack pallets.

1.6 FIELD CONDITIONS

- A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F (21 degrees C) to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F (13 degrees C).

PART 2 PRODUCTS

2.1 TILE FLOORING

- A. Vinyl Composition Tile: Homogeneous, with color extending throughout thickness.
 - 1. Manufacturers:
 - a. Armstrong World Industries, Inc; Standard Excelon Imperial Texture: www.armstrong.com.
 - b. Johnsonite, a Tarkett Company; Azrock: www.johnsonite.com.
 - c. Mannington Mills, Inc; Essentials: www.mannington.com.
 - d. Substitutions: See Section 01 6000 - Product Requirements.
 - 2. Minimum Requirements: Comply with ASTM F1066, of Class corresponding to type specified.
 - 3. Size: 12 by 12 inch (305 by 305 mm).
 - 4. Thickness: 0.125 inch (3.2 mm).
 - 5. Pattern: Marbleized.
 - 6. Color: To be selected by Architect from manufacturer's full range. Install tile per patterns indicated on Floor Finish Plan. Allow for up to 10 colors, and three colors per room, locations to be determined during color selection process.

2.2 STAIR COVERING

- A. Stair Treads with Integral Risers: Rubber; full height of riser, full width and depth of tread in one piece; tapered thickness.
 - 1. Nosing: Square.
 - 2. Striping: 2 inch (24 mm) wide contrasting color strips.
 - 3. Tread Texture: Raised.
 - 4. Color and pattern: To be selected by Architect from manufacturer's full range of colors and solid or marbleized patterns.

2.3 RESILIENT BASE

- A. Resilient Base: ASTM F1861, Type TV, vinyl, thermoplastic; top set Style B, Cove.
 - 1. Manufacturers:
 - a. Armstrong World Industries, Inc.; Rubber Wall Base: www.armstrong.com.
 - b. Johnsonite, a Tarkett Company; Baseworks: www.johnsonite.com.
 - c. Mannington Mills, Inc.; Optimum Edge: www.mannington.com.
 - d. Roppe Corp; Pinnacle: www.roppe.com.
 - 2. Height: 4 inch (100 mm).
 - 3. Thickness: 0.125 inch (3.2 mm).
 - 4. Finish: Satin.

5. Length: Roll.
6. Color: To be selected by Architect from manufacturer's full range. Allow for up to 10 colors, locations to be determined during color selection process.

2.4 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.
- C. Moldings, Transition and Edge Strips: Rubber.
- D. Sealer and Wax: Types to match those of the school system.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.
- C. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient flooring installation by testing for moisture and pH.
 1. Test in accordance with Section 09 0561.
 2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
- D. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

- A. Prepare floor substrates for installation of flooring in accordance with Section 09 0561.

3.3 Installation - General

- A. Starting installation constitutes acceptance of sub-floor conditions.
- B. Install in accordance with manufacturer's written instructions.

3.4 Installation - Tile Flooring

- A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.
- B. Lay flooring with joints and seams parallel to building lines to produce symmetrical tile pattern.
- C. Install tile to basket weave pattern. Allow minimum 1/2 full size tile width at room or area perimeter.
- D. See drawings for color and pattern of tile flooring installation.

3.5 Installation - Resilient Base

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches (45 mm) between joints.

- B. Miter internal corners. At external corners, 'V' cut back of base strip to 2/3 of its thickness and fold. At exposed ends, use premolded units.
- C. Install base on solid backing. Bond tightly to wall and floor surfaces.
- D. Scribe and fit to door frames and other interruptions.

3.6 Installation - Stair Coverings

- A. Adhere over entire surface. Fit accurately and securely.

3.7 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean, seal, and wax in accordance with manufacturer's instructions.

3.8 PROTECTION

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

SECTION 09 6623

RESINOUS MATRIX TERRAZZO FLOORING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Epoxy matrix terrazzo with ground and polished finish.
- B. Divider strips.
- C. Precast epoxy terrazzo wall base.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete subfloor with steel trowel finish.
- B. Section 07 9200 - Joint Sealants: Sealing joints between terrazzo work and adjacent construction and fixtures.
- C. Section 12 4813 - Entrance Floor Mats and Frames: Recessed floor mat frames.

1.3 REFERENCE STANDARDS

- A. NTMA (GRAD) - Aggregate Gradation Standards; The National Terrazzo and Mosaic Association, Inc; current edition.
- B. NTMA (EPOXY) - Epoxy Terrazzo Specifications; The National Terrazzo and Mosaic Association, Inc; Current Edition located at www.ntma.com.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for divider strips, control joint strips, expansion joints, and sealer; include printed copy of current NTMA recommendations for type of terrazzo specified.
- C. Shop Drawings: Indicate divider strip and control and expansion joint layout, and details of adjacent components. For precast units, detail profile and anchorage requirements.
- D. Samples: Submit two samples, 4 x 4 inch (101 x 101 mm) in size illustrating color, chip size and variation, chip gradation, matrix color and typical divider strip.
- E. Manufacturer's Qualification Statement.
- F. Installer's Qualification Statement.
- G. Cleaning and Maintenance Data: Include procedures for stain removal, stripping, and sealing.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with NTMA recommendations as posted at their web site at www.ntma.com.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section.
 - 1. Minimum five years of documented experience.
- C. Installer Qualifications: Company specializing in performing the type of work specified in this section.
 - 1. Minimum ten years of documented experience.

1.6 MOCK-UP

- A. Construct mock-up of terrazzo illustrating appearance of finished work in each configuration required. Size mock-up to be not less than 3 by 3 feet (1 by 1 m).
- B. Mock-up may remain as part of the work.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store terrazzo materials in a dry, secure area.
- B. Maintain minimum temperature of 60 degrees F (16 degrees C).
- C. Keep products away from fire or open flame.

1.8 FIELD CONDITIONS

- A. Do not install terrazzo when temperature is below 50 degrees F (10 degrees C) or above 90 degrees F (32 degrees C).
- B. Maintain temperature within specified range 24 hours before, during, and 72 hours after installation of flooring.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Other Acceptable Manufacturers - Resinous Matrix Terrazzo Flooring:
 - 1. Sika Corporation; Sikafloor Terrazzo: www.sikafloorusa.com/#sle.
 - 2. Terrazzo; TERRAZZCO Epoxy Terrazzo System, a brand of Concord Terrazzo Company, Inc: www.terrazzco.com/#sle.
 - 3. Terrazzo & Marble Supply Companies; Terroxy Resin Systems: www.tmsupply.com/#sle.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.

2.2 EPOXY MATRIX TERRAZZO APPLICATIONS

- A. Floors:
 - 1. Thickness: 3/8 inch (9 mm), nominal.
 - 2. Color(s): Match existing.
 - 3. Aggregate Type: Match existing.
 - 4. Aggregate Size: Match existing.
- B. Wall Base: Precast epoxy terrazzo.
 - 1. Thickness: Match existing units.
 - 2. Style: Match existing units.
 - 3. Color(s): Match existing units.
 - 4. Aggregate Type and Size: Match existing units.

2.3 MATERIALS

- A. Epoxy Matrix Terrazzo: Aggregate and matrix mix applied to substrate, troweled flat, and ground smooth.
 - 1. Mix Proportions: As required to achieve appearance specified.
- B. Matrix: Two component resin and epoxy hardener with mineral filler and color pigment, non-volatile, thermo-setting.

- C. Aggregate: Type as indicated; sized in accordance with NTMA aggregate gradation standards; color(s) as indicated, uniform in color.
- D. Finishing Grout: Epoxy, color to match terrazzo matrix.
- E. Precast Epoxy Terrazzo Units: Fabricate to sizes and profiles matching adjacent existing units.

2.4 ACCESSORIES

- A. Divider Strips: Match existing width and material, with concealed bottom strip and anchoring features.
- B. Divider and Control Joint Strip Height: To suit thickness of terrazzo topping, with allowance for grinding.
- C. Base Cap, Base Divider Strip, and Separator Strip: Match divider strips.
- D. Anchors and Reinforcement for Precast Units: As recommended by manufacturer for type of installation.
- E. Sealer: Colorless, non-yellowing, penetrating liquid type to completely seal matrix surface; not detrimental to terrazzo components.
- F. Subfloor Filler: Latex type.
- G. Primer: As recommended by manufacturer for project conditions.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive terrazzo.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive terrazzo.
- C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of materials to sub-floor surfaces.
- D. Verify that concrete sub-floor surfaces are ready for terrazzo installation by testing for moisture vapor emission, internal relative humidity, and alkalinity; obtain instructions if test results are not within limits recommended by terrazzo materials manufacturer.
- E. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

- A. Clean substrate of foreign matter.
- B. Prepare concrete subfloor by mechanically abrading surface in accordance with manufacturer's instructions.
- C. Apply primer in accordance with manufacturer's instructions.

3.3 INSTALLATION

- A. Saw cut substrate to install divider and control joint strips to match existing adjacent floor pattern.
- B. Install divider strips according to pattern approved on shop drawings.
- C. Install recessed floor mat frames.
- D. Install base and border divider and control joint strips to match floor pattern.

- E. Place terrazzo mix over substrate to thickness required for new flooring to be flush with existing adjacent flooring.
- F. Anchor precast units as indicated on drawings.
- G. Install precast units using specified setting material.

3.4 FINISHING

- A. Finish terrazzo to NTMA requirements.
- B. Produce terrazzo finish surface to match approved mockup.
- C. Grind terrazzo surfaces with power disc machine; sequence with coarse to fine grit abrasive, using a wet method or using a dry grinder with vacuum to control dust.
- D. Apply grout to fill voids exposed from grinding.
- E. Remove grout coat by grinding, using a fine grit abrasive.

3.5 TOLERANCES

- A. Maximum Variation from Flat Surface: 1/4 inch in 10 feet (6 mm in one m).
- B. Maximum Variation from Level (Except Surfaces Sloping to Drain): 1/8 inch (3 mm).

3.6 CLEANING

- A. Scrub and clean terrazzo surfaces with neutral pH cleaner in accordance with manufacturer's instructions. Let dry.
- B. Immediately after terrazzo has dried, apply sealer in accordance with manufacturer's instructions.
- C. Polish surfaces in accordance with manufacturer's instructions.

3.7 PROTECTION

- A. Protect finished terrazzo from damage due to subsequent construction until Date of Substantial Completion.

END OF SECTION

SECTION 09 6813

TILE CARPETING

PART A - GENERAL

1.1 SECTION INCLUDES

- A. Carpet tile, fully adhered.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-In-Place Concrete: Restrictions on curing compounds for concrete slabs and floors.
- B. Section 09 0561 - Common Work Results for Flooring Preparation: Independent agency testing of concrete slabs, removal of existing floor coverings, cleaning, and preparation.
- C. Section 09 6500 - Resilient Flooring: Cove base and transition accessories.

1.3 SUMMARY DEFINITION

- A. Modular tile carpeting shall be a high-performance, branded 100% Type 6 or 6,6 nylon. Mill extruded nylons will not be accepted. Carpet shall be tufted and have a manufacturer's PVC-free cushion backing system which provides a non-permanent installation application, using a nonreactive or high moisture, releasable adhesive, meeting or exceeding requirements for certification according to the CRI Green Label Plus IAQ Test Program. Carpet tile shall be recyclable meeting USGBC LEED Rating System requirements and shall have third party certification.

1.4 APPLICATION

- A. Intended Use:

- 1. This Design Criteria shall be used in determining and specifying tile carpeting. All products must meet or exceed design intent specification.

1.5 SELECTION CRITERIA

- A. Industry Standards and Tests

- 1. Americans with Disabilities Act (ADA): Section 4.5.3. Accessibility Guidelines for Building & Facilities
 - 2. American Association of Textile Chemists and Colors (AATCC): 16, Option E Colorfastness of Light; 165 Colorfastness to Crocking, Carpets AATCC Crock Meter Method.
 - 3. Aachener Test: Dimensional Stability (DIN Standard 54318 175 Stain Resistance; Pile Floor Covering
 - 4. American Society for Testing and Materials (ASTM) D 2859 Flammability of Finished Textile Floor Covering Materials. E 648 Critical Radiant Flux of Floor Covering System Using a Radiant Heat Energy Source (NFPA 253) E662 Specific Optical Density of Smoke Generated by Solid Materials (NFPA 258)
 - 5. Consumer Product Safety Commission (CPSC): FF-1-7 Methenamine Pill Test.
 - 6. Sustainable Compliance: Owner prefers those carpet tile manufacturers with an operation carpet tile-recycling program for 100% of the carpet product (at the end of its useful life). Third party certification shall be required.

- a. NSF/ANSI-140 Platinum: All carpet products installed shall be certified to meet the NSF/ANSI-140 standard at the Platinum certification level.
- b. Carpet must be free from LBC Red List ingredients at 100 ppm
- c. Red List Free must be 3rd party verified and publicly available through LBC Declare Labels

1.6 SUBMITTALS

- A. Shop Drawings and Product Data Sheets: Submit for all products proposed for use, describing physical characteristics, sizes, patterns, colors available, type of subfloor, and method of installation.
- B. Test Reports: Provide certified test reports, prepared by an independent testing laboratory, showing conformance to specified performance standards. Test results shall represent average results for production goods, and shall not be over two years old.
- C. Samples: Full size samples shall be required for each type of tile carpeting specified.
- D. Maintenance Data: Submit manufacturers recommend cleaning and maintenance data. Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

1.7 QUALITY ASSURANCE

- A. Contractor Qualifications:
 - 1. Employ only experienced Contractors (Installers) skilled in the successful installation of the specified materials and accessories on similar projects for a minimum of five (5) years, acceptable to the carpet tile manufacturer in writing to Owner.
 - 2. Installer shall have documented experience with a formal lift system when applicable to the job.
 - 3. Manufacturer(s) Qualifications:
 - a. Utilize only manufacturers making the specified materials as a current and regular production item.
 - b. Manufacturer: Company specializing in carpet tile manufacturing with a minimum of ten continuous years of documented experience. Carpet manufacturing processes must be certified by a recognized ISO registrar to the current requirements of either the ISO 9001 or ISO 9002 standards for quality management systems as established by the International Organization for Standardization (1987), revised 1994).
 - c. Manufacturer to provide three (3) references of installations in similar facilities.
 - 4. Quality and Performance Testing: Carpet shall comply with the following performance testing requirements:
 - a. CRI TARR Rating: "Severe" or "Heavy" using ASTM D-5252 Hexapod Tumble Test. Value must be 3.0 or higher to ensure appearance retention in high traffic areas such as school classrooms (rating of 3.0) and corridors (rating of 3.0 - 3.5).
 - b. Noise Reduction Coefficient, ASTM C423: 0.20 minimum. 0.25 for LEED facility
 - c. ASTM D 2859 or CPSC FF-1-70 Methenamine Pill Test: Pass.
 - d. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm.
 - e. Dry Breaking Strength: Not less than 100 lbf according to ASTM D 2646.

- f. Dimensional Tolerance: Within 1/32 inch of specified size dimensions, as determined by physical measurement.
- g. Dimensional Stability: 0.2% or less according to ISO 2551 (Aachen Test).
- h. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165.
- i. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.
- j. Electrostatic Propensity: Less than 3.5 kV according to AATCC 134.
- k. ASTM E 648, Critical Radiant Panel Flux Class I, not less than 0.45 watts per square centimeter.
- l. AATCC 16, Option E: Minimum rating of 4 on grey scale after 80 hours exposure.
- m. ASTM E 662 (NFPA 258): Smoke density less than 450 optical density.
- n. AATCC 165: Minimum rating of 4 wet and dry.
- o. AACHEN Test (DIN Standard 54318): Dimensional stability 0.2% shrinkage or growth.

1.8 DELIVERY, STORAGE, HANDLING

- A. Comply with CRI 104 Section 5 Storage and Handling.
 - 1. Deliver all material to the installation site in the manufacturer's original packaging. Packaging shall contain manufacturer's name, product color and pattern name, identification number, and other related information.
 - 2. Carpet tiles shall be stored between 40° F and 100° F and shall be conditioned to between 60° F and 90° F for 48 hours prior to installation.

1.9 PROJECT SITE CONDITIONS

- A. Comply with CRI's "CRI Carpet Installation Standard" for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weather tight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants.
- C. Floor temperature should be 60 °F minimum for proper adhesive curing and performance.
- D. If subfloor is contaminated with an oily residue either from removal of "cutback" during asbestos abatement or from a previous end use such as metal fabrication, this residue MUST be totally removed or covered prior to applying modular adhesive and carpet.
- E. Product is allowed to be installed over moisture stained concrete. Products not allowed to be installed over moisture stained concrete must be noted.
- F. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.
- G. Requisite field conditions for Milliken Non-Reactive Standard Adhesive.
 - 1. No moisture testing is required for On Grade renovations provided:
 - 2. Confirmed and intact ASTM E-1745 vapor retarder (Class B minimum) placed in accordance with ACI 302-2001 and directly in contact with the concrete placement.

3. No visible water on the surface.
 4. Acclimatized to service conditions.
 5. Floor prep must be performed in accordance with ASTM F 710-11 unless specifically allowed per manufacturer's installation instructions.
 6. All topical compounds must be removed prior to application of adhesive.
 7. Bond test is required with archived written and photo documentation, including any corrective action required.
 - a. If there is no vapor retarder or the presence of a vapor barrier is unknown for On Grade renovations, product may be installed if the moisture levels do not exceed 95% relative humidity as measured by the in situ relative humidity probe test per the latest edition of ASTM F2170, as described in the Milliken Non-Reactive Standard Adhesive product specifications and Milliken's then current published instructions for installation of modular carpet.
 - b. No moisture testing is required for Above Grade renovations provided:
 - 1) No visible water on the surface.
 - 2) Acclimatized to service conditions.
 - 3) Floor prep must be performed in accordance with ASTM F 710-11 unless specifically allowed per manufacturer's installation instructions.
 - 4) All topical compounds must be removed prior to application of adhesive.
 - 5) Bond test is required with archived written and photo documentation, including any corrective action required.
 - c. Precautions for cleaning materials and methods that could be detrimental to carpet tile.
- H. Special Warranty for Milliken Non-Reactive Standard Adhesive: Manufacturer warrants that the Milliken Non-Reactive Standard Adhesive, when used with current Milliken modular carpet with Comfort Plus ® or Underscore™ backing systems, will form a bond that provides tack and resistance to lateral movement while allowing for the removal of the modular carpet in high moisture slab conditions with no limit on relative humidity as long as there is no visible water on the slab surface for the Lifetime of the original carpet installation in Commercial installations subject to meeting the following conditions:
1. No moisture testing required if on-grade installations that have a confirmed vapor retarder consistent with ASTM E-1745 Class B minimum conforming vapor retarder placed in accordance with ACI 302-2001 and directly in contact with the concrete placement.
 2. If there is no vapor retarder or the presence of a vapor barrier is unknown, product may be installed if testing is done per the latest edition of ASTM F2170, as described in the Milliken Non-Reactive Standard Adhesive product specifications and Milliken's then current published instructions for installation of modular carpet, and the moisture levels do not exceed 95% relative humidity as measured by the in situ relative humidity probe test.
 3. If the concrete slab is experiencing hydrostatic pressure, or the slab surface is visibly wet, the slab should be treated by some other method and is not covered by this warranty. Failures include, but are not limited to, the following:

-
- I. Milliken does not warrant against hydrostatic pressure, instances where water is forcibly pushed into the slab and/or moisture events caused by broken pipes. In such cases the warranty will be voided.
- J. Warranty Period: Lifetime
1. "Lifetime" is defined as the period of time that the original purchaser of the original carpet installed with the adhesive product chooses to keep the carpet on the floor at the original installation site. Lifetime warranties only apply to adhesive product purchased after November 4, 2016.
- K. Validation:
1. The warranty only applies to use of the Milliken Non-Reactive Standard Adhesive product in carpet installations when bond testing, substrate preparation, adhesive application and carpet installation have all be performed in accordance with the requirements and instructions set forth on the product label, the product specification sheet, Milliken's then current published instructions for installation of modular carpet (which are specific for each carpet product), and the then current Carpet and Rug Institute publication CRI 104 (collectively, the "Documentation"). Furthermore, the carpet installation must be in an indoor commercial environment. The warranty shall not apply to:
 - a. Installations on substrates that were not prepared as instructed in the Documentation;
 - b. Installations where silicates or other sealers or curing additives have been used on the substrate;
 - c. Installations over substrates where hydrostatic pressure exists;
 - d. When the claimant does not have written and photographic documentation of the bond testing conducted prior to the installation;
 - e. Installation failures due to outside sources of water;
 - f. Installations taken up or replaced prior to inspection by authorized Milliken personnel;
 - g. Installations with chemically cleaned substrates, where improper cleaning methods have been used, or where adhesive removed have been applied;
 - h. Installations using incompatible curing compounds, mold release agents, or non-Portland cement based leveling or patch compounds;
 - i. Failure of leveling or patch compounds of any kind;
 - j. Damage caused by expansion joints or other structural areas;
 - k. Structural failure, seismic action, discoloration, caustic solutions entering the system topically through joints;
 - l. Where the adhesive product was allowed to freeze prior to use. In no event shall Milliken be liable for incidental or consequential damages, whether in contract, warranty, negligence, strict liability, or otherwise.
- L. Examination:
1. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and installation tolerances.

2. Examine carpet tile for type, color, pattern, and potential defects.
3. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits
 - a. All topical membrane forming concrete curing compounds must be removed.
 - b. Concrete subfloor must be structurally sound, clean, smooth, trowel finish (not burnished) and level. Cracks and holes in excess of 1/8" (3.2mm) should be filled with a Portland Cement based floor patching material such as W.W. Henry 547 Unipro™, DAP "Webcrete 98", Maipai "PlaniPatch", Ardex "Featherfinish" or similar. Gypsum based compounds are not recommended.
 - c. The only physical requirement for existing adhesive films is that they be scraped clean and dry. If additional smoothing is required and residual adhesive is black (cutback or asphalt emulsion) smoothing must be accomplished by applying a very thin layer of one of the above patching compounds.
 - d. If residual adhesive is not black, scrape or sand until smooth and non-tacky as required.
 - e. Protruding objects must be removed. Floor must be flat (not undulating) to within 1/4" in 12' (6.4mm across 3.66m) with no abrupt changes.
 - f. Durabond D250 is a recommended product should this type of treatment be deemed necessary; however, any non-silicone based sealer will work acceptably with non-PVC backings. This treatment is NOT intended to be a corrective for out of specification water vapor transmission levels.
 - g. When working with a Gyp-Crete or Gypsum subfloor, Milliken recommends sealing with a gypsum floor sealer prior to installation. Failure to do so will result in an unacceptable installation. Gyplock Sealer by Cornerstone Coatings International Inc. is a suitable sealant.

M. Preparation:

1. Comply with CRI's "Carpet Installation Standards" and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.
2. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.
3. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

N. Installation:

1. Comply with CRI's "CRI Carpet Installation Standard," Section 18, "Modular Carpet" and with carpet tile manufacturer's written installation instructions.
2. Installation Method: As recommended in writing by carpet tile manufacturer.
3. Maintain dye-lot integrity. Do not mix dye lots in same area.
4. Maintain pile-direction patterns recommended in writing by carpet tile manufacturer.

5. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
6. Coverage rates for Comfort Plus and Underscore cushionback full spread for all tile sizes: 35-40 sq. yards per gallon (9.5-10 sq. meters per liter).
7. In extreme environments, such as casinos and convention centers, which will routinely experience rolling loads in excess of 5,000 lbs., a heavier full spread of adhesive is recommended. Target coverage for this end use is 20-25 sq. yards per gallon (5-6 sq. meters per liter) for the Non-Reactive Standard product.
8. ADHESIVE READINESS SHOULD BE VERIFIED AS FOLLOWS BEFORE BEGINNING INSTALLATION.
 - a. A bond test is a mock-up installation done prior to the general installation of the Modular Carpet tile to indicate whether the adhesive will bond satisfactorily to the substrate and floor covering. Bond testing will aid in identifying both the working characteristics of the adhesive, such as the appropriate open and working time for the site conditions, and also any potential bonding problems to the substrate.

O. Bond Test Procedure:

1. Select an approximately 7-foot square area (4 square meters) in a typical location on the substrate or slab. The floor should be prepped and consistent with the installation plan per Milliken Modular carpet installation instructions.
2. Milliken modular carpet adhesives should be applied to the substrate for a releasable installation in the recommended manner (trowel, roller, or aerosol spray) and application rate. The adhesive should be allowed to dry completely prior to installation of modular carpet.
3. Observe the adhesive drying time, which will vary with the floor porosity and ambient conditions. Properly dried adhesive will not transfer to the finger and will have a tacky feel.
4. After placing the carpet tile on the dried adhesive apply downward pressure to assure contact with the substrate. Tiles should be immediately locked in place inhibiting lateral movement.
5. After 24 hours, observe the mock-up installation to see if any obvious problems may exist. The modular carpet should be adequately bonded to the substrate, and inhibit lateral movement with adhesive remaining firmly bonded to the substrate. To test this attempt to slide each tile. Now lift each carpet tile and check backing for adhesive transfer. All adhesive should remain on the floor. There should be no adhesive transfer to the back of the tile.
6. Document with photos that show floor prep, floor with adhesive, and back of tile upon tile removal after 24hr period.
7. Testing should be conducted approximately 72 hrs. prior to installation.
8. If installation covers multiple floors a bond test should be conducted on grade.

P. Protection:

1. Perform the following operations immediately after installing carpet tile:

- a. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
- b. Remove yarns that protrude from carpet tile surface.
- c. Vacuum carpet tile using commercial machine with face-beater element.
- d. 4. Protect installed carpet tile to comply with CRI's "Carpet Installation Standard," Section 20, "Protecting Indoor Installations." Do not use plastic, adhesive sheet.

1.10 WARRANTY

- A. Project warranty shall be as stated in Division 01 of the Specifications.
- B. Special Tile Carpeting Warranty: Written warranty, non-prorated, signed by carpet tile manufacturer agreeing to remove and replace tile carpeting installation that fails in materials and workmanship within the specified warranty period.
- C. Provide certified copies of the following manufacturer's product warranties.
 - 1. Lifetime Face Fiber Wear
 - 2. Lifetime Staining/Soiling Resistance
 - 3. Lifetime Color Pattern Permanency
 - 4. Lifetime Delamination of Backing
 - 5. Lifetime Edge Ravel
 - 6. Lifetime Tuft Bind
 - 7. Lifetime Floor Compatibility
 - 8. Lifetime Antistatic
 - 9. Lifetime Antimicrobial Protection
 - 10. Lifetime Flammability
 - 11. Lifetime Cushion Resiliency
 - 12. Lifetime Dimensional Stability
 - 13. Lifetime Floor Release
 - 14. Lifetime Moisture Resistance
- D. Warranty shall be sole source responsibility of the manufacture. Second source warranties or warranties that involve parties' other than the manufacturer is unacceptable.
- E. In case of multiple buildings where tile carpeting has been used, identify building name/number and pattern, pattern color, square yards used.
- F. Installers Warranty: The Contractor (Installer) shall fully guarantee the installation against defects in workmanship, seaming and loss of adhesion to floor for a period of one (1) year from the date of Substantial Completion. Upon written notice, the Installer shall repair or replace the affected area at no cost to Owner.

1.11 EXTRA MATERIALS

- A. Provide additional carpet tiles equal to 3% of each type, color and pattern furnished for Owner's use as maintenance stock.
- B. This stock shall be designated for use by the Owner only, after completion of the Project and shall not be used for repair or replacement during warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. All carpet tiles shall be products of one manufacturer, unless specifically indicated otherwise.
- B. Manufacturer shall be currently involved in reuse technology including renewing and repatterning used product to eliminate waste sent to landfills.
- C. Carpet shall conform to the CRI Indoor Air Quality Testing Program with specific product certification number. Manufacturer shall have a stated environmental policy and documented waste generation improvements
- D. Basis of Design Product: Milliken & Company; Journal, PVC-Free Underscore ES Cushion: www.floors.milliken.com.
- E. Other Manufacturers:
 - 1. Interface, Inc.: www.interface.com.
 - 2. Mohawk Group: www.mohawkgroup.com.
 - 3. Tarkett: www.commercial.tarkett.com.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.

2.2 CARPET TILE COMPONENT CHARACTERISTICS (MINIMUM)

- A. Fiber Content: 100% nylon Type 6 or 6,6 Fiber Type: Branded
- B. Dye Method: Digital or Solution dyed technology
- C. Color and Pattern: Selected by Architect.
- D. Pile Density: 5400 minimums.
- E. Gauge: 1/10" minimum.
- F. Surface Pile Weight: 15 oz./sq. yd. minimum.
- G. Stitches per Inch: 8.00" minimum.
- H. Backing System: Manufacturer's standard PVC-Free open cell polyurethane cushion backing
- I. Critical Radiant Flux Classification: Not less than 0.45 W/sq.cm.
- J. Colorfastness to Crocking: Not less than 4, wet and dry, per AATCC-165, per AATCC-165.
- K. Colorfastness to Light: Not less than 4 after 60 AFU (AATCC fading units) per AATCC-16.
- L. Stain Resistance: AATCC-175, must pass Acid Red 40 spot test with an 8 or better.
- M. Dimensional Stability: Aachen Method Din 54318, 0.2% or less per ISO 2551.
- N. Smoke Density: < or = 450 flaming.
- O. Static Generation: AATCC 134 w/neolite < or = 3.5KV at 20% r.h.
- P. Flame-Spread and Flammability:
 - 1. Carpet flammability shall meet federal Flammability Standards CPSC FF 1-70, when tested in accordance with ASTM D2959-70T (Methenamine Pill Test).
 - 2. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement based formulation provided by carpet tile manufacturer.

3. Adhesives: Water-resistant, mildew-resistant, non-staining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and recommended by carpet tile manufacturer for releasable installations.
4. Indoor Air Quality Control: Carpet tile and adhesive shall be CRI Green Label Plus certified by published class (product type) and certification number.
5. Water intake for Manufacturing and Finishing purposes must not exceed 1 gallon per square meter.

2.3 ACCESSORIES

- A. Adhesive shall be manufacturer approved.
- B. Subfloor filler: Ardex feather finish or other Portland cement based floor-patching compound.
- C. Cove base: As specified in Section 09 6500 Resilient Flooring.
- D. Transition strips: As specified in Section 09 6500 Resilient Flooring.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Refer above to section 1.9, L.

3.2 PREPARATION

- A. Refer above to section 1.9, M.

3.3 INSTALLATION PROCEDURES

- A. Install carpet tiles and adhesive in accordance with manufacture's installation instructions.
- B. Carpet to be secured to the floor in compliance with Americans with disabilities Act: (ADA), Section 4.5.3.
- C. Proper layout and planning must be completed prior to any application of adhesive or carpet tile.
- D. Two working chalk lines must be applied to the floor to insure a straight, square properly aligned installation. These chalklines intersect at the starting point and are exactly 90° to each other.
- E. Begin installation using a pyramid technique and aligning the first tile at the intersection of the two chalk lines.
- F. Always slide each module into position from the side to prevent trapped yarn. Set each module by firmly rubbing both joints.
- G. Modules should be tight but not compressed. Peaking will occur when modules are too tight. Too loose an installation can slip and create obvious gap with use.
- H. Arrows are embossed and printed on the back of each module indicating pile direction. All arrows shall run in the same direction.
- I. A parallel of "scribe" cutting technique may be used when cutting the modules. Any method leading to a clean, properly sized cut is acceptable.
- J. Cuts are most easily and cleanly done through the face of the module.
- K. Provide unobstructed spaces for removing and replacing furniture and equipment in the installation area.

- L. Concrete slabs must have Relative Humidity (RH) and pH range compliant to manufacturer's QC standards. Refer to Part A section 8.
- M. Remove coatings including curing compounds and other substances that are incompatible with adhesives.
- N. Install tile carpeting and entry system tile using releasable installation method. Comply with CRI 104, Section 13, Carpet Modules (Tile - Provide rubber or metal tile carpeting transition divider strip/nosing between carpet tile and walk-off tile when total thickness of each material is not equal. Divider strip nosing and typed selected by Architect.
- O. Where tile carpeting does not continue beyond a door to another room, extend carpet tile into door reveals so that carpet tile stops under door when door is in closed position.
- P. Remove any adhesives, paint, or other products on the carpet immediately during carpet installation.

3.4 FIELD QUALITY CONTROL

- A. Arrange for carpet manufacturer to provide field service specialist at commencement of installation to instruct installer in methods and to assure that project conditions are satisfactory.
- B. Review CRI 104 for guidelines on temperature, humidity, and ventilation and on "Protecting Indoor Installations."
- C. Do not install carpets over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive. Concrete slabs must have Relative Humidity (RH) and pH range compliant to manufacturer's QC standards.

3.5 CLEANING

- A. The tile carpeting and walk-off tile manufacturer shall provide instructions to designated Owner's personnel on the proper methods and procedures for cleaning tile carpeting material furnished utilizing the above method.
- B. Tile carpeting and walk-off manufacturer shall provide a representative to demonstrate cleaning and stain removal processes to Owner's maintenance personnel at: (1) 30 days prior to Substantial Completion; (2) at 6 months from date of Substantial Completion and; (3) 11 months from date of Substantial Completion.
- C. Remove excess adhesive from floor, base and wall surfaces without damage.
- D. Clean floor and base surfaces in accordance with manufacturer's instructions.
- E. A commercial upright vacuum with a beater brush approved under the CRI Seal of Approval Green Label program is recommended for vacuuming of all carpet. For a list of approved vacuums visit www.carpet-rug.org.

3.6 PROTECTION DURING CONSTRUCTION

- A. Protect tile carpeting against damage from construction operations and placement of equipment and fixtures during remainder of construction period as recommended by manufacturer and as required by CRI 104, Section 15, Protection of Indoor Installations. Do not use plastic, adhesive sheet.

END OF SECTION

SECTION 09 8430

SOUND-ABSORBING WALL AND CEILING UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Sound-absorbing wall and ceiling panels.
- B. Sound-absorbing suspended baffles.
- C. Mounting accessories.

1.2 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

1.3 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's printed data sheets for products specified.
- C. Shop Drawings: Fabrication and installation details, panel layout, and fabric orientation.
- D. Selection Samples: Manufacturer's color charts for fabric covering, indicating full range of fabrics, colors, and patterns available.
- E. Verification Samples: Fabricated samples of each type of panel specified; 12 by 12 inch (305 by 305 mm), showing construction, edge details, and fabric covering.
- F. Test Reports: Certified test data from an independent test agency verifying that panels meet specified requirements for acoustical and fire performance.
- G. Manufacturer's Qualification Statement.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company with not less than five years of experience in manufacturing acoustical products similar to those specified.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect acoustical units from moisture during shipment, storage, and handling. Deliver in factory-wrapped bundles; do not open bundles until units are needed for installation.
- B. Store units flat, in dry, well-ventilated space; do not stand on end.
- C. Protect edges from damage.

PART 2 PRODUCTS

2.1 Fabric-Covered SOUND-ABSORBING UNITS

- A. Sound Absorbing Units: Prefinished, factory assembled fabric-covered panels.
 - 1. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
- B. Fabric-Covered Acoustical Panels for Walls and Ceilings:
 - 1. Manufacturers:
 - a. Acoustical Surfaces, Inc; Walls: Noise S.T.O.P. Fabrisorb, Ceilings: Ceiling Clouds : www.acousticalsurfaces.com.

- b. Armstrong; Walls and Ceilings: SoundSoak Panels : www.armstrongceilings.com.
 - c. Conwed; : www.conwed.com.
 - d. CMA, Inc.; : www.cmainc.net.
- 2. Materials
 - a. Panel Core: Manufacturer's standard rigid or semi-rigid fiberglass core.
 - b. Panel Size: As indicated on drawings.
 - c. Panel Thickness: 2 inches (25.4 mm).
 - d. Edges: Perimeter edges reinforced by a formulated resin hardener.
 - e. Corners: Square.
 - f. Fabric: Woven polyester, Guilford of Maine - Anchorage, BeeHave, FR-701 or similar.
 - g. Color: As selected by Architect from fabric manufacturer's full range, allow multiple colors as scheduled.
 - h. Patterns: Where fabric with directional or repeating patterns or fabric with directional weave is used, mark for installation in same direction.
 - i. Mounting Method for Wall Panels: Manufacturer's standard method for concealed support, designed to allow panel removal.
- 3. Mounting Method for Ceiling Panels: Horizontally suspended from ceiling.
- C. Fabric-Covered Acoustical Baffles:
 - 1. Basis of Design Product: CMA, Inc.; Acoustical Wall Panels & Acoustical Baffle Systems: www.cmainc.net
 - 2. Other Manufacturers:
 - a. Acoustical Surfaces, Inc.; Noise S.T.O.P. Fiberglass Baffle: www.acousticalsurfaces.com.
 - b. Armstrong; Sound Soak; www.armstrongceilings.com.
 - c. Conwed; Designscape Respond: www.conwed.com.
 - d. Substitutions: See Section 01 6000 - Product Requirements.
 - 3. Materials:
 - a. Baffle Core: Manufacturer's standard rigid or semi-rigid fiberglass core.
 - b. Baffle Size: As indicated on drawings.
 - c. Baffle Thickness: 2 inches (25.4 mm).
 - d. Corners: Square.
 - e. Fabric: Ripstop nylon.
 - f. Color: As selected by Architect from manufacturer's full range.
 - g. Mounting: Vertically suspended from structure by one edge of panel.

2.2 FABRICATION

- A. Fabric Wrapped, General: Fabricate panels to sizes and configurations as indicated, with fabric facing installed without sagging, wrinkles, blisters, or visible seams.

1. Where radiused or mitered corners are indicated, install fabric to avoid seams or gathering of material.
- B. Tolerances: Fabricate to finished tolerance of plus or minus 1/16 inch (1.6 mm) for thickness, overall length and width, and squareness from corner to corner.

2.3 ACCESSORIES

- A. Back-Mounting Accessories: Manufacturer's standard accessories for concealed support, designed to allow panel removal:
- B. Ceiling-Suspended Accessories: Manufacturer's standard accessories at locations as indicated on each acoustical unit, sized appropriately for weight of acoustical unit.
 1. Provide manufacturer's recommended hardware for suspension from ceiling at heights as indicated, including but not limited to aircraft cable, hooks and turnbuckles.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates for conditions detrimental to installation of acoustical units. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install acoustical units in locations as indicated, following manufacturer's installation instructions.
- B. Align panels accurately, with edges plumb and top edges level. Scribe to fit accurately at adjoining work and penetrations.
- C. Suspend ceiling panels and baffles at locations and heights as indicated on drawings.
- D. Install acoustical units to construction tolerances of plus or minus 1/16 inch (1.6 mm) for the following:
 1. Plumb and level.
 2. Flatness.

3.3 CLEANING

- A. Clean fabric facing upon completion of installation from dust and other foreign materials, following manufacturer's instructions.

3.4 PROTECTION

- A. Provide protection of installed acoustical panels until Date of Substantial Completion.
- B. Replace panels that cannot be cleaned and repaired to satisfaction of the Architect.

3.5 SCHEDULE

- A. Media Center: 1 color.
- B. Cafeteria: 9 colors.
- C. Gymnasium: 2 colors.

END OF SECTION

SECTION 09 9113

EXTERIOR PAINTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Items indicated on drawings and unless otherwise indicated, including the following:
 - 1. Exposed surfaces of steel lintels and ledge angles.
 - 2. Steel ladders and roof hatches.
 - 3. Steel handrails and guardrails.
 - 4. Soffits (Gypsum and/or fiber cement) and trim.
 - 5. CMU at courtyard adjacent to Media Center.
- D. Do Not Paint or Finish the Following Items:
 - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
 - 5. Non-metallic roofing and flashing.
 - 6. Stainless steel, anodized aluminum, bronze, terne coated stainless steel, zinc, and lead.
 - 7. Floors, unless specifically indicated.
 - 8. Ceramic and other types of tiles.
 - 9. Brick, unless specifically indicated.
 - 10. Existing stone-textured cement panels.
 - 11. Glass.
 - 12. Concealed pipes, ducts, and conduits.

1.2 RELATED REQUIREMENTS

- A. Section 05 5000 - Metal Fabrications: Shop-primed items.
- B. Section 09 9123 - Interior Painting.
- C. Section 32 1723.13 - Painted Pavement Markings: Painted pavement markings.

1.3 DEFINITIONS

- A. Comply with ASTM D16 for interpretation of terms used in this section.

1.4 REFERENCE STANDARDS

- A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2014.

- B. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition, www.paintinfo.com.
- C. SSPC-SP 1 - Solvent Cleaning; 2015.
- D. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide complete list of products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
 - 2. MPI product number (e.g. MPI #47).
 - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
 - 4. Manufacturer's installation instructions.
 - 5. If proposal of substitutions is allowed under submittal procedures, explanation of substitutions proposed.
- C. Samples: Submit one set of paper chip samples, illustrating range of colors and textures available for each surface finishing product scheduled.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Paint and Finish Materials: 1 gallon (4 L) of each color; from the same product run, store where directed.
 - 3. Label each container with color in addition to the manufacturer's label.

1.6 MOCK-UP

- A. See Section 01 4000 - Quality Requirements, for general requirements for mock-up.
- B. Locate where directed by Architect.
- C. Mock-up may remain as part of the work.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.8 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

- C. Do not apply exterior paint and finishes during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- D. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surface.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.
- B. Paints:
 - 1. Benjamin Moore & Co.: www.benjaminmoore.com.
 - 2. PPG Paints; : www.ppgpaints.com/#sle.
 - 3. Sherwin-Williams Company; : www.sherwin-williams.com/#sle.
- C. Primer Sealers: Same manufacturer as top coats.
- D. Substitutions: See Section 01 6000 - Product Requirements.

2.2 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready mixed, unless required to be a field-catalyzed paint.
 - 1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 - 2. Provide 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.
 - 3. Supply each paint material in quantity required to complete entire project's work from a single production run.
 - 4. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. Colors: To be selected from manufacturer's full range of available colors.
 - 1. Selection to be made by Architect after award of contract.
 - 2. Allow for minimum of three colors for each system, unless otherwise indicated, without additional cost to Owner.

2.3 PAINT SYSTEMS - EXTERIOR

- A. Paint E-OP - Exterior Surfaces to be Painted, Unless Otherwise Indicated: Including metal, concrete masonry units, brick, fiber cement siding, and gypsum soffits.
 - 1. Two top coats and one coat primer.
 - 2. Top Coat(s): Exterior Light Industrial Coating, Water Based; MPI # 161 and 163.
 - 3. Top Coat Sheen:
 - a. Eggshell: MPI gloss level 3; use this sheen for CMU adjacent to Media Center, soffit panels and trim.
 - b. Semi-Gloss: MPI gloss level 5; use this sheen for metal ladders and roof hatches, handrails and guardrails, lintels and ledge angles.

4. Primer: As recommended by top coat manufacturer for specific substrate. Provide block filler at concrete substrate.

2.4 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin application of paints and finishes until substrates have been properly prepared.
- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
- D. Test shop-applied primer for compatibility with subsequent cover materials.
- E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 1. Fiber Cement Siding: 12 percent.
 2. Masonry, Concrete, and Concrete Masonry Units: 12 percent.

3.2 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or repair existing paints or finishes that exhibit surface defects.
- D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.
- E. Seal surfaces that might cause bleed through or staining of topcoat.
- F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- G. Masonry:
 1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
 2. Prepare surface as recommended by top coat manufacturer.
- H. Fiber Cement Siding: Remove dirt, dust and other foreign matter with a stiff fiber brush. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
- I. Exterior Gypsum Board: Fill minor defects with exterior filler compound. Spot prime defects after repair.
- J. Ferrous Metal:
 1. Solvent clean according to SSPC-SP 1.
 2. Remove rust, loose mill scale, and other foreign substances using using methods recommended in writing by paint manufacturer. Protect from corrosion until coated.

3.3 APPLICATION

- A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- B. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
- C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- D. Apply each coat to uniform appearance.
- E. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply additional coats until complete hide is achieved.
- F. Sand metal surfaces lightly between coats to achieve required finish.
- G. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- H. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.5 PROTECTION

- A. Protect finishes until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

SECTION 09 9123

INTERIOR PAINTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
 - 1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
 - 2. Mechanical and Electrical:
 - a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
 - b. In finished areas, paint shop-primed items.
- D. Do Not Paint or Finish the Following Items:
 - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
 - 5. Stainless steel and anodized aluminum items.
 - 6. Marble, granite, slate, and other natural stones.
 - 7. Floors, unless specifically indicated.
 - 8. Ceramic and other tiles.
 - 9. Brick and architectural concrete, unless otherwise indicated.
 - 10. Glass.
 - 11. Acoustical materials, unless specifically indicated.
 - 12. Concealed pipes, ducts, and conduits.

1.2 RELATED REQUIREMENTS

- A. Section 05 1200 - Structural Steel: Shop-primed items.
- B. Section 09 9113 - Exterior Painting.

1.3 DEFINITIONS

- A. Comply with ASTM D16 for interpretation of terms used in this section.

1.4 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.

- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2014.
- C. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition, www.paintinfo.com.
- D. SSPC-SP 1 - Solvent Cleaning; 2015.
- E. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).
- F. SSPC-SP 3 - Power Tool Cleaning; 1982 (Ed. 2004).
- G. SSPC-SP 13 - Surface Preparation of Concrete; (Reaffirmed 2015); 2003.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide complete list of products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
 - 2. MPI product number (e.g. MPI #47).
 - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
 - 4. Manufacturer's installation instructions.
- C. Samples: Submit one set of paper chip samples, in size illustrating range of colors and textures available for each surface finishing product scheduled.
- D. Manufacturer's Instructions: Indicate special surface preparation procedures and substrate conditions requiring special attention.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Paint and Finish Materials: Provide 5%, but not less than 1 gallon (4 L), of each color; from the same product run, store where directed.
 - 3. Label each container with color, type, and sheen in addition to the manufacturer's label.

1.6 MOCK-UP

- A. See Section 01 4000 - Quality Requirements, for general requirements for mock-up.
- B. Provide panel, minimum 8 feet (2.4 m) high by 8 feet (2.4 m) wide, illustrating paint color, texture, and finish.
- C. Provide door and frame assembly illustrating paint color, texture, and finish.
- D. Locate where directed by Architect.
- E. Mock-up may remain as part of the work.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.8 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surface.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Provide paints and finishes from the same manufacturer.
 - 1. In the event that a single manufacturer cannot provide specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
- B. Paints:
 - 1. Benjamin Moore & Company: www.benjaminmoore.com.
 - 2. PPG Paints: www.ppgpaints.com/#sle.
 - 3. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
- C. Primer Sealers: Same manufacturer as top coats.
- D. Substitutions: See Section 01 6000 - Product Requirements.

2.2 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready mixed, unless intended to be a field-catalyzed paint.
 - 1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 - 2. Provide 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.
 - 3. Supply each paint material in quantity required to complete entire project's work from a single production run.
 - 4. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. Volatile Organic Compound (VOC) Content:
 - 1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
 - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - b. Architectural coatings VOC limits of North Carolina .

2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- C. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
- D. Colors: To be selected from manufacturer's full range of available colors.
 1. Selection to be made by Architect after award of contract.
 2. In each room, allow for minimum of three colors for each system, unless otherwise indicated, without additional cost to Owner.
 3. Extend colors to surface edges or as indicated on drawings; colors may change at any location as directed by Architect.
 4. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.

2.3 PAINT SYSTEMS - INTERIOR

- A. Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board and concrete masonry units.
 1. Two top coats and one coat primer. Provide block filler at concrete and concrete masonry units.
 2. Top Coat(s): Institutional Low Odor/VOC Interior Latex; MPI # 143 & 145.
 3. Top Coat Sheen:
 - a. Flat: MPI gloss level 1; use this sheen for ceilings and other overhead surfaces.
 - b. Eggshell: MPI gloss level 3; use this sheen unless otherwise noted.
- B. Paint I-OP-MD-DT - Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals:
 1. Medium duty applications include doors and door frames.
 2. Two top coats and one coat primer.
 3. Top Coat(s): Interior Light Industrial Coating, Water Based; MPI # 153.
 4. Top Coat Sheen:
 - a. Semi-Gloss: MPI gloss level 5; use this sheen at all locations.
- C. Paint I-OP-MD-WC - Medium Duty Vertical: Including metals, gypsum board and concrete masonry units in wet areas.
 1. Medium duty vertical applications include: See finish schedule for locations.
 2. Two top coats and one coat primer. Provide block filler at concrete and concrete masonry units.
 3. Top Coat(s): Interior Epoxy-Modified Latex; MPI # 215.
 4. Top Coat Sheen: MPI gloss level 5; use this sheen at all locations.
- D. Paint I-OP-DF - Dry Fall: Metals; exposed structure and overhead-mounted services in spaces with ceiling open to structure, including shop primed structural steel, metal fabrications, galvanized ducts, galvanized conduit, and piping.
 1. Shop primer by others.

2. Two top coats:
3. Top Coat: Latex Dry Fall; MPI # 118.
 - a. Products:
4. Top Coat Sheen: MPI gloss level 1; use this sheen at all locations.
5. Primer: As recommended by top coat manufacturer for specific substrate.

2.4 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin application of paints and finishes until substrates have been properly prepared.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 1. Gypsum Wallboard: 12 percent.
 2. Masonry, Concrete, and Concrete Masonry Units: 12 percent.

3.2 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or repair existing paints or finishes that exhibit surface defects.
- D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- E. Seal surfaces that might cause bleed through or staining of topcoat.
- F. Masonry:
 1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
 2. Prepare surface as recommended by top coat manufacturer.
- G. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
- H. Galvanized Surfaces:
 1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
 2. Prepare surface according to SSPC-SP 2.

I. Ferrous Metal:

1. Solvent clean according to SSPC-SP 1.
2. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer. Protect from corrosion until coated.

3.3 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
- D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- E. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- F. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.
- G. Sand metal surfaces lightly between coats to achieve required finish.
- H. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- I. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.5 PROTECTION

- A. Protect finishes until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

SECTION 10 1101

VISUAL DISPLAY BOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Markerboards and Tackboards.

1.2 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

1.3 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's data on markerboard, tackboard, trim, and accessories.
- C. Shop Drawings: Indicate wall elevations, dimensions, joint locations, special anchor details.
- D. Samples: Submit color charts for selection of color and texture of tackboard.
- E. Maintenance Data: Include data on regular cleaning, stain removal.

1.4 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year warranty for markerboard to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Visual Display Boards:
 - 1. MooreCo, Inc; : www.moorecoinc.com.
 - 2. Claridge Products and Equipment, Inc; : www.claridgeproducts.com.
 - 3. Polyvision Corporation (Nelson Adams); : www.polyvision.com.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.

2.2 VISUAL DISPLAY BOARDS

- A. Markerboards: Porcelain enamel on steel, laminated to core, surface finish suitable for markers and projection.
 - 1. Color: White.
 - 2. Steel Face Sheet Thickness: 24 gage, 0.0239 inch (0.61 mm).
 - 3. Core: Fiberboard, 1/2 inch (13 mm) thick, laminated to face sheet.
 - 4. Backing: Aluminum foil, laminated to core.
 - 5. Size: As indicated in schedule at the end of this section.
 - 6. Frame: Extruded aluminum, with concealed fasteners.
 - 7. Frame Finish: Anodized, natural.
 - 8. Accessories: Provide chalk tray, map rail, and flag holder.

- B. Dry Erase Panels: Porcelain enamel on steel, laminated to core, surface finish suitable for marks and projection
 - 1. Color: White
 - 2. Steel Face Sheet Thickness: 28 gage, 0.0149 inc (0.38mm)
 - 3. Core: Aluminum composite plate consisting of thermoplastic PE core between two black "pre coated" aluminum plates for a total thickness of 4mm
 - 4. Size: Maximum size available to result in a full wall installation with interior joints butted and perimeter edge trimmed. Minimum size individual pane 44" x 96".
 - 5. Frame Finish: Anodized, natural.
- C. Tackboards: Composition cork, through-body color. Color to be selected by Architect from manufacturer's full range.
 - 1. Cork Thickness: 1/4 inch (6 mm).
 - 2. Backing: Hardboard, 1/4 inch (6 mm) thick, laminated to tack surface.
 - 3. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.
 - 4. Height: 48 inches (1220 mm).
 - 5. Length: 48 inches (1220 mm), in one piece.
 - 6. Frame: Extruded aluminum, with concealed fasteners.
 - 7. Frame Finish: Anodized, natural.
 - 8. Accessories: Provide map rail and flag holder.

2.3 ACCESSORIES

- A. Aluminum Frames: Extruded aluminum at perimeter.
- B. Map Rail: Extruded aluminum, manufacturer's standard profile, with cork insert and runners for accessories; 1 inch (25 mm) wide overall, full width of frame.
- C. Map Supports: Formed aluminum sliding hooks and roller brackets to fit map rail.
- D. Temporary Protective Cover: Sheet polyethylene, 8 mil (0.2 mm) thick.
- E. Flag Holders: Cast aluminum bored to receive 1 inch (25 mm) diameter flag staff, bracketed to fit top rail of board.
- F. Tray: Aluminum, manufacturer's standard profile, molded ends, concealed fasteners, same finish as frame.
- G. Mounting Brackets: Concealed.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as indicated on shop drawings.

3.2 INSTALLATION

- A. Install boards in accordance with manufacturer's instructions.
- B. Secure units level and plumb.

3.3 CLEANING

- A. Clean board surfaces in accordance with manufacturer's instructions.
- B. Cover with protective cover, taped to frame.
- C. Remove temporary protective cover at Date of Substantial Completion.

3.4 SCHEDULE

- A. Gymnasium
 - 1. 802 - Locker Room: One 48 by 96 inch marker board.
 - 2. 805 - Locker Room: One 48 by 144 inch marker board.
- B. Media Center
 - 1. 200A - Small Group: Two 48 by 96 inch marker boards.
 - 2. Group Study Area: (2) walls 9' x 12', (3) 48 by 96 inch dry erase panels full width of wall each side.
- C. Administrative
 - 1. 108 - Work Room: One 48 by 48 tackboard.
 - 2. 110 - Teachers Lounge: One 48 by 48 tackboard.
- D. Computer Lab 401: One 48 by 144 inch marker board.

END OF SECTION

SECTION 10 1400

SIGNAGE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Room and door signs.
- B. Interior directional and informational signs.
- C. Emergency evacuation maps.
- D. Building identification signs.

1.2 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2009.
- C. NC Building Code 2012 edition

1.3 SUBMITTALS

- A. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
- B. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
 - 1. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
 - 2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
 - 3. Submit for approval by Owner through Architect prior to fabrication.
- C. Samples: Submit one sample of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.
- D. Selection Samples: Submit one set of color selection charts or chips.
- E. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.
- B. Package room and door signs in sequential order of installation, labeled by floor or building.
- C. Store tape adhesive at normal room temperature.

1.6 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Flat Signs:
 - 1. Best Sign Systems, Inc; Product ImPressions: www.bestsigns.com. Basis of Design product.
 - 2. Cosco Industries (ADA signs): www.coscoarchitecturalsigns.com.
 - 3. Mohawk Sign Systems, Inc; : www.mohawksign.com/#sle.
 - 4. Seton Identification Products; : www.seton.com/aec/#sle.
 - 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Dimensional Letter Signs:
 - 1. APCO Signs: www.apcosigns.com.
 - 2. Cosco Industries: www.coscoarchitecturalsigns.com/#sle.
 - 3. Gemini Sign Letters. www.geminisignletters.com
 - 4. Substitutions: See Section 01 6000 - Product Requirements.

2.2 SIGNAGE APPLICATIONS

- A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
- B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including lobbies and similar open areas.
 - 1. Sign Type: Flat signs with engraved panel media as specified.
 - 2. Provide "tactile" signage, with letters raised minimum 1/32 inch (0.8 mm) and Grade II braille.
 - 3. Character Height: 1 inch (25 mm).
 - 4. Sign Height, unless otherwise indicated:
 - a. Signs with numbers only: 2 inches (50 mm).
 - b. Signs with room names or other additional information: 6 inches (150mm).
 - 5. Office Doors: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section for replaceable occupant name.
 - 6. Conference and Meeting Rooms: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section with sliding "In Use/Vacant" indicator.
 - 7. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.

8. Rest Rooms: Identify with pictograms, the names indicated on the Room Schedule shown on the drawings, room numbers to be determined later, and braille.

C. Interior Directional and Informational Signs:

1. Sign Type: Flat signs digital print media.

D. Building Identification Signs:

1. Use individual metal letters as shown on drawings.
2. Mount on building exterior, in location indicated on drawings.

2.3 SIGN TYPES

A. Flat Signs: Signage media without frame.

1. Edges: Square.
2. Corners: Radiused.
3. Wall Mounting of One-Sided Signs: Foam adhesive tape or other adhesive suitable for painted CMU walls and glass.

B. Color and Font: Unless otherwise indicated:

1. Character Font: Helvetica, Arial, or other sans serif font.
2. Character Case: Upper case only.
3. Background Color: As selected from manufacturer's full range.
4. Character Color: Contrasting color, as selected from manufacturer's full range.

2.4 TACTILE SIGNAGE MEDIA

A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:

1. Total Thickness: 1/8 inch (3 mm).

2.5 DIMENSIONAL LETTERS

A. Metal Letters:

1. Metal: Aluminum sheet, fabricated to provide letter height.
2. Finish: Painted, color to be selected by Architect from Manufacturer's full range.
3. Letter Height: 11 inches.
4. Letter Thickness: 3/8 inches.
5. Letter Font: To match artwork provided by Owner.
6. Letter Case: Upper case only.
7. Mounting: Metal standoffs, 1/2" long, mounting on fascia of aluminum canopy.

2.6 ACCESSORIES

A. Concealed Screws: Stainless steel

B. Tape Adhesive: Double sided foam tape permanent adhesive and liquid adhesive for mounting on painted CMU walls and glass.

C. Blank back up panel for mounting on glass to conceal back side of panel signs installed on glass.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install neatly, with horizontal edges level.
- C. Install back up panels on all signs installed on glass.
- D. Protect from damage until Substantial Completion; repair or replace damaged items.

END OF SECTION

SECTION 10 2113.19

PLASTIC TOILET COMPARTMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Toilet compartments.
- B. Shower compartments.
- C. Changing compartments.
- D. Urinal and vestibule screens.

1.2 RELATED REQUIREMENTS

- A. Section 10 2800 - TOILET, BATH, AND LAUNDRY ACCESSORIES.

1.3 REFERENCE STANDARDS

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- B. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2015.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on panel construction, hardware, and accessories.
- C. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.
- D. Samples: Submit two samples of partition panels, 4 x 4 inch (100 x 100 mm) in size illustrating panel finish, color, and sheen.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Solid Plastic Toilet Compartments:
 - 1. Ampco Products, Inc; Solid Plastic Polyethylene (HDPE): www.ampco.com.
 - 2. Inpro; Endurant Toilet Partitions: www.inprocorp.com/#sle.
 - 3. Metpar Corp; Solid Plastic Toilet Partitions: www.metpar.com/#sle.
 - 4. Partition Systems International of South Carolina; PolyLife HDPE Toilet Partitions: www.psisc.com/#sle.
 - 5. Substitutions: Section 01 6000 - Product Requirements.

2.2 PLASTIC TOILET COMPARTMENTS

- A. Solid Plastic Compartments: Factory fabricated doors, pilasters, and divider panels made of solid molded high density polyethylene (HDPE), tested in accordance with NFPA 286; floor-mounted headrail-braced.
- B. Doors:
 - 1. Thickness: 1 inch (25 mm).

2. Width: 28 inch (711 mm).
 3. Width for Handicapped Use: 36 inch (915 mm), out-swinging.
 4. Height: 55 inch (1397 mm).
- C. Panels:
1. Thickness: 1 inch (25 mm).
 2. Height: 55 inch (1397 mm).
- D. Pilasters:
1. Thickness: 1 inch (25 mm).
 2. Width: As required to fit space; minimum 3 inch (76 mm).
- E. Screens: Without doors; to match compartments; mounted to wall with continuous panel brackets.

2.3 ACCESSORIES

- A. Pilaster Shoes: Formed ASTM A666, Type 304 stainless steel with No. 4 finish, 3 in (75 mm) high, concealing floor fastenings.
- B. Head Rails: Hollow stainless steel, 1 x 1-1/2 inch (25 x 38 mm) size, with anti-grip profile and cast socket wall brackets.
- C. Pilaster Brackets: Satin stainless steel.
- D. Wall Brackets: Continuous type, satin stainless steel.
- E. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
- F. Hardware: Satin stainless steel:
1. Coat hook with rubber bumper; one per compartment, mounted on door at 48" A.F.F. Max.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated on shop drawings.
- B. Verify correct spacing of and between plumbing fixtures.

3.2 INSTALLATION

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
- B. Maintain 3/8 inch to 1/2 inch (9 mm to 13 mm) space between wall and panels and between wall and end pilasters.
- C. Attach panel brackets securely to walls using anchor devices.
- D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.

3.3 TOLERANCES

- A. Maximum Variation From True Position: 1/4 inch (6 mm).
- B. Maximum Variation From Plumb: 1/8 inch (3 mm).

3.4 ADJUSTING

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch (5 mm).

- B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.
- C. Adjust adjacent components for consistency of line or plane.

END OF SECTION

SECTION 10 2800

TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Commercial toilet accessories.
- B. Commercial shower and bath accessories.
- C. Utility room accessories.

1.2 RELATED REQUIREMENTS

- A. Section 10 2113.19 - Plastic Toilet Compartments.
- B. See drawings for accessories to be Furnished by Owner & installed by Contractor.

1.3 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2015.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- E. ASTM C1036 - Standard Specification for Flat Glass; 2011.
- F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.

1.4 SUBMITTALS

- A. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Bobrick Washroom Equipment, Inc.; www.bobrick.com.
- B. Commercial Toilet, Shower, and Bath Accessories:
 - 1. AJW Architectural Products; : www.ajw.com.
 - 2. ASI - American Specialties, Inc; : www.americanspecialties.com.
 - 3. Bradley Corporation; : www.bradleycorp.com.
 - 4. Substitutions: Section 01 6000 - Product Requirements.
- C. Provide products of each category type by single manufacturer.

2.2 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
- B. Stainless Steel Sheet: ASTM A666, Type 304.

- C. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.
- D. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.
- E. Mirror Glass: Tempered safety glass, ASTM C1048; and ASTM C1036 Type I, Class 1, Quality Q2, with silvering as required.
- F. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.
- G. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.3 FINISHES

- A. Stainless Steel: No. 4 Brushed finish, unless otherwise noted.

2.4 Commercial Toilet Accessories

- A. Toilet Tissue Dispenser: Furnished by Owner, installed by Contractor.
- B. Paper Towel Dispenser: Furnished by Owner, installed by Contractor.
- C. Soap Dispenser: Furnished by Owner, installed by Contractor.
- D. Waste Receptacle: Furnished by Owner, installed by Contractor.
- E. Sanitary Napkin Disposal: Stainless steel, surface-mounted, self-closing door, locking bottom panel with full-length stainless steel piano-type hinge, removable receptacle.
 - 1. Product: B5806 Series by Bobrick.
- F. Framed Safety Mirrors:
 - 1. Indicated on Drawing Schedule as "Mirror, Polished Steel": Stainless steel framed, polished stainless steel reflecting surface.
 - a. Size: 24 x 60 inches or as indicated on drawings.
 - b. Product: Super #8 Framed Safety Mirrors, manufactured by Mirrored Stainless Solutions, LLC; www.mirroredstainlessolutions.com.
 - 2. Indicated on Drawing Schedule as "Mirror": Stainless steel framed, 1/4 inch (6mm) thick tempered safety glass; ASTM C1048.
 - a. Size: 24 x 36 inches, or as indicated on drawings.
 - b. Product: B-1658 manufactured by Bobrick.
 - c. Frame: 0.050 inch (1.3mm) angle shapes, with mitered, welded and ground corners, and tamperproof hanging system; stain finish.
 - d. Backing: Full-mirror sized, minimum 0.030 inch (0.8mm) galvanized steel sheet and nonabsorptive filler material.
 - 3. Mount 24 x 60 mirrors with bottom edge 18 inches AFF.
- G. Grab Bars: Stainless steel, smooth surface.
 - 1. Standard Duty Grab Bars:
 - a. Push/Pull Point Load: 250 pound-force (1112 N), minimum.
 - b. Dimensions: 1-1/4 inch (32 mm) outside diameter, minimum 0.05 inch (1.3 mm) wall thickness, concealed flange mounting, 1-1/2 inch (38 mm) clearance between wall and inside of grab bar.

- c. Length and Configuration: 18, 36, 42 inch, and shower corner unit and as indicated on drawings.
 - d. Products: B-5806 Series by Bobrick.
 - H. Sanitary Napkin Disposal Unit: Stainless steel, surface-mounted, self-closing door, locking bottom panel with full-length stainless steel piano-type hinge, removable receptacle.
- 2.5 Commercial Shower and Bath Accessories
- A. Shower Curtain Rod: Stainless steel tube, 1 inch (25 mm) outside diameter, 0.04 inch (1.0 mm) wall thickness, satin-finished, with 2 1/2 inch (63 mm) minimum outside diameter, minimum 0.04 inch (1.0 mm) thick satin-finished stainless steel flanges, for installation with exposed fasteners. Length as indicated on drawings, field verify.
 - B. Shower Curtain:
 - 1. Material: Opaque vinyl, 0.008 inch (0.2 mm) thick, matte finish, with antibacterial treatment, flameproof and stain-resistant.
 - 2. Material: Polyester, machine washable, and mildew-resistant.
 - 3. Size: 48 by 72 inches (1219 by 1830 mm), hemmed edges.
 - 4. Grommets: Stainless steel; pierced through top hem on 6 inch (150 mm) centers.
 - 5. Color: White.
 - 6. Shower Curtain Hooks: Chrome-plated or stainless steel spring wire designed for snap closure.
 - 7. Product: B-204-1 (Hooks) and B-204-2 (Curtain) manufactured by Bobrick.
 - C. Folding Shower Seat: Wall-mounted surface; welded tubular seat frame, structural support members, hinges and mechanical fasteners of Type 304 stainless steel, L-shaped, right hand and L-shaped, left hand seat.
 - 1. Seat: Phenolic or polymeric composite one-piece seat or seat slats, of color as selected.
 - 2. Size: ADA Standards compliant.
 - 3. Product: B-5181 manufactured by Bobrick.
 - D. Towel Pin: Stainless steel, 3 inch (75 mm) extension from wall; rectangular-shaped bracket and backplate for concealed attachment, satin finish.
 - 1. Product: B-6677 manufactured by Bobrick.
 - E. Robe Hook: Heavy-duty stainless steel, single-prong, rectangular-shaped bracket and backplate for concealed attachment, satin finish.
 - 1. Product: B-6717 manufactured by Bobrick.
- 2.6 Utility Room Accessories
- A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch (1.3 mm) thick stainless steel, Type 304, with 1/2 inch (12 mm) returned edges, 0.06 inch (1.6 mm) steel wall brackets.
 - 1. Drying rod: Stainless steel, 1/4 inch (6 mm) diameter.
 - 2. Hooks: 3, 0.06 inch (1.6 mm) stainless steel rag hooks at shelf front.
 - 3. Mop/broom holders: 4 spring-loaded rubber cam holders at shelf front.
 - 4. Length: 36 inches (900 mm).

- 5. Length: Manufacturer's standard length for number of holders/hooks.
- 6. Product: B-224 manufactured by Bobrick.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.

3.2 INSTALLATION

- A. See drawings for items to be furnished by Owner and installed by Contractor.
- B. Install accessories in accordance with manufacturers' instructions in locations indicated on the drawings.
- C. Install plumb and level, securely and rigidly anchored to substrate.
- D. Mounting Heights: As shown on drawings and required by accessibility regulations, unless otherwise indicated.

3.3 PROTECTION

- A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION

SECTION 10 4400

FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fire extinguisher cabinets.

1.2 RELATED REQUIREMENTS

- A. Sections 04 2000 Unit Masonry and 09 2116 Gypsum Board Assemblies: Roughed-in wall openings.

1.3 REFERENCE STANDARDS

- A. NFPA 10 - Standard for Portable Fire Extinguishers; 2013.
- B. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.

1.5 FIELD CONDITIONS

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Fire Extinguisher Cabinets and Accessories:
 - 1. Larsen's Manufacturing Co; Architectural: www.larsensmfg.com.
 - 2. Nystrom, Inc; Alpine: www.nystrom.com/#sle.
 - 3. Potter-Roemer; Alta: www.potterroemer.com.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.

2.2 FIRE EXTINGUISHER CABINETS

- A. Cabinet Construction: Non-fire rated.
- B. Fire Rated Cabinet Construction: One-hour fire rated.
- C. Cabinet Configuration: Semi-recessed type.
 - 1. Sized to accommodate extinguisher and accessories. Where cabinets are installed in existing rough opening, size cabinet such that flange will completely conceal rough opening.
- D. Door: Reinforced for flatness and rigidity; latch. Hinge doors for 180 degree opening with manufacturer's standard hinge. Provide manufacturer's standard catch.
- E. Door Glazing: Acrylic plastic, clear, 1/8 inch (3 mm) thick, flat shape and set in resilient channel glazing gasket.
- F. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
- G. Finish of Cabinet Exterior Trim and Door: Aluminum, Clear anodized.

H. Finish of Cabinet Interior: White colored enamel on steel.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install cabinets plumb and level in wall openings, 48 inches inches (1219 mm) from finished floor to top of extinguisher bracket, max.
- C. Secure rigidly in place.

END OF SECTION

SECTION 10 5100

LOCKERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Locker benches.

1.2 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's published data on bench construction and sizes.
- C. Manufacturer's Installation Instructions: Indicate component installation assembly.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Protect bench finish and adjacent surfaces from damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Locker Benches:
 - 1. Art Metal Products; www.artmetalproducts.com
 - 2. ASI Storage Solutions; www.asistorage.com
 - 3. Penco Products, Inc; www.pencoproducts.com
 - 4. Substitutions: See Section 01 6000 - Product Requirements.

2.2 LOCKER APPLICATIONS

- A. Locker Benches: Stationary type; bench top of laminated maple; painted steel pedestals.
 - 1. Height: 17-1/2"
 - 2. Tops: 18x36" Standard, 20x42" ADA

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that flooring has been installed and is ready to receive benches.

3.2 INSTALLATION

- A. During and after installation, maintain same temperature and humidity conditions in building spaces as will occur after occupancy.
- B. Install in accordance with manufacturer's instructions. Neatly and securely fasten bench bases to slab using stainless steel anchors, carefully predrilling per anchor manufacturer's installation instructions.
- C. Protect benches from damage until project completion.
- D. Touch-up, repair or replace damaged products before Substantial Completion.

3.3 CLEANING

- A. Clean benches.

END OF SECTION

SECTION 10 6000

WOOD STORAGE SHELVING

PART 1.0 GENERAL

DESCRIPTION

- 2.1 Work Included: Install pre-manufactured wood storage shelving, hanging rods and other items not specifically described as being installed under other Sections of these Specifications.

A. SUBMITTALS

1. Shop Drawings:
 - a. Submit shop drawings for storage units, identified with location, materials and finishes.
 - b. Indicate materials, methods of assembly and jointing, thickness of parts, location and type of hardware.
 - c. Take measurements at the site for space where each item is to be placed.
2. Product Data: Submit manufacturer's detailed product description. Indicate unit construction including finishes.

B. DELIVERY, STORAGE AND HANDLING

1. Deliver storage units only after building is enclosed and wet operations in building are completed.
2. Protect finished surfaces from soiling and damage during handling and installation.

PART 2.0 PRODUCTS

ACCEPTABLE MANUFACTURERS

- 4.1 Excalibur Shelving Systems; Standard Pine: www.excaliburshelvingsystems.com.
- 4.2 Lundia USA; Stockroom Shelving: www.lundiausa.com.
- 4.3 Newood Manufacturing Inc; Stockroom Shelving: www.newood.com.
- 4.4 Palmetto Shelving Inc; Wood Shelving: www.palmettoshelving.com.
- 4.5 Substitutions: See Section 01 6000 - Product Requirements.

A. FABRICATION

1. Manufacture shelving in sizes as necessary to fit wall-to-wall as indicated on the drawings. Gaps in excess of 2" are not acceptable.
 - a. Where dead corners are indicated on drawings, solid end panels will be required.
 - b. Shelves shall not exceed 42" in length in general storage areas and 36" in book storage rooms. Shelves with inset end supports and/or less than 3/4" thick must be pre-approved (sample required) and may not exceed 30" in length.
 - c. Modifications for shelves with inset end supports must be performed by the manufacturer. Field modifications will not be accepted.

PART 3.0 EXECUTION

SURFACE CONDITIONS

- 6.1 Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

A. INSTALLATION

1. Install in strict accordance with manufacturer's current instructions and approved shop drawings.
2. Anchor all wall units.

END OF SECTION

SECTION 10 7300

PROTECTIVE COVERINGS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Furnish and install an extruded aluminum structural panel protective canopy system in strict accordance with specification details and plan drawings.

1.2 RELATED WORK

- A. Section 05 4000 - Cold-Formed Metal Framing: Providing support for canopy connections to structure.
- B. Section 07 2500 - Weather Barriers: Sealing around connections to maintain continuity of air barrier.

1.3 SUBMITTALS

- A. Furnish shop drawings bearing the seal of a state registered structural engineer to indicate proper construction in compliance with all local codes including, but not limited to, wind ratings, load bearing, footings required, spacing of posts in accordance with fire codes for entrance and egress, and drainage of precipitation.
- B. Submit signed Certification by a state registered structural engineer that design complies with latest Standard building Code applicable to location and applicable ANSI/ASCE requirements.
- C. Submit detailed product data on all components including part numbers and characteristics.
- D. Furnish samples of the color and finish.

1.4 QUALITY ASSURANCE

- A. The manufacturer shall provide evidence of experience designing and producing at least five prior projects of similar scope in the past three years, and at least five years experience specializing in the manufacture of aluminum covering systems.
- B. The erector shall provide evidence of experience completing at least five prior projects of similar scope in the past three years.

PART 2 - MATERIALS

2.1 MANUFACTURER

- A. Basis of Design: Rusco Entry Canopy SUPERDECK by Rusco Custom Canopies, Knoxville, TN 865 938-4717. Products evaluated for consideration as substitutes shall meet or exceed specifications in shapes, thickness, function, and installation methods. Component specifications may be reviewed at: <http://www.swbrownco.com/architecturalspecifications>
- B. Mapes Super Lumideck Hanger Rod Canopy Flat Soffit by Mapes Architectural Canopies, Lincoln, New England 68514-9724.
- C. MASA Architectural Canopies Extrudedeck Series, Piscataway Township, New Jersey 08854

2.2 PRODUCTS

- A. Frame shall be integrated beam, fascia, and gutter. Dimensions and thickness shall be capable of receiving and supporting extruded flat aluminum soffit decking.
- B. Trim Fascia shall have a minimum dimension of 13" and maximum of 15" in height.

- C. Decking shall be flat bottom style 5-7" wide and capable of securely interlocking for a watertight seal and interface with frame and fascia components.
- D. Color shall be clear anodized electrolytic sealing finish, and meet AAMA 611 Class I performance specifications.
- E. Deck: Deck design shall have sufficient strength and camber for dead, live, and wind loads, including uplift, as needed to meet requirements of structural drawings and applicable code and assure proper drainage, in accordance with sealed engineering drawings.
- F. Beams: Beams shall be sized in accordance with sealed engineering drawings specific to the application. The drain beam shall have nominal dimensions 3 5/8"W x 6"H, 0.190" thickness. Other supporting beams and columns shall be extruded shapes of width, height, and thickness as shown on engineering drawings, but in no case less than 0.125 thickness.
- G. Fasteners shall be stainless steel bolts and nuts with washers as shown on shop drawings and shall be of suitable grade, quality, and finish for exterior overhead support use. General purpose, consumer grade, or unrated fasteners are not acceptable.
- H. Flashing shall be 0.032" aluminum applied in accordance with instructions.
- I. Sealer shall be commercial grade high viscosity permanent sealer designed to bond aluminum with minimal flow and maximum fill properties. General purpose consumer grade caulks and silicones are not acceptable.

PART 3 - EXECUTION

3.1 FABRICATION

- A. Where corners occur, they shall be mitered ends of the fascia material itself, factory cut using a fixed calibrated large format saw. Separately fabricated corner assemblies overlaid in the field are not acceptable. Field cutting corners using hand tools is not acceptable.
- B. Structural connections shall be securely made using stainless steel bolts, nuts, and washers as shown on engineering drawings with a minimum of four bolts per joint. Mechanical fastening shall take place on-site employing a transit level to insure plumb and true construction in the field with correction for any variances in elevations and construction of supports and adjacent structures. Use of prefabricated support sections is not acceptable. Field welding is not acceptable.
- C. The canopy shall be built to drain rainwater internally through the columns and beams, and into downspout to discharge into stormwater drainage piping below ground surface level.

3.2 INSTALLATION

- A. Install canopy in a plumb manner to the highest standards of the trade and in strict accordance with the engineering drawings and manufacturer's instructions.
- B. Securely fasten all hardware and tighten nuts and bolts in accordance with engineering drawings.
- C. Mitered corners shall be mechanically fastened and sealed.
- D. Install flashing between adjacent structures and the canopy in a manner to prevent any runoff between the two. Ends of decking, beams, and joints shall be capped and sealed to control drainage.
- E. Touch-up any irregular finishes according to manufacturer's instructions
- F. Thoroughly clean and wash canopy. Test drainage system.

END OF SECTION

SECTION 11 6623

GYMNASIUM EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wall mounted protection pads.

1.2 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

1.3 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's data showing configuration, sizes, materials, finishes, hardware, and accessories; include:
 - 1. Fire rating certifications.
 - 2. Manufacturer's installation instructions.
- C. Samples: Submit samples of wall pad coverings in manufacturer's available range of colors.
- D. Operating and maintenance data, for each operating equipment item.
- E. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project site in manufacturer's original packaging with factory original labels attached.
- B. Store products indoors and elevated above floor; prevent warping, twisting, or sagging.
- C. Store products in accordance with manufacturer's instructions; protect from extremes of weather, temperature, moisture, and other damage.

1.5 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. See drawings for sizes and locations, unless noted otherwise.
- B. Provide mounting plates, brackets, and anchors of sufficient size and strength to securely attach equipment to building structure; comply with requirements of contract documents.

2.2 WALL PADDING

- A. Wall Padding: Foam filling bonded to backing board, wrapped in covering; each panel fabricated in one piece. Field measure and factory fabricate mats to provide clearance around built-in elements including light switches, electrical outlets, etc. while maintaining product warranty. Provide 1 year minimum manufacturer's warranty.
 - 1. Surface Burning Characteristics: Flame spread index (FSI) of 25 or less, smoke developed index (SDI) of 450 or less, Class A, when tested in accordance with ASTM E84 as a complete panel.

2. Covering: Vinyl-coated polyester fabric, mildew and rot resistant; stapled to back of board.
 - a. Color: As selected from manufacturer's standard range. Provide custom printed graphics, artwork to be provided by Owner.
 - b. Texture: Embossed leather-look.
 - c. Fabric Weight: 18 oz/sq yd (___ kg/sq m).
3. Foam: Urethane, soft, 3.5 pcf (55 kg/cu m) nominal density.
4. Foam Thickness: 2 inches (50 mm).
5. Backing Board: Oriented strand board.
6. Size: Provide panel assemblies sized as indicated on drawings, with individual panels measuring 2 feet wide by 7 feet high.
7. Manufacturers:
 - a. Draper, Inc; Graphic Wall Pad: www.draperinc.com.
 - b. Greatmats.com Corporation; Gym Wall Pad, custom logo: www.greatmats.com.
 - c. Resilite Sports Products, Inc; Digitally Printed Wall Padding: www.resilite.com.
 - d. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Take field measurements to ensure proper fitting of work.
- B. Inspect areas and conditions before installation, and notify Architect in writing of unsatisfactory or detrimental conditions.
- C. Do not proceed with this work until conditions have been corrected; commencing installation constitutes acceptance of work site conditions.

3.2 INSTALLATION

- A. Install in accordance with contract documents and manufacturer's instructions.
- B. Install equipment rigid, straight, plumb, and level.
- C. Secure equipment with manufacturer's recommended anchoring devices.
- D. Install wall padding securely, with edges tight to wall and without wrinkles in fabric covering.

3.3 CLEANING

- A. Remove masking or protective covering from finished surfaces.
- B. Clean equipment in accordance with manufacturer's recommendations.

END OF SECTION

SECTION 12 2400

WINDOW SHADES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Window shades and accessories.

1.2 REFERENCE STANDARDS

- A. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2015.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week prior to commencing work related to products of this section; require attendance of all affected installers.
- B. Sequencing:
 - 1. Do not fabricate shades until field dimensions for each opening have been taken.
 - 2. Do not install shades until final surface finishes and painting are complete.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.
- C. Shop Drawings: Include shade schedule indicating size, location and keys to details.
- D. Selection Samples: Include fabric samples in full range of available colors and patterns.
- E. Verification Samples: Minimum size 6 inches (150 mm) square, representing actual materials, color and pattern.
- F. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- G. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.
- H. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.
- B. Handle and store shades in accordance with manufacturer's recommendations.

1.6 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manually Operated Roller Shades:

1. Manufacturers:
 - a. Draper, Inc; Clutch Operated FlexShade: www.draperinc.com/#sle.
 - b. Hunter Douglas Architectural; RB500 Manual Roller Shades: www.hunterdouglasarchitectural.com/#sle.
 - c. Levolor; Manually Operated Roller Shades: www.levolor.com/commercial/#sle.
2. TimberBlindMetroShade; SolarVue Manual Roller Shade: www.timberblinds.com/commercial-division/#sle.
 - a. SWFcontract, a division of Springs Window Fashions, LLC.; Manual Roller Shades: www.swfcontract.com/#sle.
3. Substitutions: See Section 01 6000 - Product Requirements.

2.2 WINDOW SHADE APPLICATIONS

- A. Interior Roller Shades: Sheer shades.
 1. Type: Roll down, closed position is at window sill.
 2. Basis of Design Fabric: Mermet E-Screen.
 3. Other Manufacturers:
 - a. Ferrari Soltis.
 - b. Phifer SheerWeave.
 - c. Substitutions: See Section 01 6000 - Product Requirements.
 4. Fabric Performance Requirements:
 - a. Openness Factor: 10%.
 5. Color: As selected by Architect from manufacturer's full range of colors.
 6. Mounting: Inside and outside, where indicated on drawings.
 7. Operation: Manual.

2.3 ROLLER SHADES

- A. Roller Shades: Fabric roller shades complete with mounting brackets, roller tubes, hembars, hardware and accessories.
 1. Size: As indicated on drawings.
- B. Fabric: Non-flammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
 1. Flammability: Pass NFPA 701 large and small tests.
- C. Roller Tubes: As required for type of operation.
- D. Hembars: Designed for weight requirements and adaptation to uneven surfaces, to maintain bottom of shade straight and flat.
- E. Manual Operation for Interior Shades: Clutch operated continuous loop; beaded ball chain.

2.4 ACCESSORIES

- A. Fascias: Size as required to conceal shade mounting.
 1. Style: As selected by Architect from shade manufacturer's full selection.
- B. Brackets and Mounting Hardware: As recommended by manufacturer for mounting configuration and span indicated.

- C. Fasteners: Non-corrosive, and as recommended by shade manufacturer.

2.5 FABRICATION

- A. Fabricate shades to fit openings within specified tolerances.
 - 1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch (13 mm) space between bottom bar and window stool.
 - 2. Horizontal Dimensions - Inside Mounting: Fill openings from jamb to jamb.
 - 3. Horizontal Dimensions - Outside Mounting: Cover window frames, trim, and casings completely.
- B. Dimensional Tolerances: As recommended in writing by manufacturer.
- C. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine finished openings for deficiencies that may preclude satisfactory installation.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Start of installation shall be considered acceptance of substrates.

3.2 PREPARATION

- A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.
- B. Coordinate with window installation and placement of concealed blocking to support shades.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.
- B. Installation Tolerances:
 - 1. Maximum Offset From Level: 1/16 inch (1.5 mm).
- C. Replace shades that exceed specified dimensional tolerances at no extra cost to Owner.
- D. Adjust level, projection and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.4 CLEANING

- A. Clean soiled shades and exposed components as recommended by manufacturer.
- B. Replace shades that cannot be cleaned to "like new" condition.

3.5 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. Demonstration: Demonstrate operation and maintenance of window shade system to Owner's personnel.
- 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 two hours training by manufacturer's authorized personnel at location designated by the Owner.

3.6 PROTECTION

- A. Protect installed products from subsequent construction operations.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 12 3600

COUNTERTOPS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Countertops for architectural cabinet work.

1.2 RELATED REQUIREMENTS

- A. Section 06 4100 - Architectural Wood Casework.
- B. Section 22 0000 - Plumbing: Sinks.

1.3 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
- C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.
- D. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
- E. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- F. PS 1 - Structural Plywood; 2009.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. 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. Specimen warranty.
- C. Shop Drawings: Complete details of materials and installation; combine with shop drawings of cabinets and casework specified in other sections.
- D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.
- E. Test Reports: Chemical resistance testing, showing compliance with specified requirements.
- F. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.7 FIELD CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.1 COUNTERTOPS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Plastic Laminate Countertops: High-pressure decorative laminate (HPDL) sheet bonded to substrate.
 - 1. Laminate Sheet: NEMA LD 3, Grade HGS, 0.048 inch (1.2 mm) nominal thickness.
 - a. Manufacturers:
 - 1) Arborite; Standard and Premium Laminate: www.arborite.com.
 - 2) Formica Corporation; : www.formica.com/#sle.
 - 3) Panolam Industries International, Inc. Nevamar; : www.nevamar.com.
 - 4) Panolam Industries International, Inc. Pionite; : www.pionitelaminates.com.
 - 5) Wilsonart; : www.wilsonart.com/#sle.
 - b. Finish: Matte or suede, gloss rating of 5 to 20.
 - c. Surface Color and Pattern: As selected by Architect from the manufacturer's full line.
 - 2. Exposed Edge Treatment: Square, substrate built up to minimum 1-1/4 inch (32 mm) thick; covered with matching laminate.
 - 3. Back and End Splashes: Same material, same construction.
- C. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
 - 1. Flat Sheet Thickness: 1/2 inch (12 mm), minimum.
 - 2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
 - a. Manufacturers:
 - 1) Avonite Surfaces; Avonite Acrylic Solid Surface: www.avonitesurfaces.com.
 - 2) Dupont; Corian Solid Surfaces: www.corian.com.
 - 3) Formica Corporation; Formica Solid Surfacing: www.formica.com.
 - 4) Meganite, Inc; Meganite Solid Surface: www.meganite.com/#sle.
 - 5) Wilsonart, LLC; Wilsonart Solid Surface: www.wilsonart.com.
 - 6) Substitutions: See Section 01 6000 - Product Requirements.
 - b. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
 - c. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.

- d. Color and Pattern: As selected by Architect from manufacturer's full line.
- 3. Other Components Thickness: 1/2 inch (12 mm), minimum.
- 4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch (32 mm) thick; square edge; use marine edge at sinks.
- 5. Back and End Splashes: Same sheet material, square top; minimum 4 inches (102 mm) high.
- 6. Skirts: As indicated on drawings.

2.2 MATERIALS

- A. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch (19 mm) thick; join lengths using metal splines.
- B. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.
- C. Joint Sealant: Mildew-resistant silicone sealant, white or clear.

2.3 FABRICATION

- A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
 - 1. Join lengths of tops using best method recommended by manufacturer.
 - 2. Fabricate to overhang fronts and ends of cabinets 1 inch (25 mm) except where top butts against cabinet or wall.
 - 3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
- B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
 - 1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
 - 2. Height: 4 inches (102 mm), unless otherwise indicated.
- C. Solid Surfacing: Fabricate tops and wall panels up to 144 inches (3657 mm) long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
- B. Attach plastic laminate countertops using screws with minimum penetration into substrate board of 5/8 inch (16 mm).
- C. Seal joint between back/end splashes and vertical surfaces.

3.4 TOLERANCES

- A. Variation From Horizontal: 1/8 inch in 10 feet (3 mm in 3 m), maximum.
- B. Offset From Wall, Countertops: 1/8 inch (3 mm) maximum; 1/16 inch (1.5 mm) minimum.
- C. Field Joints: 1/8 inch (3 mm) wide, maximum.

3.5 CLEANING

- A. Clean countertops surfaces thoroughly.

3.6 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 12 4813

ENTRANCE FLOOR MATS AND FRAMES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Extruded aluminum entrance floor mats.
- B. Recessed mat frames.

1.2 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating properties of walk-off surface, component dimensions and recessed frame characteristics.
- C. Shop Drawings: Indicate dimensions and frame details.
 - 1. For frames located within a dimensionally restricted area, show dimensions of space within which the frame will be installed.
- D. Samples: Submit two samples, 12 x 12 inch (305 x 305 mm) in size illustrating pattern, color, finish, edging .
- E. Maintenance Data: Include cleaning instructions and stain removal procedures.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Entrance Mats:
 - 1. Activar Construction Products Group - JL Industries; Activ-Mat 700 Series, EM705 Tuff Tread Inserts: www.activarepg.com/#sle.
 - 2. American Floor Products Company, Inc; StratoFlex III Foot Grid System, UX-280 C: www.afco-usa.com/#sle.
 - 3. Babcock-Davis; QuietFLEX BMQ38R: www.babcockdavis.com/#sle.
 - 4. Pawling Corporation; Rol-Dek EM-650-BF: www.pawling.com/#sle.
 - 5. Reese Enterprises, Inc; Perfec Mat 538: www.reeseusa.com/#sle.
 - 6. Substitutions: See Section 01 6000 - Product Requirements.

2.2 ENTRANCE FLOOR GRILLES AND GRATINGS

- A. Entrance Floor Mats: Surface mounted extruded aluminum mat assembly with nominal 2 inch (50 mm) wide tread strips running perpendicular to traffic flow, with vinyl hinges; mats hinged for removal and cleaning.
 - 1. Mat Thickness: 3/8 inches (9 mm).
 - 2. Tread Surfaces: Polypropylene brush.
 - 3. Colors: To be selected by Architect from manufacturer's standard selection.
 - 4. Length in Direction of Traffic Flow: As indicated on drawings.
 - 5. Width Perpendicular to Traffic Flow: As indicated on drawings.
 - 6. Frame: Surface-mounted, aluminum.
 - a. Tapered profile where mats abut finished flooring; abrasive or serrated texture.

- b. Provide end fillers at both ends for a snug fit.
- B. Structural Capacity: Capable of supporting a rolling load of 350 pounds (159 kg) minimum without permanent deformation or noticeable deflection.

2.3 FABRICATION

- A. Construct recessed mat frames square, tight joints at corners, rigid. Coat surfaces with protective coating where in contact with cementitious materials.
- B. Fabricate mats in single unit sizes.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that floor opening for mats are ready to receive work.

3.2 PREPARATION

- A. Mats: Verify size of floor area before fabricating mats.
- B. Vacuum clean floor recess.

3.3 INSTALLATION

- A. Install walk-off surface after cleaning of finish flooring.

END OF SECTION

SECTION 12 6613

TELESCOPIC BLEACHERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Telescoping Gym Seating includes, either manually or electrically operated systems of multiple-tiered seating rows comprising of seat, deck components, understructure that permits closing without requiring dismantling, into a nested configuration for storing or for moving purposes.
 - 1. Typical applications include the following:
 - a. Wall Attached Telescoping Gym Seats.
- B. Related Sections:
 - 1. Division 9 - Finishes sections for adequate floor & wall construction for operation of Telescoping Gym Seats. Flooring shall be level and rear wall plumb within 1/8" [3mm] in 8'-0" [2438mm]. Maximum bleacher force on the floor, of a 25'-6" [7772] section, shall be a static point load of less than 300 psi [2.068 N/mm²].
 - 2. Division 26 - Electrical sections for electrical wiring and connections for electrically operated Telescoping Gym Seats.
- C. Alternates: This section specifies alternates for Telescoping Gym Seat products. Refer to Part 2 products for alternate products, and to Division 1 Alternates sections and other bid documents, if any, for alternate requirements.
- D. Qualifications and Capabilities:
 - 1. BIDDER QUALIFICATIONS:
 - 2. Bidders are required to be an authorized dealer or manufacturer for equipment proposed which on a day-to-day basis regularly provide the equipment offered. Bidders are further advised that only standard production models or standard options will be acceptable for award. Equipment offered shall be currently manufactured on an active assembly line. The State is only interested in proven equipment; provided, installed, and serviced by Authorized Dealers capable of providing references.
 - 3. INSTALLER QUALIFICATIONS:
 - 4. Bleacher installer shall be Factory Certified by the Manufacturer. Proof of Factory Certified Installation Certificate shall be provided along with the Invitation to Bid. Failure to provide this information shall result in rejection of bid. (No Exceptions Taken)
 - 5. SERVICE CAPABILITY: The Bleacher Contractor must be able to show proof of full time service capability by factory certified technicians directly employed by the Bleacher Contractor. Sub-Contractors of the Bleacher Contractor or Factory Technicians located outside of the State do not qualify under this service response requirement. Adequate and satisfactory availability of repair parts and supplies, and ability to meet warranty and service requirements are a requirement of this Invitation to Bid. The State reserves the right to satisfy itself by inquiry or otherwise as to bidder's capabilities in this regard. A four (4) to eight (8) hour maximum on-site repair response is required during normal working hours, 8 a.m. to 5 p.m. weekdays (excluding holidays) All Full Time Service Personnel shall be Factory Authorized and Trained. Proof of Service Capability along

with a listing of service parts regularly maintained in inventory shall be provided along with the Invitation for Bid. Failure to provide this information shall result in rejection of bid.

1.2 REFERENCE

- A. International Building Code (IBC)
- B. ICC 300 - Standard for Bleachers, Folding and Telescopic Seating and Grandstands
- C. American Welding Society (AWS)
 - 1. AWS D1.1 Structural Welding Code - Steel
 - 2. WS D1.3 Structural Welding Code - Sheet Steel
- D. American Institute of Steel Construction (AISC):
 - 1. AISC - Design of Hot Rolled Steel Structural Members.
- E. American National Standards Institute (ANSI).
- F. American Iron & Steel Institute (AISI):
 - 1. AISI - Design Cold Formed Steel Structural Members.
- G. Aluminum Association (AA):
 - 1. AA - Aluminum Structures, Construction Manual Series.
- H. American Society for Testing Materials (ASTM):
 - 1. ASTM - Standard Specification for Properties of Materials.
- I. National Forest Products Association (NFoPA):
 - 1. NFoPA - National Design Specification for Wood Construction.
- J. Southern Pine Inspection Bureau (SPIB):
 - 1. SPIB - Standard Grading Rules for Southern Pine.
- K. National Bureau of Standards/Products Standard (NBS/PS):
 - 1. PS1 - Construction and Industrial Plywood.
- L. Americans with Disability Act (ADA)
 - 1. ADA - Standards for Accessible Design.

1.3 MANUFACTURER'S SYSTEM ENGINEERING DESCRIPTION

- A. Structural Performance: Engineer, fabricate and install telescopic gym seating systems to the following structural loads without exceeding allowable design working stresses of materials involved, including anchors and connections. Apply each load to produce maximum stress in each respective component of each gym seat unit.
 - 1. Design Loads: Comply with ICC 300 - 2007 Edition
- B. Manufacturer's System Design Criteria:
 - 1. Gymnasium seat assembly; Design to support and resist, in addition to its own weight, the following forces:
 - a. Live load of 120 lbs per linear foot [162.69 N/m] on seats and decking
 - b. Uniformly distributed live load of not less than 100 lbs per sq. ft. [135.58N/m] of gross horizontal projection.

- c. Parallel sway load of 24 lbs. [32.53 N/m] per linear foot of row combined with (b.) above
 - d. Perpendicular sway load of 10 lbs. [13.56 N-m] per linear foot of row combined with (b.) above
2. Hand Railings, Posts and Supports: Engineered to withstand the following forces applied separately:
 - a. Concentrated load of 200 lbs. [90.72 kg] applied at any point and in any direction.
 - b. Uniform load of 50 lbs. per foot [.344 N/mm²] applied in any direction.
3. Guard Railings, Post and Supports: Engineered to withstand the following forces applied separately:
 - a. Concentrated load of 200 lbs. [90.72 kg] applied at any point and in any direction along top rail.
 - b. Uniform load of 50 lbs. per foot [.344 N/mm²] applied horizontally at top rail and a simultaneous uniform load of 100 lbs. per foot [.689 N/mm²] applied vertically downward.
4. Member Sizes and Connections: Design criteria (current edition) of the following shall be the basis for calculation of member sizes and connections:
 - a. AISC: Manual of Steel Construction
 - b. AISI: Specification for Design of Cold Formed Steel Structural Members
 - c. AA: Specification for Aluminum Structures
 - d. NFOPA: National Design Guide For Wood Construction.

1.4 SUBMITTALS

- A. Section Cross-Reference: Required submittals in accordance with "Conditions of the Contract" and Division 1 General Requirements sections of this "Project Manual."
- B. Project Data: Manufacturer's product data for each system. Include the following:
 1. Project list: Ten(10) seating projects of similar size, complexity and in service for at least five (5) years.
 2. Deviations: List of deviations from these project specifications, if any.
- C. Shop Drawings: Indicate Telescoping Gym Seat assembly layout. Show seat heights, row spacing and rise, aisle widths and locations, assembly dimensions, anchorage to supporting structure, material types and finishes.
 1. Wiring Diagrams: Indicate electrical wiring and connections.
 2. Graphics Layout Drawings: Indicate pattern of contrasting or matching seat colors
- D. Samples: Seat materials and color finish as selected by Architect from manufacturers standard offered color finishes.
- E. Manufacturer Qualifications: Certification of insurance coverage and manufacturing experience of manufacturer, and copy of a telescopic load test to all loads described in 1.03 above, observed by a qualified independent testing laboratory, and certified by a registered professional structural engineer verifying the integrity of the manufacturer's geometry design and base structural assumptions.

- F. Installer Qualifications: Installer qualifications indicating capability, experience, and official Certification Card issued by manufacturer of telescopic seating.
- G. Engineer Qualifications: Certification by a professional engineer REGISTERED IN THE STATE OF NORTH CAROLINA - NO EXCEPTIONS - that the equipment to be supplied meets or exceeds the design criteria of this specification.
- H. Operating/Maintenance Manuals: Provide to Owner maintenance manuals. Demonstrate operating procedures, recommended maintenance and inspection program.
- I. Warranty: Manufacturers standard warranty documents.

1.5 QUALITY ASSURANCE

- A. Seating Layout: Comply with ICCC 300 -2007 Standard for Bleachers, Folding Telescopic Seating and Grandstands, except where additional requirements are indicated or imposed by authorities having jurisdiction.
- B. Welding Standards & Qualification: Comply with AWS D1.1 Structural Welding Code - Steel and AWS D1.3 Structural Welding Code - Sheet Steel.
- C. Insurance Qualifications: Mandatory that each bidder submit with his bid an insurance certificate from the manufacturer evidencing the following insurance coverage:
 - 1. Workers Compensation - including Employers Liability with the following limits:
 - a. \$500,000.00 (US) Each Accident
 - b. \$500,000.00 (US) Disease - Policy Limit
 - c. \$500,000.00 (US) Disease - Each Employee
 - 2. Commercial General Liability - including premises/ operations, independent contractors and products completed operations liability. Limits of liability shall not be less than \$2,000,000.00 (US).
- D. Manufacturer Qualifications: Manufacturer who has a minimum of 40 years of experience manufacturing telescoping gym seats and can demonstrate continual design enhancement and 25-year minimum product life-cycle support of telescopic seating.
- E. Installer Qualifications: Engage experienced Installer who has specialized in installation of telescoping gym seat types similar to types required for this project and who carries an official Certification Card issued by telescoping gym seat manufacturer.
- F. Engineer Qualifications: Engage licensed professional engineer experienced in providing engineering services of the kind indicated that have resulted in the successful installation of telescoping bleachers similar in material, design, fabrication, and extent to those types indicated for this project.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver telescopic gym seats in manufacturers packaging clearly labeled with manufacturer name and content.
- B. Handle seating equipment in a manner to prevent damage.
- C. Deliver the seating at a scheduled time for installation that will not interfere with other trades operating in the building.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Coordinate actual dimensions of construction affecting telescoping bleachers installation by accurate field measurements before fabrication. Show recorded

measurements on final shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid delay of Work.

1.8 WARRANTY

- A. Manufacturer's Product Warranty: Submit manufacturer's standard warranty form for telescoping bleachers. This warranty is in addition to, and not a limitation of other rights Owner may have under Contract Documents.
 - 1. Warranty Period: Five years from Date of Acceptance.
 - 2. Beneficiary: Issue warranty in legal name of project Owner.
 - 3. Warranty Acceptance: Owner is sole authority who will determine acceptance of warranty documents.

1.9 MAINTENANCE AND OPERATION

- A. Instructions: Both operation and maintenance shall be transmitted to the Owner by the manufacturer of the seating or his representative.
- B. Service: Maintenance and operation of the seating system shall be the responsibility of the Owner or his duly authorized representative, and shall include the following:
 - 1. Operation of the Seating System shall be supervised by responsible personnel who will assure that the operation is in accordance with the manufacturer's instructions.
 - 2. Only attachments specifically approved by the manufacturer for the specific installation shall be attached to the seating.
 - 3. An annual inspection and required maintenance of each seating system shall be performed to assure safe conditions. At least biannually the inspection shall be performed by a professional engineer or factory qualified service personnel.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design Manufacturer: Hussey Seating Company, U.S.A. - BASIS OF DESIGN
 - 1. Address: North Berwick, Maine, 03906
 - 2. Telephone: (207) 676-2271; Fax: (207) 676-9690
 - 3. Product: MAXAM26 Telescopic Gym Seat System by Hussey Seating Company
 - a. Model: MAXAM26 Series Telescopic Gym Seats, adjustable row spacing in two inch increments from 22 inches [559] to 26 inches [660].
 - b. MAXAM26 Series Telescopic Gym Seats, Rise Spacing: 9 5/8" [244]
 - c. Aisle Type: foot level aisles, front steps, intermediate aisle steps.
 - d. Seat Type: 10" Courtside Collection
 - 1) Seat color finish: Manufacturer's 15 standard for Courtside Collection
 - e. Rail Type: Store-in-place aisle hand rails
 - 1) Rail color finish: 15 standard colors to match Courtside Collection seat.
 - f. Operation: Electric
 - 1) Electrical Power System: Integral power with pendant Control, limit switches
 - 4. Handicap Seating Provisions: Provide first tier modular recoverable Flex-rows.

- B. Other Acceptable Manufacturers: STRICTLY LIMITED TO MODEL 5000 SERIES IRWIN AND UNIVERSAL.

2.2 MATERIALS

- A. Lumber: ANSI/Voluntary Product 20, B & B Southern Pine
- B. Plywood: ANSI/Voluntary Product PS1, APA A-C Exterior Grade.
- C. Structural Steel Shapes, Plates and Bars: ASTM A 36.
- D. Uncoated Steel Strip (Non-Structural Components): ASTM A569, Commercial Quality, Hot-Rolled Strip.
- E. Uncoated Steel Strip (Structural Components): ASTM A570 Grade 33, 40, 45, or 50, Structural Quality, Hot-Rolled Strip.
- F. Uncoated Steel Strip (Structural Components): ASTM A607 Grade 45 or 50, High-Strength, Low Alloy, Hot-Rolled Strip.
- G. Galvanized Steel Strip: ASTM A653 Grade 40, zinc coated by the hot-dip process, structural quality.
- H. Structural Tubing: ASTM A500 Grade B, cold-formed.
- I. Polyethylene Polymer: ASTM D 1248, Type III, Class B; molded, color-pigmented, textured, impact-resistant, structural formulation; in color indicated or, if not otherwise indicated, as selected by Architect from manufacturer's standard colors.
- J. Fasteners: Vibration-proof, of size and material standard with manufacturer.

2.3 UNDERSTRUCTURE FABRICATION

- A. Frame System:
 - 1. Wheels: Not less than 5" [127] diameter by 1 1/4" [32] with non-marring soft rubber face to protect wood and synthetic floor surfaces, with molded-in sintered iron oil-impregnated bushings to fit 3/8" [10] diameter axles secured with E-type snap rings.
 - 2. Lower Track: Continuous Positive Interglide System interlocks each adjacent CPI unit using an integral, continuous, anti-drift feature and through-bolted guide at front to prevent separation and misalignment. CPI units at end sections of powered banks and manual sections shall contain a Low Profile Posi-Lock LX to lock each row in open position and allow unlocking automatically. Provide adjustable stops to allow field adjustment of row spacings.
 - 3. Slant Columns: High tensile steel, tubular shape.
 - 4. Sway Bracing: High tensile steel members through-bolted to columns.
 - 5. Deck Stabilizer: High tensile steel member through-bolted to nose and riser at three locations per section. Interlocks with adjacent stabilizer on upper tier using low-friction nylon roller to prevent separation and misalignment. Incorporates multiple stops to allow field adjustment of row spacings.
 - 6. Deck Support: Securely captures front and rear edge of decking at rear edge of nose beam and lower edge of riser beam for entire length of section.
- B. Deck System:
 - 1. Section Lengths: Each bank shall contain sections not to exceed 25'-6" [7772] in length with a minimum of two supporting frames per row, each section.

2. Nose beam and Rear Riser beam: Nose beam shall be continuously roll-formed closed tubular shape of ASTM A653 grade 40, Riser beam shall be continuously roll-formed of ASTM A653 grade 40. Nose and Riser beam shall be designed with no steel edges exposed to spectator after product
 - a. assembly.
3. Attachment: Through-Bolted fore/aft to deck stabilizers, and frame cantilevers.
4. Decking: 5/8" [16], AC grade clear-top-coated tongue and groove Southern Yellow Pine. Plywood shall be cut and installed with top, center and bottom ply grain-oriented from front of deck to rear of deck (nose beam to riser beam). Adjacent pieces shall be locked together with tongue and groove joint from front to rear of deck. Longest unsupported span: MAXAM 26, 21 1/2" [546].
5. Deck End Overhang: Not to exceed frame support by more than 5'-11" [1804].

2.4 SEAT FABRICATION

- A. Basis of Design Polymer Seat System - Courtside Collection XC10 (10"):
- B. Seat Modules: 18" [457] long assembled, gas assisted injection-molded, high density, 100% recyclable HDPE (high density polyethylene) modules in monochromatic colors providing, dual textured scuff resistant 10" [254] or 12" [305] wide seat surface with 1/2" [13] minimum interlock on seat and face. Unit structural tested to 600 lbs occupant load.
 1. CourtSide XC10 Seat Module
 - a. XC10 - 10" [254] Comfort Profile
 - 1) 10" [254] depth continuous comfort curve style bench seat module
 - 2) Ergonomically contoured forward "waterfall" edge for enhanced spectator comfort and minimization of sensitive pressure point area, regardless of leg positioning.
 - 3) Fore & Aft contoured seat surface for uniform support and minimize high pressure points under the buttocks.
 - 4) Seat height ranges from deck to t/o seat range from 16-1/8" [410] to 18-1/8" [460]
 - 5) 21-1/8" [537] clear foot space area, regardless of leg positioning.
 - b. Integrally molded end caps at aisle end locations for clean finished appearance.
 - c. Integrally molded recess pockets to accept seat number and row letters.
 - d. Integrally molded rear closure panel at back of seat to allow for "continuous clean sweep" of debris at deck level and minimized visibility of structural ribbing.
 - e. Seat Attachment: Each polymer seat module shall be securely anchored by a 12 ga steel clamp bracket that provides steel-to-steel, through bolted attachment to the front nose beam of the bleacher. Attachment eliminates fore / aft movement of the seat module on the nose beam.

2.5 SHOP FINISHES

- A. Understructure: For rust resistance, steel understructure shall be finished on all surfaces with black "Dura-Coat" enamel. Understructure finish shall contain a silicone additive to improve scratch resistance of finish.

- B. Wear Surfaces: Surface subject to normal wear by spectators shall have a finish that does not wear to show different color underneath:
 - 1. Steel nosing and rear risers shall be pre-galvanized with a minimum spangle of G-60 zinc plating.
 - 2. Decking shall have use-surfaces to receive both a sealer coat and wear-resistant high gloss clear urethane finish.
 - 3. Injection Molded Courtside seats shall be per manufacturer standard 15 colors.
- C. Railings: Steel railings shall be finished with powder-coated semi-gloss black or optional 15 standard colors to match or contrast with polymer seat color.

2.6 FASTENINGS

- A. Welds: Performed by welders certified by AWS standards for the process employed.
- B. Structural Connections: Secured by structural bolts with prevailing torque lock nuts, free-spinning nuts in combination with lock washers, or Riv-nuts in combination with lock washers.

2.7 ELECTRICAL OPERATION

A. Integral Power

- 1. Default operation shall be with a removable pendant control unit which plugs into seating bank for tethered operator management of stop, start, forward, and reverse control of the power operation.
- 2. PF3: Furnish and install Hussey PF3, an integral automatic electro mechanical powered frame propulsion system, to open and close telescopic seating.
 - a. Electrical - Seating Manufacturer shall provide all wiring within seating bank, including pendant control. Motors, housing, and wiring shall be installed and grounded in complete accord with the National Electrical Code. The electrical contractor shall perform all connections at and upstream of the equipment specified herein, and ensure that supplied voltage drops no more than 4% below nominal where power connects thereto. To prevent 3rd party control of the system, power is made available to the Remote Control Receiver for a limited time by a Radio Frequency Identification (RFID) system that requires activation by the operator. Once the power system is activated, an audio beep and visual light is active to notify the user that the system is energized and ready for operation. The wireless remote shall be used by trained authorized operators to open and close the system with continuous pressure applied to the desired button.
 - b. Each unit for PF3 is driven by a 1/2 horsepower, 1725 RPM motor.
 - 1) 208V 3 Phase:

This 1.25 Service Factor motor runs on 208V at 60 Hz and draws a full load current of 2.2 amperes. The required power supply shall be 3 asynchronous phases of 120 Volts each, plus neutral plus ground, each with 20 Amp capacity.

This system shall be UL Listed in its entirety (motors, circuit protection, motor controls, user interface, enclosures, conductors and connectors all evaluated and approved for correct sizing and compatibility under maximum rated load on the motors) under UL Product Category FHJU, titled Electrical Drive and Controls for Folding and Telescopic Seating.

- 2) Each pair of Powered Frames shall consist of output shaft gear reducer with 6" [152] diameter x 4" [102] wide wheels covered with non marring 1/2" [13] thick composite rubber, and operate the bleacher as follows:

PF3 - Pulls at 25 feet / min [9.3 meters / min] with 1/2 Hp through 111:1 speed reduction to 4 drive wheels. Max pull approx 478 lbs [2126 N];

3. Options

a. Limit Switches

- 1) Limit switches will automatically stop integral power operation when seating has reached the fully extended or closed position. Manufacturer shall furnish and install both open and closed limit switches for the integral power system. Power operation shall utilize a combination of contactors and limit switches to insure the wiring is not energized except during operation. Straight wired electric system is not allowed.

2.8 ACCESSORIES | STANDARD TELESCOPIC GYMSEAT ACCESSORIES

- A. Access Panels (Hatchway): Provide access to unit at 4th or 5th tier.
- B. Flex-Row: Provide first row modular recoverable seating units to be utilized by persons in wheelchairs and able-bodied persons. Each Flex-Row unit shall have an unlock handle for easy deployment if wheelchair or team seating access is needed. Unlock handle shall lock the bleacher seats into position when fully opened.
 1. Provide a black full-surround steel skirting with no more than 3/4" floor clearance for safety and improved aesthetics.
 2. Provide a black injection molded end cap for the nose beam for safety and improved aesthetics.
 3. Provide a mechanical positive lock when the Flex-Row system is in the open and used position.
 4. Flex-Row modular units are designed to achieve multi-use front row seating to accommodate team seating, ADA requirements and facility specific requirements. Flex-Row units are available in modular units from 2 to 7 seats wide as well as full section widths.
- C. Front Aisle Steps: Provide at each vertical aisle location front aisle step. Front steps shall engage with front row to prevent accidental separation or movement. Steps shall be fitted with four non-skid rubber feet each 1/2" [13] in diameter. Blow molded end caps shall have full radius on all four edges. Quantity and location as indicated.
- D. Non-Slip Tread: Provide at front edge of each aisle location an adhesive-backed abrasive non-slip tread surface.
- E. Foot Level Aisles: Provide deck level full width vertical aisles located as indicated.
- F. Intermediate Aisle Steps: Intermediate aisle steps shall be of boxed fully enclosed type construction. Blow molded end caps shall have full radius on all four edges. Step shall have adhesive-backed abrasive non-slip tread surface. Quantity and location as indicated.
- G. Intermediate Store-In-Place Aisle Handrails: Provide single pedestal mount handrails 34" [864] high with terminating mid rail. Handrails shall be lifted, rotated 90° and reinserted for

easy storage in socket. Ends of the handrail shall return to the post, and not extend away from it. Rails having openings to avoid interference with closed decks are not acceptable.

- H. Scorer's Table: Provide one 8' x 18" x 30" scorer's table, portable for use on any seating row or flat floor surface. Table top shall be gray textured blow molded polymer, 2" in thickness with eased edges for reduced pressure points and improved ergonomics. Provide integral 16 gauge cantilevered C-style leg design for ample clearance space and stability during use, and folding for ease of storage on the seating deck. Provide speckled gray finish.
- I. Modular Video Platforms: Provide semi-permanent 4' x 8' video platform with safety rails and step.
- J. Safety Accessories: Provide the following safety features:
 - 1. Coin Round or Roll all edges of exposed metal on top and underneath Bleacher to eliminate sharp edges. Provide safety ease edges, coined edges, or rounded edges for the bleacher understructure components as follows. Diagonal or X braces and deck support or deck stabilizers. Systems provided with sharp edges or corners, to be rounded off in the field and field painted.
 - 2. Provide polymer end cap on nose metal at Bank ends to close off edges to prevent spectator injury.
 - 3. Provide polymer end cap on back of deck supports on 1st 7 Rows to prevent spectator injury.
 - 4. On 1st Row, provide front and side skirt boards anywhere there is an exposed end to prevent players/balls from sliding underneath the 1st Row.
 - 5. Provide metal cover over motor chains and wheels to protect chains from debris and provide a safety switch that if cover is taken off the power system will not work.
 - 6. Provide metal end deck cover on each row to cover exposed edge of plywood at the ends of the bleachers.
 - 7. Powered frames systems without a metal protective housing, covering drive chain and drive wheels are not permitted under this specification.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Verify area to receive telescoping gym seats are free of impediments interfering with installation and condition of installation substrates are acceptable to receive telescoping gym seats in accordance with telescoping gym seats manufacturer's recommendations. Do not commence installation until conditions are satisfactory.

3.2 INSTALLATION

- A. Manufacturer's Recommendations: Comply with telescoping gym seats manufacturer's recommendations for product installation requirements.
- B. General: Manufacturer's Certified Installers to install telescoping gym seats in accordance with manufacturer's installation instructions and final shop drawings. Provide accessories, anchors, fasteners, inserts and other items for installation of telescoping gym seats and for permanent attachment to adjoining construction.

3.3 ADJUSTMENT AND CLEANING

- A. Adjustment: After installation completion, test and adjust each telescoping gym seats assembly to operate in compliance with manufacturer's operations manual.

- B. Cleaning: Clean installed telescoping gym seats on both exposed and semi-exposed surfaces. Touch-up finishes restoring damage or soiled surfaces.

3.4 PROTECTION

- A. General: Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer to ensure telescoping gym seats are without damage or deterioration at time of substantial completion.

END OF SECTION

SECTION 22 0000

PLUMBING

220001 GENERAL

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.
- B. Contractor shall provide coordination drawings per Division 1.
- C. Plumbing work shall be performed as outlined in "Information for Bidders".
- D. These specifications and the accompanying plumbing drawings are intended to provide for all labor, materials and equipment necessary for the installation complete of all
 - 1. Plumbing Fixtures
 - 2. Equipment
 - 3. Rough-Ins
 - 4. Waste and Vent System
 - 5. Cold Water System
 - 6. Hot Water System
 - 7. Fuel Gas System
 - 8. Roof Drainage Systemand accessories including necessary apparatus, valves and fittings hereinafter described or called for on the plumbing drawings accompanying these specifications.
- E. All plumbing work shall be installed in accordance with the following Codes and all Local Ordinances. Materials, equipment and workmanship shall be as hereinafter specified.
 - 1. North Carolina State Plumbing Code
 - 2. North Carolina State Fire Prevention Code
 - 3. North Carolina Electrical Code
 - 4. North Carolina State Fuel Gas Code
 - 5. North Carolina Accessibility Code
 - 6. NSF Standard # 61
- F. This contractor shall secure all required permits and inspection fees necessary for this work. Permits may be secured from the Building Inspections Department.
- G. The accompanying drawings are schematic only and are not intended to show all fittings, bolts, connections, offsets, etc., unless specifically dimensioned. Follow drawings as closely as possible, provide all adjustments as necessary to conform to the structural conditions, machinery, equipment, work of other contractors and the intent of the drawings, without additional cost to the Owner. Plumbing drawings should not be scaled. Secure dimensions from Architectural drawings. Refer to drawings of other trades and coordinate with other contractors. All items of equipment shall be installed in accordance with the manufacturer's published installation instructions and diagrams.
- H. The Contractor shall coordinate water and sewer taps and pay all fees in conjunction to provide services as required, for this project.

220002 SCOPE OF WORK

- A. The Contractor shall be required to perform all the following work, in general and provide a complete plumbing system as shown on the plans. The items in general are to be as follows:
1. Furnish and install complete waste and vent system with connections to services as shown on the plumbing drawings and here-in specified.
 2. Furnish and install cold water system complete with connections to point as shown on the plumbing drawings and here-in specified.
 3. Furnish and install hot water system complete with connections to equipment as shown on the plumbing drawings and here-in specified.
 4. Furnish and install fuel gas piping system with connections to equipment as noted and/or as shown on the plumbing drawings and here-in specified.
 5. Furnish and install roof drainage leader system as shown on the plumbing drawings and here-in specified.
 6. Provide connections to equipment furnished and installed by General Contractor or Owner as shown on the plumbing drawings and here-in specified.

220003 LIST OF MATERIALS, FIXTURES AND EQUIPMENT

- A. The Plumbing Contractor shall obtain written approval from the Engineer/Architect for the use of substitute materials claimed as equal to those specified. Such approvals must be obtained as soon after contract awards as possible and before any materials are ordered. Applications for approvals shall be made by the Plumbing Contractor and not by subcontractors or manufacturer's representative. The Plumbing Contractor shall submit within ten days following award of contract and written notice to begin the work a complete list of materials proposed for the job. All like items shall be by the same manufacturer. When this list is approved, no further substitutions will be permitted except in unusual or extenuating circumstances. If no list is submitted, the Contractor shall supply materials specified. *Contractor should note that all items specified in section 220000 shall be submitted independently of other 220000 series sections.* The Plumbing Contractor shall review and stamp the submittals as being in accordance with his bid and these specifications. **Private labeled materials are not acceptable.**
- B. The Plumbing Contractor shall submit shop drawings to the Architect after award of the contract, and before any materials, fixtures, and equipment to be incorporated in the work has been ordered. Shop drawings shall include the name and address of the manufacturer and their catalog numbers and trade names clearly marked. All items shall be referenced to the plans and specifications by **fixture designation or specification paragraph number on an index tab.** One complete set of submittal data shall be manufacturer's original published material. **FAXED COPIES WILL NOT BE ACCEPTABLE.** Approval of materials will be based upon the manufacturer's published ratings. Submit shop drawings and/or catalog data for the following material and equipment:
1. Waste Piping, Fittings and Couplings
 2. Water Piping, Fittings and Equipment
 3. Fuel Gas Piping, Fittings and Equipment
 4. Roof Drainage Piping, Fittings and Couplings
 5. Laboratory Safety Device System

6. Circulator Pumps
7. Cleanouts and Access Doors
8. Valves
9. Insulation
10. Hangers
11. U. L. penetration systems
12. Pipe Markers
13. Fixtures
14. Coordination Drawings per Division 1.

- C. Approval of shop drawings and/or submittal data shall not relieve the Plumbing Contractor of the responsibility to comply with the requirements and intent of the plans and specifications with regard to dimensions, capacities, quality, quantity, performance characteristics, etc. If data submitted deviates from the contract documents, the Plumbing Contractor shall point out such deviations in writing and also state reasons for same. All similar items shall insofar as possible be one make and manufacturer.
- D. Where any special make, fixture or materials are specified by plate number, trademark or name, deliver to the building with original labels or other identification marks placed thereon by the manufacturer and do not remove until inspected and approved by the Architect. Similar and equal materials and equipment by other manufacturers will be acceptable, subject to approval.
- E. Failure to submit materials, equipment, fixtures, etc., in the time period specified above, the Architect shall assume that all items shall be installed as specified.

220004 DEMOLITION

- A. General Requirements: The work includes the demolition or removal of all construction indicated, specified or necessary to accomplish the work under this contract. The drawings define the scope of work but it is not intended that all items of demolition work be specifically indicated. After carefully reviewing the drawings and specifications to determine intent, the Contractor shall visit the site and determine the extent of demolition work required to properly complete the work under his contract.
- B. Protection of Materials and Work: Before beginning any cutting or demolition work, the Contractor shall carefully survey the existing work and examine the drawings and specifications to determine the extent of work required. The Contractor shall take all necessary precautions to insure against damage to existing work to remain in place, to be reused, or to remain the property of the Owner and any damage to such work shall be repaired or replaced at no additional cost to the Owner.

220005 WORKMANSHIP

- A. Layout:
1. Drawings indicate general locations of fixtures. Secure exact location from Architectural plans before proceeding with work.
 2. Furnish and install all necessary sleeves, inserts, bolts, etc., for concrete floor slabs, roof, walls, and partitions. Failure to install such items in time to avoid delaying the general contractor shall result in the Contractor doing all cutting and repairing at his own expense.

3. Sleeves as here-in-after specified shall be installed on all through the floor piping above slab on grade except water closet rough-ins. Water closet rough-ins shall be cast in place. Core drilling of slabs shall be sealed with approved fire retardant caulking and sealed watertight.
4. All equipment shall be installed in accordance with manufacturer's written installation instructions.

B. Drainage, Waste and Vent Piping:

1. Grade all sanitary waste lines 2" and smaller 1/4" per foot.
2. Grade all sanitary waste lines 3" and larger 1/4" per foot, where possible, 1/8" per foot minimum.
3. All underground piping shall be graded by the use of a laser beam alignment system.
4. All floor drains shall be set 1/2 inch below the room finished floor perimeter and the entire floor sloped to the floor drain.
5. Run all piping as directly as possible, avoiding unnecessary bends and turns so as not to interfere with proper installation of work of other contractors.
6. All PVC-DWV piping shall be protected by a cast iron sleeve under the following condition with a sleeve as follows:
 - a. Piping passing thru foundation walls: Sleeve shall extend 6 inches beyond wall footing on both sides.
 - b. Piping passing below a footing: Per Contract Drawings.
7. Provide removable caps for cleanouts with at least six threads engaged. Provide cleanouts at foot of waste and drainage stacks, all changes in direction of horizontal lines more than 135 degrees, in straight lines at intervals not exceeding 100-feet and anywhere additionally noted on the drawings.
8. Support horizontal cast iron soil pipe with a minimum of one hanger for each pipe length. Location close to hub or no-hub connector.
9. Run all horizontal and vertical piping true and plumb to building structure and connect all piping with 'Y' branches and 1/8 or 1/16 bends.
10. Tapped tees and crosses will not be permitted. Tapped sanitary tees and crosses shall be used.
11. No soil, waste, or vent piping shall be covered or concealed, until tested and approved by the Architect.
12. Conceal all soil and vent piping. Vents shall be tied together as shown with minimum number of vents extending through roof. All vents extended through the roof shall be a minimum of 12" above roof level.
13. All PVC-DWV and PVC drainage lines shall be bedded per the manufacturer's recommendations and shall be maintained under a continuous head of 10-feet until after all concrete slabs are poured and/or all heavy equipment has been removed from the site. Contractor shall be responsible for the protection of the piping system at all times including freezing weather.

C. Water System:

1. Conceal water supply piping in walls, below floor or above ceiling except where exposed for connections to fixtures. Install and secure all piping as walls are built. Wedging of piping will not be permitted. All piping shall be isolated from mortar.
2. All water piping shall be routed with a minimum clearance of ten (10) feet from any electrical switchboards, panel boards or telephone backboards.
3. Arrange all pipes to freely drain through a ball valve when water is cut off. All branch valves shall be installed adjacent to the water piping main.
4. All supplies to fixtures shall have individual stop valves.
5. Provide water hammer shock arrestors as required to prevent water hammer. Arresters shall be A.S.S.E. Standards Number 1010 certified. Arresters shall be installed in accordance with manufacturer's published recommendations. Air chambers are not acceptable. Water hammer shock arrestors shall be as manufactured by Precision Plumbing Products, Inc. or approved equal by Zurn, Josam, J.R. Smith, or Sioux Chief.
6. All exposed piping to fixtures shall be chrome plated installed true and plumb.
7. Insulate all water piping inside the building as hereinafter specified.
8. All tees shall be installed such that the flow shall be straight thru the tee and/or out the side. Tees **shall not** be installed where the flow is into the side and out of both ends of the tee (bullhead tee). Bullhead tees installations are not acceptable and shall not be used.
9. Extend water lines to water mains where shown on the plans.

D. Fuel Gas System:

1. Gas piping shall be concealed in walls or above ceilings unless noted otherwise.
2. Gas piping shall be graded 1/4" per 15-feet towards drip legs. Drip legs shall be full size of the main and shall be 6 inches in length.
3. Gas piping shall be installed in accordance with North Carolina State Fuel Gas Code.

E. Roof Drainage Piping:

1. Roof drains shall be provided by the General Contractor and installed where shown on the architectural roof plan by the General Contractor. The Plumbing Contractor shall connect to these roof drains and install the collector and leader system as shown on the plans.
2. Grade all horizontal leaders with slopes as shown on the drawings.
3. All PVC-DWV and PVC drainage lines shall be maintained under a continuous head of 10 foot until after all concrete slabs are poured and/or all heavy equipment has been removed from the site.

F. Insulation:

1. All pipe insulation joints shall be sealed to maintain integrity of the vapor jacket and shall pass thru all sleeves unbroken except for fire stops.
2. Pipe insulation at all fire separations shall be butted tightly to the firewall or to the floor after fire stop material has been installed.

220006 CUTTING, PATCHING AND CHASING

- A. All cutting and patching shall be in accordance with the "General Conditions" of these specifications.

220007 EXCAVATION, TRENCHING AND BACKFILLING

- A. All excavation, trenching and backfilling shall be in accordance with Division 31 of these specifications.

220008 SEISMIC RESTRAINTS

- A. The Contractor shall be responsible for providing restraints to resist the earthquake effects on the plumbing system. The requirements for these restraints are found in Section 1613 of the North Carolina Building Code. All tables and references shall conform to the building's location. Restraints shall be per Seismic Design Category C.
- B. The Contractor shall refer to the latest edition of the "Seismic Restraints Manual Guidelines for Mechanical Systems" published by SMACNA for guidelines to determine the correct restraints for piping and conduit, etc. This manual refers to Seismic Hazard Level (SHL).
- C. The anchorage of the equipment and machinery for this project shall be an integral part of the design and specification of such equipment and machinery. Manufacturers of all equipment including pumps, hot water heaters, tanks, etc. shall provide anchorage details, isolators, seismic mounts and restraints, etc. necessary to comply with Section 1613 to the Contractor for installation. It shall be the Contractor's responsibility to provide and install the equipment, machinery, systems, and assemblies, etc. For this project that satisfies these requirements.
- D. Where seismic restraints are required, the Contractor shall provide restraints per details and instructions included in SMACNA's Seismic Restraints Manual. Contractor shall include shop drawings of the specific methods of seismic restraint to be used for this project before installation of piping and equipment.
- E. The Contractor shall retain the services of a Professional Engineer registered in the State of North Carolina to design seismic restraint elements required for this project. The engineer's computations, bearing his professional seal, shall accompany shop drawings that show Code compliance. Computations and shop drawings shall be submitted for review prior to the purchasing of materials, equipment, systems and assemblies.
- F. Internal seismic restraint elements of manufactured equipment shall be certified by a Professional Engineer retained by the manufacturer. Such certificate applies only to internal elements of the equipment. All equipment anchorage requirements shall be coordinated with the building structure and shall be compatible thereto. All such anchorage shall be reviewed by the project's structural engineer.
- G. The Professional Engineer retained by the Contractor for seismic restraint calculations, shall visit the job site upon completion of the seismic restraint installation. This engineer shall provide in writing verification of compliance with the approved seismic submittal. This verification shall bear the Engineer's professional seal. Job site inspections by other than this engineer are not acceptable.
- H. Review of the seismic design and shop drawings by the Engineer/Architect or his agent shall not relieve the Contractor of his responsibility to comply with the seismic or any other requirements of the North Carolina State Building Code.

220009 WASTE & VENT SYSTEMS

- A. Piping:
 - 1. Waste and vent piping shall be schedule 40 PVC-DWV solid wall conforming to ASTM D-2665 and C.S. 272 with NSF seal.
- B. Fittings:

1. Fittings for PVC-DWV piping shall be PVC-DWV fittings conforming to piping specifications.

C. Joints:

1. Joints for PVC-DWV piping shall be made using the piping manufacturer's approved solvent cement.

220010 HOT AND COLD WATER SYSTEMS

A. Water Piping:

1. Water piping 2-1/2" and smaller, below grade, shall be type 'K' soft copper conforming to ASTM B-88.
2. Water piping 4" and smaller above grade inside the building shall be Type 'L' hard copper conforming to ASTM B-88.

B. Fittings:

1. Fittings for copper piping shall be wrought copper, solder joint fittings conforming to ANSI B 16.22.
2. Fittings for copper piping 2" and smaller may be press fittings conforming to ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117.

C. Joints:

1. All copper piping joints, 1-1/4" and smaller shall be made using lead free solder with a minimum melting point of 410 degrees Fahrenheit.
2. All copper piping joints, 1-1/2" and larger shall be made using Phos-copper silver alloy material with a minimum melting point of 1000 degrees Fahrenheit.
3. Press fitting joints shall be made using the press fitting manufacturer's tools and per manufacturer's instructions. Upon completion of the project, the press fitting manufacturer's tools used for installation shall be turned over to the Owner.

D. Backflow Preventer:

1. Backflow preventer shall be lead-free double check valve design, high hazard, with strainer, test valves, gate valve on inlet and discharge, inlet and outlet pressure gauges, designed to meet AWWA C-510, ASSE 1015. Unit shall be size as shown on the drawings and be manufactured by Watts LF007S or approved equal by Wilkins, Febco, or Conbraco.

E. Thermometers and Gauges:

1. Thermometers shall be metal-case, liquid-in-glass, 9" long with a range of 30F to 240F, 2 degree scale division and an accuracy of plus or minus 1 percent of range.
2. Pressure gauges shall be cast aluminum, 4-1/2" diameter glass window, with a range of two times the operating pressure and an accuracy of plus or minus 1 percent of middle half of scale.

220011 FUEL GAS SYSTEM

A. Gas Piping:

1. Gas piping above grade and inside the building shall be standard weight schedule 40 black steel conforming to ASTM A-53.

B. Fittings:

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1. Fittings for piping 2" and smaller above grade and inside building shall be malleable iron threaded fittings conforming to ASME B16.3 with threads conforming to ASME B1.20.1.
 2. Fittings for piping 2-1/2" and larger above grade and inside the building shall be steel.
- C. Joints:
1. Joints for threaded piping shall be made using pipe dope applied sparingly to the male thread of pipe. Pipe dope shall be resistant to actions of gas.
 2. Joints for steel piping 2-1/2" and larger shall be welded.
- D. Pressure Regulators:
1. Regulators shall have the minimum capacities as shown on the drawings with single stage pressure reduction. Regulators installed inside the building shall be of the limited venting design.
 2. Regulators shall be listed as complying with ANSI Z21.80, and shall be equal to those as manufactured by Maxitrol, American Meter Company, or Invensys.
- E. Gas Valves:
1. Gas valves shall be U.L. or AGA approved bronze construction, full port ball with threaded ends designed for 600-PSI gas working pressure conforming to ASME B16.44. Valves located on 2 psi gas lines shall be labeled "2G".
 2. Gas valves controlling each piece of equipment shall be full ported, bronze body, threaded ends, ball valve with gauge tapping.
 3. Each valve shall be lubricated and turned during the installation to assure good working order. Plug valves shall be greased again after turning to aid the shut off. All valve boxes shall be encased in 18" square x 6" thick concrete pad at grade level.
- F. Connections:
1. The Plumbing Contractor shall coordinate the rough-in connections for the mechanical equipment with the Mechanical Contractor. The Plumbing Contractor shall make the final connection to the gas train with an approved AGA flexible connector.

220012 ROOF DRAINAGE SYSTEM

- A. Piping:
1. Roof drain leaders above grade and inside of the building shall be hubless cast iron piping conforming to C.I.S.P.I. Standards 301 and shall carry country of origin, manufacturer's name or manufacturer's registered trade-mark.
 2. Roof drain leaders located outside of the building above grade, and all roof drain leaders below grade or slab on grade shall be Schedule 40 PVC-DWV solid wall, conforming to ASTM D-2665.
- B. Fittings:
1. Fittings for cast iron roof drain leaders shall be the sanitary drainage pattern cast iron conforming to ASTM A-74 and shall be marked with the Cast Iron Soil Pipe Institute symbol cast into the fitting.
 2. Fittings for PVC-DWV roof drain leaders shall be Schedule 40 PVC-DWV conforming to ASTM D-2665.
- C. Joints:

1. Joints for hubless cast iron piping shall be made using neoprene gasket and cast iron clamping band with stainless steel bolts torqued to manufacturer's specifications. Clamps shall be as manufactured by MG Piping Products Company or approved equal.
2. Joints for PVC-DWV piping shall be made using manufacturer's approved solvent cement.

D. Drains:

1. Primary roof drains shall be large sump body coated cast iron drains with galvanized cast iron domes, adjustable extension, combination flashing device/gravel guard, static extension and top set deck plate. Drains shall be Zurn ZC-100-DP-E or approved equal by Josam, J. R Smith, Wade or Watts. Height of static extension shall be as shown on architectural drawings. No hub outlet shall be sized as shown on the drawings.

220013 LABORATORY SAFETY DEVICE SYSTEM

- A. All components shall be by the same manufacturer.
- B. Emergency shut-off system shall be provided for each location as noted on the drawings. The shut-off system shall include U.L. listed flush-mounted, white powder coat finish enclosure, 2 circuit control switches for electricity and cold water, red momentary mushroom panic button with clear hinged cover, absolute authority enabling key, resets for solenoids, integration wiring blocks for building fire alarm panel and/or energy mgmt. system. Controller shall require 120v power source and utilize 24vac output signals to companion solenoids and electric contact enclosures. Enclosure circuit switches to be labeled "Electric" and "Water". Activation of output circuits shall be enabled only by switch ON and then keying, including reset after Panic condition. Provide Isimet Model #UTC-12X2-R-C or approved equal by ASCO or Alderon.
- C. Provide Water Solenoid Valve Assemblies with 24VAC Conduit Ready Coils. Valve assemblies shall include solenoid valves, threaded union ball shut-off valves, in-line y-strainers, and shall be factory assembled and tested. Solenoids shall be low differential/low resistance valves. Size per Contract Drawings. Provide Isimet or approved equal by ASCO or Alderon.
- D. Solenoids shall close upon loss of operating power and require re-keying for reactivation of service.
- E. Surface mounted Electrical Contact Enclosure shall be gray powder coat finish, NEMA 10-circuit pre-assembled contact enclosure, 16" x 12" x 4" enclosure with (10) 120V mechanically held contacts, screwdriver slot door lock and pre-wired to central junction box for 24VAC Control. Provide Isimet Model #E-3110-S-L approved equal by ASCO or Alderon.
- F. Systems to be included are domestic cold water and electrical.
- G. The system start up shall be by the authorized factory representative. Manufacturer's representative shall provide training in system operation to the Owner.

220014 HOT WATER CIRCULATOR

- A. Circulator shall have capacity as shown on drawings and shall be specifically designed for domestic hot water service.
- B. Circulator shall have lead-free bronze body and flanges with lead-free impeller; circulator motor shall be shaded-pole type, rubber mounted, and shall be equipped with overload protection. Bearings for all motors shall be prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading. Circulator shall be direct connected to motor. Circulator shall be Taco, B&G, or Grundfos with capacity as noted on the drawings.

- C. Circulator shall be supported by appropriate hangers to avoid piping strain. Circulators shall be mounted horizontally.
- D. Startup shall be by manufacturer's representative.

220015 CLEANOUTS AND ACCESS DOORS

- A. Cleanouts shall be the same diameter as the pipe they are connected to. If the pipe is greater than 4" in diameter, the cleanout shall be 4".
- B. Cleanouts installed in walls or pipe chases shall be installed using cast iron cleanout tee with cast bronze slotted plug, stainless steel cover with vandalproof securing screw. Cleanouts shall be Zurn ZS-1468, Josam 58600-PLG, or J. R. Smith 4472.
- C. Cleanouts installed in floors and walks shall have adjustable cast iron body with cast brass plug, lead seal and square nickel bronze top with watertight gasketed cover. Cleanouts shall be Zurn ZN-1400-T, Josam 57000-X-SQ or J. R. Smith 4040.
- D. Cleanouts installed in crawl space or above ceiling, where permitted by authority having jurisdiction, shall be a pipe cap installed using a no-hub band and clamp.
- E. The Contractor shall provide access doors in accordance with Division 08. Access doors shall be provided for all valves and shock arrestors located behind hard ceilings and in walls to provide access to valves and/or equipment. Ceiling access doors shall be a minimum of 24" x 24".

220016 VALVES

- A. Valves shall be installed at all points noted on the plans by standard symbols or as required by best general practice for proper control and operation of the system. All valves, **including existing valves and mixing valves**, shall be identified with 1" diameter, 19 gauge, polished brass identification tags with a number and valve service indicated. Provide two copies of a valve chart listing all valves (**including existing**) with size and service framed and mounted under glass, as well as two copies of a floor plan with all valve locations and valve tag numbers noted (**including existing**), also framed and mounted under glass. One copy of each shall be mounted in a mechanical room or custodial room near each water entrance. Provide a self-sticking 1/2" diameter dot on lay-in ceiling grid at all valve locations. Orange dot for domestic hot water supply and return, blue for cold water, green for mixing valves.
- B. All valves shall be by a single manufacturer.
- C. Check valves 2 inches and smaller shall be Class 125, lead free design cast bronze body with threaded ends.
- D. Domestic cold and hot water system valves 1-1/4 inches and smaller shall be lead free design cast bronze body, two-piece, full ported, soldered end ball valves, minimum 400-psig CWP rating. Valves shall be provided with stem extensions for insulation thickness specified.
- E. Domestic cold and hot water system valves 1-1/2 inch and 2 inch shall be lead free design cast bronze body, two-piece, full ported, threaded end ball valves, minimum 400-psig CWP rating. Valves shall be provided with stem extensions for insulation thickness specified.
- F. Domestic cold and hot water system valves 2-1/2 inch and larger shall be flanged end, iron body ball valves rated for Class 150, 200 WOG service. Valves shall be provided with stem extensions for insulation thickness specified.
- G. Balancing valves shall be installed on domestic hot water return systems shall be lead free design cast bronze body equipped with indicating dial and memory stop. Balancing valves shall B&G, Taco or approved equal.

H. Valve Boxes:

1. Boxes shall be two piece cast iron complete with cover.
2. Valve boxes for water cut off valve shall have cover labeled "WATER".

220017 PIPE INSULATION

- A. All plumbing pipe insulation systems shall be installed as a subcontract to the Plumbing contract. All plumbing pipe insulation systems, including jacketing, coverings, adhesives when used, shall have a flame spread rating not exceeding twenty-five (25) and a smoke development rating not exceeding fifty (50) when the insulation assembly is tested as a composite. Fibrous glass pipe insulation shall be pre-molded with a thermal conductivity of 0.24BTU/in/hr/ft² at 100°F.
1. Insulate all cold water piping above grade with 1" thick pre-molded fibrous glass pipe insulation with self-sealing fire retardant vapor barrier jacket.
 2. Insulate all hot water piping, 1-1/2" and smaller, above grade with 1" thick pre-molded fibrous glass pipe insulation with self-sealing fire retardant jacket.
 3. Insulate all hot water piping, 2" and larger, above grade with 1-1/2" thick pre-molded fibrous glass pipe insulation with self-sealing fire retardant jacket.
 4. Insulate all hot water return piping with 1-1/2" thick fibrous pre-molded glass pipe insulation with self-sealing fire retardant jacket.
 5. All drain bodies receiving rain water shall be insulated with 1" thick insulating cement insulation.
 6. All roof drain leaders, horizontal and vertical, above slab on grade shall be insulated with 1" thick pre-molded fibrous glass pipe insulation with self-sealing fire retardant vapor barrier jacket.
 7. Rigid pipe insulation inserts shall be provided for all insulated piping 2" and larger. Inserts shall be water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass. Inserts on cold water piping shall have vapor barrier and extend 2 inches beyond sheet metal shield.
 8. Provide 20 gauge galvanized metal jackets on all exposed insulated piping installed within 8 feet above finished floor in occupied spaces. Prime metal jacket with paint grip finish.
- B. Exposed pre-molded pipe insulation in finished areas and mechanical rooms shall be finished with factory jacket neatly pasted in place and left ready for painting as specified hereinafter.
- C. All pipe insulation for pipe fittings shall be pre-molded to fit fittings and shall be enclosed under pre-molded PVC fitting jacket.
- D. Plumbing piping located in CMU walls shall be insulated with closed cellular foam insulation with thicknesses as specified above. Foam insulation thermal properties shall match or exceed the specified thermal insulation properties for the intended usage. Insulation shall be secured with insulation manufacturer's approved tape.

220018 HANGERS

- A. Hangers for vertical piping shall be Riser Clamp design, galvanized steel, and shall conform to MSS SP-58 Types 1 through 58.
- B. Hangers for horizontal piping shall be the Clevis type, galvanized steel, and shall conform to MSS SP-58 Types 1 through 58.

- C. **Hangers for insulated piping shall extend around the insulation.** Provide 16 gage galvanized steel insulation protection saddles 12" long at each hanger on all insulated lines. At the contractor's option, hangers for insulated piping may be Michigan Hangers Model 4031 or 4041. Insulation Shields shall cover lower 180 degrees of pipe in the case of clevis hangers, and entire circumference of pipe in the case of trapeze hangers or clamps.
- D. Hangers shall be spaced per the NC State Plumbing Code in accordance with the piping material.
- E. A hanger shall be provided within one (1) foot of each bend in horizontal piping. Vertical piping shall be supported at each floor or at intervals not exceeding ten (10) feet.
- F. For piping 4" in diameter and larger, rigid support sway bracing shall be provided at changes in direction greater than 45 degrees.
- G. Hangers shall be fastened by means of threaded rods to steel beam clamps, center of bar joist, center of trusses, etc. All hangers shall permit adequate adjustment after erection while still supporting the load. All hanger rods attached to bar joist and trusses shall be installed between bottom or top cords of the structural member. Structural members to span from building structure to structure shall be provided by the Contractor. Steel pipe hanger installation shall comply with MSS SP-69 and MSS SP-89.
- H. Hangers SHALL NOT be fastened to joist bridging or roof deck.
- I. Hangers shall only be hung with drilling into the slab with "drop-in" hangers with the approval of the Structural Engineer of record and the Mechanical Engineer of record with complete dead and operating load information provided for each location. Loading information shall be provided by the Plumbing Contractor.
- J. Piping supported on a trapeze hanger shall conform to MSS SP-69, Type 59. Piping shall be secured to the trapeze hanger by means of a pipe clamp around the pipe insulation and insulation saddle. Bare piping shall be secured by a pipe clamp and isolated by an isolation cushion. Provide MSS SP-58 hanger rods, nuts, saddles, and U-bolts. Insulation shields shall cover entire circumference of pipe at trapeze hangers. Trapeze pipe hanger installation shall comply with MSS SP-69 and MSS SP-89.
- K. Piping supported from the floor shall be supported using a base plate securely anchored to the floor and be equipped with a pipe riser. Riser shall be a minimum size of one inch. Horizontal piping above the floor shall be anchored and rest on a manufactured saddle. Piping shall be secured to each saddle as approved by the Engineer.

220019 PIPE SLEEVES, PLATES, ESCUTCHEONS, ETC.

- A. Pipe sleeves shall be standard weight schedule 40 black steel above slab on grade or cast iron below slab on grade. All sleeves shall be equal to construction thickness except that pipe sleeves passing through floors, other than slab on grade, shall extend 3/4" above the finished floor. Pipe sleeve sizes shall be sized two pipe sizes larger than piping passing thru the sleeve.
- B. Piping thru non-fire rated walls, floors above slab on grade or ceilings, piping passing through foundation walls, and piping installed below structural footings shall have sleeves installed concentric and centered on pipe. Ream all sleeves to prevent cutting of piping. The Contractor shall furnish shop drawings to the general contractor and the Architect showing location, dimensions, and sizes of holes required. Sleeves on piping passing through foundation walls shall extend 6" beyond wall footing on both sides. Sleeves on piping installed below structural footings shall extend beyond footing as indicated on contract drawings.

- C. Install escutcheons snug against room finish on all exposed pipe passing through walls, floors above slab on grade or ceilings. Use cup type escutcheons at floors where sleeves extend above finished floors. Escutcheons shall be chrome plated steel with spring clip.
- D. Sleeves for insulated piping shall be large enough to allow the insulation to pass thru sleeve unbroken.
- E. Core drill openings for all floor openings may be utilized in lieu of sleeved openings. All openings shall be sized two pipe sizes larger than pipe passing thru the opening. All cored openings shall be fireproofed as required and shall be made water tight.
- F. All penetrations in rated floors, firewalls and any other rated separations shall be protected using a through-penetration firestopping method with an "F" rating equivalent to the rating of the membrane being penetrated for particular piping materials used and membrane construction type. Floor penetrations shall additionally have a "T" rating equivalent to the rating of the floor being penetrated. Through-penetration firestop systems shall be installed and tested in accordance with ASTM E814 or UL 1479 with a minimum positive pressure differential 0.01 inch w.g. All openings through horizontal fire separations shall be protected by Metacaulk U.L. Systems or approved U.L. listed system by other manufacturers.
- G. All openings through floors and vertical fire separations shall be protected by combination water seal and fire stops as manufactured by HoldRite, or approved equal by Proset, Metacaulk, or 3M.

220020 PLUMBING SYSTEM IDENTIFICATION

- A. All **exposed** piping in the building shall be identified by snap-on pipe markers or secured with two zip ties. Markers shall have ANSI colored letters at ANSI height on ANSI colored background with flow arrows and shall be located at 10' on center along pipeline, near each valve, at access doors, near major equipment at each tee branch, and at each floor/wall penetration, both sides. A pipe marker shall be located adjacent to each valve. Pipe identification markers shall comply with ANSI A13.1 and be Custom MS-790 as manufactured by Marketing Service Incorporated or approved equal Steton, Emed or DuraLabel. Stenciling of piping and/or insulation is not acceptable. Wording on markers shall be as follows where more stringent than ANSI Standards:
 - 1. Cold Water
 - 2. Hot Water
 - 3. Hot Water Return
 - 4. Vent
 - 5. Fuel Gas (with pressure noted)
 - 6. Roof drain
- B. Engraved plastic laminate signs for **new** listed plumbing equipment shall be 1/16 inch thick and be secured with self-tapping stainless steel screws in center holes, and conform to ANSI A13.1. Plastic laminate face color shall be red for all emergency applications and black for all other uses. Background color shall be white. Signage for all equipment, etc., shall show equipment or service identification, areas served (use actual room numbers used at the facility, not architectural room numbers), substantial completion date, temperature setting (as applicable), capacity, final date of acceptance for equipment item and warranty information. Signage shall be provided for the following items:
 - 1. Water Heaters

2. Emergency cut-off switches
3. Circulator pumps
4. Starters
5. Disconnects
6. Access panels (to indicate service behind)

Examples: WH-1 (Room 000 – Mech.)

S.C.: 1/1/2000 (3 year warranty)

Capacity: 119 gallons

Temperature Setting: 110 deg. F

CP-1 (HW Rec. Pump – First Floor Classrooms)

S.C.: 1/1/2000 (3 year warranty)

Capacity: 1 gpm @ 6 ft head.

220021 PROTECTION OF WORK AND EQUIPMENT

- A. It is imperative that waste and vent lines not be filled with concrete, concrete grindings, sand, gravel, or other foreign matter. Under no circumstances shall any line be left open while the Contractor's workers are not on the job site.
- B. Plug each opening of waste and vent lines the same day it is installed with test plug securely held in place.
- C. All floor drains shall be covered immediately after installation.
- D. The Contractor shall be responsible for all work damaged by him/her. Any plumbing work damaged by any other contractor shall be replaced by the Contractor and placed in perfect working condition without extra cost to the Owner. All fixtures and fittings shall be adequately protected before, during and after installation.
- E. The Contractor shall be responsible for all plumbing fixtures at time of final inspection. Any broken fixtures will be replaced by the Contractor at no cost to the owner regardless of by whom the fixture was broken.

220022 TESTING

- A. The Contractor shall notify the Engineer forty-eight (48) hours in advance of all tests. The Contractor shall make all necessary preliminary tests to insure a tight system. Any joint found to leak under test shall be broken, cleaned and remade.
- B. All tests shall be applied before any work is concealed or covered in any manner.
- C. All sanitary waste and vent piping shall be tested in the following manner: Plug all openings and fill entire waste and vent system to overflow with water and sustain a constant level for a minimum period of three (3) hours. All portions of each floor system shall be tested under a minimum of a 10-foot head including roof vent terminal.
- D. All water piping, hot and cold shall be made tight under a hydrostatic test pressure of 150-lbs. per square inch and maintained without pressure loss for a minimum of four (4) hours. No caulking of joints will be permitted. Any joint found to leak under this test shall be broken, remade and a new test applied.
- E. All backflow preventers shall be tested and certified by an approved and licensed backflow prevention company.

- F. All fuel gas piping shall be tested by applying an air pressure of 100-lbs. per square inch and shall be maintained for minimum of eight (8) hours. Air receivers shall be charged with peppermint for odor test and any indication of leakage will be checked by applying a soap and water solution at each joint to determine leaking joint. Test shall be conducted using an eight inch pressure-temperature recorder with a pressure range of 0-150-psi with a 24 hour recording time. Pressure measuring elements shall be heat treated to prevent hysteresis-related inaccuracies. The original chart with copies shall be included in the "Owners and Operating Manuals.
- G. The roof drain piping system shall be tested in the following manner: Plug pipe outlet and fill entire under floor system with water under a 10-foot head above finished floor and sustain a constant level for a minimum period of three (3) hours. All piping above the lowest floor level shall be tested from a test tee installed at that level with the entire system filled with water into drain body and sustain the constant level for a period of three (3) hours.
- H. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1" wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
- I. The Contractor shall furnish all necessary equipment, materials and labor to perform the above-specified tests.

220023 STERILIZATION

- A. All new water piping shall be charged with a chlorine solution containing not less than 50-ppm available chlorine. The solution shall remain in the piping for a minimum period of 24 hours, during which time valves shall be opened and closed to permit a small flow of the solution. At the end of the 24 hours, the solution shall be tested and must contain a residual of at least 5 to 10 ppm chlorine. The system shall then be drained and flushed to provide satisfactory potable water before final connection is made to the existing distribution system.
- B. The Contractor shall contract with an independent Testing Laboratory for a certification letter that the system sterilization meets or exceeds standards for potable water.

220024 PLACING IN SERVICE

- A. Upon completion of the entire system installation, the entire system and all equipment shall be tested by actual operation to provide that it will function as intended.
- B. The Contractor shall flush and rod out all new and existing waste and roof drain leader piping prior to final connection to existing system, to ensure that no foreign materials are in these lines, and that a continuous flow of water and waste can be affected.
- C. The Contractor shall flush all water piping prior to the connection of flush valves, mixing valves, and faucet aerators to provide a clean and operational water system.
- D. The Contractor shall place the entire system in a satisfactory operating condition and shall furnish all assistance and instructions required by the Owner's representative during initial operating period. The Contractor shall acquaint the Owner's representative with the special parts required for the operation of the flush valves furnished and installed on the project.
- E. It is the Contractor's responsibility to turn over to the owner all fixtures and floor drains in a clean condition.

220025 PAINTING

- A. The Contractor should note that plumbing piping may be exposed in various areas. The contractor should specifically note that all exposed cast iron piping be uncoated.
- B. All exposed plumbing pipe and plumbing pipe insulation in areas other than mechanical rooms shall be left clean and free from oil ready for painting by the General Contractor. All finished painting will be by the General Contractor with colors to match the surrounding areas.
- C. The Plumbing Contractor shall paint all plumbing insulation, exposed plumbing piping, etc., in Mechanical Equipment Rooms. Insulation to be painted with two (2) coats of glue sizing and two coats lead free enamel paint. Exposed piping and pipe hangers shall be painted flat black. Paint colors shall be as follows:

<u>SERVICE</u>	<u>Benjamin Moore</u>		<u>Sherwin Williams</u>	<u>Devoe</u>
	<u>Number</u>	<u>Color</u>		
Cold water		Blue	Blue	Blue
Hot water	1330	My Valentine	SW1581	3W4-6
Hot water return	2081-50	Pink Ruffle	SW1575	5W3-3

- D. All exposed gas piping exposed to the exterior and exposed in mechanical rooms shall be cleaned of all rust and painted with one (1) coat of rust inhibitor primer and two (2) coats of oil base Yellow paint.
- E. All plumbing equipment pads shall be painted yellow.

220026 ELECTRICAL WIRING

- A. Electrical wiring of plumbing equipment shall be performed as detailed on the Contract Drawings.
- B. Fused disconnect switches shall be heavy-duty industrial type. Switches shall be Siemens, General Electric Company, Square D or Cutler/Hammer fusible type mounted so handle is approximately 4 feet 0 inches above floor or grade. Switches shall have a factory applied standard finish and the usage or designation shall be indicated on cover with engraved plastic laminated labels with 1/2" high contrasting letters. Each switch for motor circuits shall have a complete set of Bussman "Fusetron" or equal time delay fuses
- C. Motor Starters and Fused Disconnect Switches shall be neatly arranged, and securely fastened to walls with expansion bolts, lead shields, etc. Each starter or switch shall have its usage or letter designation indicated on its cover with engraved plastic laminated labels with 1/2" high contrasting letters. Where connections are made to motors not near walls or columns, a vertical conduit attached to floor and ceiling shall be installed and the wiring carried in and out of this conduit by means of condulets. An 18-inch length of flexible metallic conduit shall be installed in the circuit to each connection to a motor. Liquid tight shall be used in all wet locations. Grounding wire shall run inside of flexible conduit.

220027 CONTROLS

- A. General:
1. The Controls Contractor will provide a DDC-controlled circuit in the Mechanical Room. The Contractor shall connect at this point and provide water heating system controls as here in after specified.

2. Furnish and install an electric control system to fulfill the intent of the drawings and specifications. The system shall include all necessary labor, materials, electrical wiring and devices for a complete installed control system.
3. All electric wiring in connection with the temperature controls and all interlock wiring shall be furnished under this section of the specifications. The wiring shall be installed by licensed electricians employed by Contractor in strict accordance with all local, State, and National Codes. All control and interlock wiring whether line or low voltage shall be run in EMT conduit or as specified under the electrical section of these specifications. Installation of all concealed conduit shall be coordinated with contractor for general construction so it may be installed before slabs are poured or walls are erected.
4. The control diagrams indicated on the drawings and specified herein show the intended sequences of operation of the various control systems and shall be followed as closely as practicable.

B. Temperature Sensing Devices:

1. Strap-on Aquastat shall have an adjustable range and be mounted directly on the building hot water recirculating line as indicated on the Contract Drawings. Aquastat shall be set to 105°F.

C. Sequence of Operation:

1. The control circuit shall energize the power circuit to the circulator pump wiring circuit.

D. Instructions and Diagrams:

1. The Contractor shall provide to the owner a complete instruction manual covering the function and operation of all control components. The manual shall also contain a schematic drawing of each control system properly marked and keyed with the equipment list to identify each item of control equipment.
2. The Contractor shall also provide a complete schematic control diagram framed under glass and mounted on the wall in the equipment room.

220028 OPERATING AND MAINTENANCE MANUAL

- A. All operation and maintenance manuals **shall** be delivered by the Contractor to the Owner thru the Architect. The manuals **shall** be installed in 3-ring hard cover heavy duty notebooks with the name of the project and the words “**Operation and Maintenance Manual**” permanently affixed to the cover and spine. All items for the project shall be separated by identification tabs correlated to the index. The manuals **shall** contain the following items as a minimum:

1. Index and page number.
2. Certificate of substantial completion.
3. A summary sheet of warranties with dates noted and a copy of all warranties.
4. List of subcontractors and suppliers with names, addresses, and phone numbers.
5. Water Line test data for sterilization.
6. Backflow preventer certificate of operation.
7. A copy of the valve tag chart that is to be mounted on the wall of the mechanical room.
8. Complete start-up, operation, and shutdown procedures for each system including sequence of events, locations of switches, emergency procedures, and any other critical items

9. Lubrication schedules and types of lubricants.
 10. Complete set of current shop drawings and equipment description showing all capacities and other operation conditions.
 11. Equipment summary showing all capacities and ratings (HP, KW, etc.).
 12. Operation manuals, installation manuals, and parts list for all installed equipment.
 13. All submittal data indexed with tabs and shop drawings.
- B. One copy shall be manufacturer's original published literature with manufacturer's name on all items. **FAXED COPIES WILL NOT BE ACCEPTABLE.**

220029 AS BUILT DRAWINGS

- A. The General Contractor and Plumbing Contractor shall maintain "during the course of the work" a set of drawings marked up to show the work as installed, including dimensions to and elevations of buried work. Both Contractors shall initial and date all changes to the contract drawings. The Architectural Observer may check this set of documents monthly for compliance. Upon completion of the work, return this set of drawings to the Architect.

220030 FIXTURES

- A. All exposed piping and metal parts shall be chrome plated. Slip joints will not be permitted except on fixture side of trap. Rigid supplies are specified for fixtures and it is intended that they be installed true and plumb from fixture to wall rough in. Connections for water closets shall be made by use of flanges compatible to waste piping materials and verminproofed wax gaskets.
- B. **MANUFACTURER'S MODEL NUMBERS ARE PROVIDED FOR GENERAL INFORMATION ONLY.** Description of product shall take precedence over model numbers.
- C. All water closets shall flush properly when flushing with 25 PSIG at the flush valve.
- D. All floor drains and mop receptors shall have a deep seal P-trap installed below floor as a separate item. Joint connection shall be compatible to piping system.
- E. All floor-mounted water closets shall be set and grouted with white grout between floor and closet base.
- F. All wall-hung fixtures shall be sealed between wall and fixture with white "G.E. Silicone Seal" caulking.
- G. All counter mounted fixture rims shall be sealed with clear "G.E. Silicone Seal" caulking.

WC-1 **WATER CLOSET:** (Adult ADA) Existing bowl and seat. Flush valve with 1" screwdriver angle check stop, vandal resistant stop cap, ADA flush handle, vacuum breaker, 1" chrome plated wall supply cover pipe, chrome plated cast brass escutcheon with set screw, 1-1/2" chrome plated flush pipe, Zurn, Sloan, or Delany. Provide extended flush pipe as needed to connect to existing rough-ins.

WC-2 **WATER CLOSET:** (Adult) Existing bowl and seat. Flush valve with 1" screwdriver angle check stop, vandal resistant stop cap, ADA flush handle, vacuum breaker, 1" chrome plated wall supply cover pipe, chrome plated cast brass escutcheon with set screw, 1-1/2" chrome plated flush pipe, Zurn Z6000AV-HET-YK, Sloan No. 111-1.28YK or Delany F-414-1.6-T42-T36. Contractor should note flush valve rough-in height as shown on the drawings. Flush valve handle shall be roughed in and mounted to the wide side of the toilet stall.

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- WC-3 WATER CLOSET: (Adult ADA) Existing bowl, seat, and flush valve. Flush valve shall be manual type. Contractor should note flush valve rough-in height as shown on the drawings. Flush valve handle shall be roughed in and mounted to the wide side of the toilet stall.
- WC-4 WATER CLOSET: (Adult) Existing bowl, seat, and flush valve. Flush valve shall be manual type. Contractor shall coordinate flush valve height with rough-ins. ADA accessibility is not required, but acceptable.
- WC-5 WATER CLOSET: (Adult ADA) 16-1/2" high, floor mounted, vitreous china, elongated siphon jet water saver 1.28 GPF bowl with 1-1/2" top spud, china caps, American Standard No. 3461.128, or approved equal by Kohler, or Zurn. Flush valve with 1" screwdriver angle check stop, vandal resistant stop cap, ADA flush handle, vacuum breaker, 1" chrome plated wall supply cover pipe, chrome plated cast brass escutcheon with set screw, 1-1/2" chrome plated flush pipe, Zurn Z6000AV-HET-YK, Sloan No. 111-1.28YK or Delany F-414-1.6-T42-T36. White moltex open front seat with concealed stainless steel check hinge, less cover, American Standard 5901.100, Church No. 9500CT, Centoco 1500CCSS Bemis 1955SSCT, or Benekee 527. Contractor should note flush valve rough-in height as shown on the drawings. Flush valve handle shall be roughed in and mounted to the wide side of the toilet stall.
- U-1 URINAL: (Adult ADA) Existing urinal fixture. Chair carrier with chrome plated cap nuts, Zurn Z-1222, or approved equal by J.R. Smith, Watts. Lip shall be mounted at height as shown on the drawings.
- U-2 URINAL: (Adult) Existing urinal fixture. Chair carrier with chrome plated cap nuts, Zurn Z-1222, or approved equal by J.R. Smith, Watts. Lip shall be mounted at height as shown on the drawings.
- L-1 LAVATORY: (Adult ADA) Existing bowl. Chrome plated, lead free, metering faucet with single push button, chrome-plated cover plate, and 0.5 GPM vandal resistant aerator shall be Chicago Faucets 807-E2805-665PSHAB (basis of design), or approved equal by Kohler or American Standard. Connect faucet to cold water only. Chrome plated lead free angle stop with loose key handle and 1/2" chrome plated nipple to wall and escutcheon with set screw shall be McGuire, Zurn, or Engineered Brass Company. Stainless steel braided flexible supply shall be as manufactured by McGuire SSLAV12050038 or approved equal by Brass Craft, Watts. Chrome plated cast brass strainer with open grid, overflow openings, cast brass locknut and 1-1/4" 17 gauge tailpiece shall be McGuire Model 155A, Zurn Model Z-8743, or Engineered Brass Company Model SG7L05. 1-1/4" by 1-1/2" chrome plated adjustable cast brass P-trap with 1-1/4" slip in inlet, cleanout, ground joint, 1-1/2" I.P.S. outlet, shall be McGuire, Zurn, or Engineered Brass Company. 1-1/2" chrome plated nipple to wall with escutcheon and setscrew shall be McGuire Model N150060, Zurn Model Z-8919-6 w/Z-8909, or Engineered Brass Company Model NF9.06. Chair carrier with floor anchor plate, upright supports, and bearing plate shall be Zurn Model Z-1224, Mifab Model MC-30 or J. R, Smith Model 0800. Lavatory shall be mounted at height as shown on the drawings. Lavatory supply and trap shall be protected by A.D.A. approved premolded insulation assembly as manufactured by Truebro, McGuire or EBC.
- L-2 LAVATORY: (Adult ADA) Existing bowl. Chrome plated, lead free, metering faucet with dual push buttons and 0.5 GPM vandal resistant aerator shall be Chicago

Faucets 802-VE2805-665ABCP (basis of design), or approved equal by Kohler or American Standard. Thermostatic lead free mixing valve with locking set point, 3/8" inlet check stops, 3/8" outlet, shall be installed under the lavatory to supply 110 F tempered water to the faucet. Mixing valve shall be ASSE 1016 approved and shall be Watts Model LFUSG-B or approved equal by Combraco or Heatguard. A bronze lead free body strainer with stainless steel strainer shall be installed between the stop and the mixing valve. Chrome plated lead free angle stops with loose key handle and 1/2" chrome plated nipple to wall and escutcheon with set screw shall be McGuire, Zurn, or Engineered Brass Company. Stainless steel braided flexible supplies shall be as manufactured by McGuire SSLAV12050038 or approved equal by Brass Craft, Watts. Chrome plated cast brass strainer with open grid, overflow openings, cast brass locknut and 1-1/4" 17 gauge tailpiece shall be McGuire Model 155A, Zurn Model Z-8743, or Engineered Brass Company Model SG7L05. 1-1/4" by 1-1/2" chrome plated adjustable cast brass P-trap with 1-1/4" slip in inlet, cleanout, ground joint, 1-1/2" I.P.S. outlet, shall be McGuire, Zurn, or Engineered Brass Company. 1-1/2" chrome plated nipple to wall with escutcheon and setscrew shall be McGuire Model N150060, Zurn Model Z-8919-6 w/Z-8909, or Engineered Brass Company Model NF9.06. Chair carrier with floor anchor plate, upright supports, and bearing plate shall be Zurn Model Z-1224, Mifab Model MC-30 or J. R. Smith Model 0800. Lavatory shall be mounted at height as shown on the drawings. Lavatory supplies and trap shall be protected by A.D.A. approved premolded insulation assembly as manufactured by Truebro, McGuire or EBC.

- L-3 LAVATORY-STAFF: (Adult ADA) Existing bowl. Single lever, chrome plated, lead free supply faucet with 0.5 GPM vandal resistant aerator, single hole shall be Chicago Faucets 2200-E70ABCP (basis of design), or approved equal by Kohler or American Standard. Thermostatic lead free mixing valve with locking set point, 3/8" inlet check stops, 3/8" outlet, shall be installed under the lavatory to supply 110 F tempered water to the faucet. Mixing valve shall be ASSE 1016 approved and shall be Watts Model LFUSG-B or approved equal by Combraco or Heatguard. A bronze lead free body strainer with stainless steel strainer shall be installed between the stop and the mixing valve. Chrome plated lead free angle stops with loose key handle and 1/2" chrome plated nipple to wall and escutcheon with set screw shall be McGuire, Zurn, or Engineered Brass Company. Stainless steel braided flexible supplies shall be as manufactured by McGuire SSLAV12050038 or approved equal by Brass Craft, Watts. Chrome plated cast brass strainer with open grid, overflow openings, cast brass locknut and 1-1/4" 17 gauge tailpiece shall be McGuire Model 155A, Zurn Model Z-8743, or Engineered Brass Company Model SG7L05. 1-1/4" by 1-1/2" chrome plated adjustable cast brass P-trap with 1-1/4" slip in inlet, cleanout, ground joint, 1-1/2" I.P.S. outlet, shall be McGuire, Zurn or Engineered Brass Company. 1-1/2" chrome plated nipple to wall with escutcheon and setscrew shall be McGuire Model N150060, Zurn Model Z-8919-6 w/Z-8909, or Engineered Brass Company Model NF9.06. Chair carrier with floor anchor plate, upright supports, and bearing plate shall be Zurn Model Z-1224, Mifab Model MC-30 or J. R. Smith Model 0800. Lavatory shall be mounted at height as shown on the drawings. Lavatory supplies and trap shall be protected by A.D.A. approved premolded insulation assembly as manufactured by Truebro, McGuire or EBC.

- L-4 LAVATORY: (Adult ADA) Existing bowl and faucet. Lavatories connected to hot water shall have thermostatic lead free mixing valve with locking set point, 3/8" inlet

check stops, 3/8" outlet, shall be installed under the lavatory to supply 110 F tempered water to the faucet. Mixing valve shall be ASSE 1016 approved and shall be Watts Model LFUSG-B or approved equal by Combraco or Heatguard. A bronze lead free body strainer with stainless steel strainer shall be installed between the stop and the mixing valve. Chrome plated lead free angle stops with loose key handle and 1/2" chrome plated nipple to wall and escutcheon with set screw shall be McGuire, Zurn, or Engineered Brass Company. Stainless steel braided flexible supplies shall be as manufactured by McGuire SSLAV12050038 or approved equal by Brass Craft, Watts. Chrome plated cast brass strainer with open grid, overflow openings, cast brass locknut and 1-1/4" 17 gauge tailpiece shall be McGuire Model 155A, Zurn Model Z-8743, or Engineered Brass Company Model SG7L05. 1-1/4" by 1-1/2" chrome plated adjustable cast brass P-trap with 1-1/4" slip in inlet, cleanout, ground joint, 1-1/2" I.P.S. outlet, shall be McGuire, Zurn or Engineered Brass Company. 1-1/2" chrome plated nipple to wall with escutcheon and setscrew shall be McGuire Model N150060, Zurn Model Z-8919-6 w/Z-8909, or Engineered Brass Company Model NF9.06. Chair carrier with floor anchor plate, upright supports, and bearing plate shall be Zurn Model Z-1224, Mifab Model MC-30 or J. R. Smith Model 0800. Lavatory shall be mounted at height as shown on the drawings. Lavatory supplies and trap shall be protected by A.D.A. approved premolded insulation assembly as manufactured by Truebro, McGuire or EBC. Where faucet is connected to hot water, provide thermostatic lead free mixing valve with locking set point, 3/8" inlet check stops, 3/8" outlet, shall be installed under the lavatory to supply 110 F tempered water to the faucet. Mixing valve shall be ASSE 1016 approved and shall be Watts Model LFUSG-B or approved equal by Combraco or Heatguard. A bronze lead free body strainer with stainless steel strainer shall be installed between the stop and the mixing valve.

SH-1 SHOWER: (Adult ADA) ADA shower stall will be constructed by the General Contractor. Shower drain with cast iron body, 2" hub outlet, 5" square nickel bronze heelproof top, vandal resistant securing screws, Zurn ZN-415S-VP-Y, or approved equal by Josam or J. R. Smith. Complete shower valve and shower head package shall include single-handle, pressure-balance, chrome-plated bronze shower valve with hot and cold water indicators and check stops, chrome-plated bronze diverter valve, chrome-plated ABS, 2.5 gpm, fixed spray pattern shower head with arm and ball joint, and 2.5 gpm fixed spray pattern hand spray with non-positive push button shut-off, double check valve backflow preventer, 60" braided stainless steel flexible hose, 24" glide rail, supply elbow and flange. Package shall be Leonard 4505 or approved equal by Symmons or Delta. Showerheads and controls shall be mounted as shown on the drawings.

EWC-1 ELECTRIC WATER COOLER: (Single Height) Wall mounted, vandal resistant, air cooled type cooler with stainless steel anti-splash receptor, stainless steel cabinet, non-filtered, anti-squirt dual stream bubbler, automatic stream regulator, push controls on front and sides, hands free water bottle filler, counter to indicate number of plastic bottles saved, wall hanger, sealed hermetic compressor with capacity of 8-GPH of 50°F drinking water at 90°F room temperature and 80° F inlet water temperature, Elkay EZS8WSVRSK, or approved equal by Halsey Taylor or Oasis, factory wired for 115 volt, single phase electrical service. Provide cane touch apron where indicated on the Contract Drawings. Cane touch apron shall be by the same manufacturer as the electric water cooler. Chair carrier with steel upright support

legs, backing plates shall be Zurn Z-1225, or approved equal by J.R. Smith or Watts. The Plumbing Contractor shall furnish the electrical receptacle rough-in dimensions to the Electrical Contractor to provide for a concealed electrical service to the unit. Plumbing Contractor shall provide PVC P-trap the same size as the electric water cooler drain. Wheel handle lead free stop valve shall be McGuire LF175 or approved equal. Plumbing Contractor should note that spout should be set at height as shown on the drawings.

- EWC-2 ELECTRIC WATER COOLER: (Dual Height) Wall mounted, vandal resistant, air cooled type cooler with stainless steel anti-splash receptor, stainless steel cabinet, non-filtered, anti-squirt dual stream bubbler, automatic stream regulator, push controls on front and sides, hands free water bottle filler, counter to indicate number of plastic bottles saved, wall hanger, sealed hermetic compressor with capacity of 8-GPH of 50°F drinking water at 90°F room temperature and 80° F inlet water temperature, Elkay EZSTL8WSVRSK, or approved equal by Halsey Taylor or Oasis, factory wired for 115 volt, single phase electrical service. Provide cane touch apron where indicated on the Contract Drawings. Cane touch apron shall be by the same manufacturer as the electric water cooler. Chair carrier with steel upright support legs, backing plates shall be Zurn Z-1225, or approved equal by J.R. Smith or Watts. The Plumbing Contractor shall furnish the electrical receptacle rough-in dimensions to the Electrical Contractor to provide for a concealed electrical service to the unit. Plumbing Contractor shall provide PVC P-trap the same size as the electric water cooler drain. Wheel handle lead free stop valve shall be McGuire LF175 or approved equal. Plumbing Contractor should note that spout should be set at height as shown on the drawings.
- SK-1 CLINIC SINK: (ADA) 22" x 19" x 4-1/2" deep single compartment, self-rimming, 18-gauge, type 304 nickel bearing stainless steel with backledge, sound deadening applied to under side, rear center drain outlet shall be Elkay LRAD2219-4.5 or Just SL-ADA-1921-A-GR-4.5 GR or approved equal by Advance Tabco. Stainless steel crumbcup strainer with 1-1/2" offset tailpiece shall be Elkay LKAD35 or Just J-ADA-35 GR or approved equal by Advance Tabco. Lead-free hot and cold water supply faucet with renewable cartridge, 8" gooseneck swing spout, 1.5 GPM soft flow aerator, less spray, shall be Chicago 1895-GN8AE35ABCP, or approved equal by Zurn or Delta. 1/2" sweat x 1/2" compression sink supply stops shall be equipped with 5" extension, wheel handle ball valve angle stops shall be McGuire, Zurn, or approved equal by Brasscraft. 1-1/2" x 1-1/2" chrome plated adjustable cast brass P-trap with 1-1/2" slip joint inlet, cleanout, and 1-1/2" 17-gauge tube outlet shall be McGuire, Zurn, or Kohler. Install chrome plated escutcheons with setscrew on all piping entering base cabinet. Supplies and trap shall be protected by A.D.A. approved premolded insulation assembly as manufactured by Truebro, McGuire or EBC.
- SK-2 TEACHERS LOUNGE SINK: (ADA) 22" x 19" x 4-1/2" deep single compartment, self rimming, 18-gauge, type 304 nickel bearing stainless steel with backledge, sound deadening applied to under side, rear center drain outlet shall be Elkay LRAD2219-4.5 or Just SL-ADA-1921-A-GR-4.5 GR or approved equal by Advance Tabco. Stainless steel crumbcup strainer with 1-1/2" offset tailpiece shall be Elkay LKAD35 or Just J-ADA-35 GR or approved equal by Advance Tabco. Lead-free hot and cold water supply faucet with renewable cartridge, swing spout, 1.5 GPM soft flow aerator, less spray, shall be Chicago 1100-E35ABCP, Zurn Z871G2-XL-18F, or

- approved equal by Delta. 1/2" sweat x 1/2" compression sink supply stops shall be equipped with 5" extension, wheel handle ball valve angle stops shall be McGuire, Zurn, or Brasscraft. 1-1/2" x 1-1/2" chrome plated adjustable cast brass P-trap with 1-1/2" slip joint inlet, cleanout, and 1-1/2" 17-gauge tube outlet shall be McGuire, Zurn, or Kohler. Install cast brass escutcheons with setscrew on all piping entering base cabinet. Supplies and trap shall be protected by A.D.A. approved premolded insulation assembly as manufactured by Truebro, McGuire or Mainline.
- SK-3 CLASSROOM SINK: (ADA) 33" x 19-1/2" x 5" deep, double compartment, self rimming, 18-gauge, type 302 (18-8) nickel bearing stainless steel with backledge, 4" center set punching, sound deadening applied to underside shall be Elkay LRADQ331950 or approved equal by Just or Advance Tabco. Stainless steel crumcup strainer with 1-1/2" offset tailpiece shall be Elkay LKAD35 or Just J-ADA-35 GR or approved equal by Advance Tabco. Lead-free hot and cold water supply faucet with renewable cartridge, 8" gooseneck swing spout, 1.5 GPM soft flow aerator, less spray, shall be Chicago 1895-GN8AE35ABCP, or approved equal by Zurn or Delta. 1/2" sweat x 1/2" compression sink supply stops shall be equipped with 5" extension, wheel handle ball valve angle stops shall be McGuire, Zurn, or approved equal by Brasscraft. 1-1/2" x 1-1/2" chrome plated adjustable cast brass P-trap with 1-1/2" slip joint inlet, cleanout, and 1-1/2" 17-gauge tube outlet shall be McGuire, Zurn, or Kohler. Install chrome plated escutcheons with setscrew on all piping entering base cabinet. Supplies and trap shall be protected by A.D.A. approved premolded insulation assembly as manufactured by Truebro, McGuire or EBC.
- MR-1 MOP RECEPTOR: 24" x 24" x 10" deep molded stone receptor with 3" inside caulked drain, stainless steel strainer, Fiat Model MSB-2424, Williams Model MTB 2424 or Mustee Model 63. Two (2) sets of wall mounted, polished chrome plated supply faucets with top brace, vacuum breaker, integral screwdriver shank check stops, 3/4" hose end, T&S B-0665-BSTP or approved equal by Chicago Faucets or Kohler. Heavy duty, cloth reinforced rubber hose and hose hook, Fiat Model 832-AA, Williams Model T-35, or Mustee Model 65.700. Wall mounted, 24" long, 3 mop spring clip hanger, Fiat Model 889-CC, Williams Model T-40, or Mustee Model 65.600. Stainless steel wall guards with corner bracket shall be Fiat Model MSG 2424 or approved equal Williams, or Mustee 67.2424. Supply faucet outlet shall be mounted 24" above receptor floor. Contractor should note that joint between receptor, wall and floor should be sealed with clear silicone sealant.
- HB-1 HOSE BIBB: Wall mounted, polished chrome plated brass with 3/4" vacuum breaker hose end, locking shield, tee handle, 1/2" inlet wall flange, Woodford Model 26P-1/2, Mifab MHY-9240, T & S Brass B-0702/B-972 or Preir C-257CP.75.
- HB-2 ROOF HYDRANT: Freeze-proof, automatically draining, brass roof hydrant with field serviceable double check backflow preventer or vacuum breaker shall be Woodford Model RHY2-MS, or approved equal by Mifab or Prier.
- FD-1 FLOOR DRAIN: Cast iron body drain with 3" outlet to match piping system, 6" square nickel bronze heelproof top, vandal resistant securing screws with flashing device, Zurn ZN415S-VP, or approved equal by Josam, J. R. Smith, Wade, or Watts
- WH-1 WATER HEATER: Factory assembled electric 119-gallon storage type heater shall be equipped with glass lined steel tank, ASME pressure temperature relief valve, magnesium anode rods, tank drain with hose connection, ASHRAE/IESNA 90.1

insulated factory applied baked enamel finish jacket, six bolt-in, 4,000-watt immersion elements set to run simultaneously (24 kw total) and control box. Heater shall be controlled by immersed bulb thermostat and be equipped with high limit temperature control, control box, transformer, contactors and junction box. Control circuits shall be a maximum of 120-volts. Heaters shall be U.L. approved and shall carry 3-year factory warranty. Heater shall be factory wired for 480-volt, three-phase electrical service as shown on the plans and shall be A.O. Smith DRE-120-24, or approved equal by State, Bradford White, or Rheem. Water heater shall be started by the manufacturer's factory representative.

220031 GUARANTEE

- A. Guarantee: The Contractor shall guarantee the entire plumbing system subject to the General Conditions of these specifications.

220032 BIDDING PROCEDURE

- A. The Contractor shall provide bidding for Alternate Bids in accordance with Division 1. Contractor shall refer to Division 1 for any required unit prices and allowances.

END OF SECTION

SECTION 23 0130

EXISTING HVAC AIR DISTRIBUTION SYSTEM CLEANING

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 cleaning existing HVAC supply air and return air ducts, plenums, and system components as indicated on the drawings. Cleaning of existing exhaust air ducts and system components are not included in the project.
- B. Related Requirements:
 - 1. Section 230500 "Heating and Air Conditioning".

1.3 DEFINITIONS

- A. ACAC: American Council for Accredited Certification.
- B. AIHA-LAP: American Industrial Hygiene Association Lab Accreditation Program
- C. ASCS: Air systems cleaning specialist.
- D. CESB: Council of Engineering and Scientific Specialty Boards.
- E. EMLAP: Environmental Microbiology Laboratory Accreditation Program.
- F. IEP: Indoor Environmental Professional.
- G. IICRC: Institute of Inspection, Cleaning, and Restoration Certification.
- H. NADCA: National Air Duct Cleaners Association.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
 - 1. For an ASCS.
 - 2. For an IEP.
- B. Field Quality-Control Reports:
 - 1. Project's existing conditions.
 - 2. Evaluations and recommendations, including cleanliness verification.
 - 3. Strategies and procedures plan.

1.5 CLOSEOUT SUBMITTALS

- A. Post-Project report.

1.6 QUALITY ASSURANCE

- A. ASCS Qualifications: A certified member of NADCA.
 - 1. Certification: Employ an ASCS certified by NADCA on a full-time basis.
 - 2. Supervisor Qualifications: Certified as an ASCS by NADCA.
- B. IEP Qualifications: CMI who is certified by ACAC and accredited by CESB.
- C. UL Compliance: Comply with UL 181 and UL 181A for fibrous-glass ducts.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 PREPARATION

- A. Inspect HVAC air-distribution equipment, ducts, plenums, and system components to determine appropriate methods, tools, and equipment required for performance of the Work.
- B. Perform "Project Evaluation and Recommendation" according to NADCA ACR.
- C. Cleaning Plan: Prepare a written plan for air-distribution system cleaning that includes strategies and step-by-step procedures. At a minimum, include the following:
 - 1. Supervisor contact information.
 - 2. Work schedule, including location, times, and impact on occupied areas.
 - 3. Methods and materials planned for each HVAC component type.
 - 4. Required support from other trades.
 - 5. Equipment and material storage requirements.
 - 6. Exhaust equipment setup locations.
- D. Existing Conditions Report: Prepare a written report that documents existing conditions of the systems and equipment. Include documentation of existing conditions, including inspection results, photo images, laboratory results, and interpretations of the laboratory results by an IEP.
 - 1. Prepare written report listing conditions detrimental to performance of the Work.
- E. Proceed with work only after conditions detrimental to performance of the Work have been corrected.
- F. Use new and existing service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry and for inspection.
- G. Service Openings in HVAC Systems shall be in accordance with Access Doors in Section 230500.
- H. Mark the position of manual volume dampers and air-directional mechanical devices inside the system prior to cleaning.

3.2 CLEANING

- A. Comply with NADCA ACR, including items identified as "recommended," "advised," and "suggested."
- B. Perform electrical lockout and tagout according to Owner's standards or authorities having jurisdiction.
- C. Remove non-adhered substances and deposits from within the HVAC system.
- D. Systems and Components to Be Cleaned:
 - 1. Air devices for supply and return air including existing registers, grilles, and diffusers.
 - 2. Ductwork:
 - a. Supply-air ducts, including turning vanes and reheat coils, to the air-handling unit.
 - b. Return-air ducts to the air-handling unit.
 - c. Transfer ducts.

3. Casings.
- E. Collect debris removed during cleaning. Ensure that debris is not dispersed outside the HVAC system during the cleaning process.
- F. Particulate Collection:
 1. For particulate collection equipment, include adequate filtration to contain debris removed. Locate equipment downwind and away from all air intakes and other points of entry into the building.
 2. HEPA filtration with 99.97 percent collection efficiency for particles sized 0.3 micrometer or larger shall be used where the particulate collection equipment is exhausting inside the building,
- G. Control odors and mist vapors during the cleaning and restoration process.
- H. Protect new ductwork, new air devices, new HVAC units and their coils, etc. during the cleaning process. Deenergize equipment during the cleaning process. Any new work found to be dirty as a part of the cleaning process shall be cleaned in accordance with this Section.
- I. Mark the position of manual volume dampers and air-directional mechanical devices inside the system prior to cleaning. Restore them to their marked position on completion of cleaning.
- J. System components shall be cleaned so that all HVAC system components are visibly clean. On completion, all components must be returned to those settings recorded just prior to cleaning operations.
- K. Clean non-adhered substance deposits according to NADCA ACR.
- L. Air-Distribution Systems:
 1. Create service openings or use duct access doors in the HVAC system as necessary to accommodate cleaning.
 2. Mechanically clean air-distribution systems specified to remove all visible contaminants, so that the systems are capable of passing the HVAC System Cleanliness Tests (see NADCA ACR).
- M. Debris removed from the HVAC system shall be disposed of according to applicable Federal, state, and local requirements.
- N. Mechanical Cleaning Methodology:
 1. Source-Removal Cleaning Methods: The HVAC system shall be cleaned using source-removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and to safely remove these contaminants from the facility. No cleaning method, or combination of methods, shall be used that could potentially damage components of the HVAC system or negatively alter the integrity of the system.
 - a. Use continuously operating vacuum-collection devices to keep each section being cleaned under negative pressure.
 - b. Cleaning methods that require mechanical agitation devices to dislodge debris that is adhered to interior surfaces of HVAC system components shall be equipped to safely remove these devices. Cleaning methods shall not damage the integrity of HVAC system components or damage porous surface materials, such as duct and plenum liners.
 2. Cleaning Mineral-Fiber Insulation Components:

- a. Fibrous-glass thermal or acoustical insulation elements present in equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment while the HVAC system is under constant negative pressure and shall not be permitted to get wet according to NADCA ACR.
- b. Cleaning methods used shall not cause damage to fibrous-glass components and will render the system capable of passing the HVAC System Cleanliness Tests (see NADCA ACR).
- c. Fibrous materials that become wet shall be discarded and replaced.

3.3 CLEANLINESS VERIFICATION

- A. Verify cleanliness according to NADCA ACR, "Verification of HVAC System Cleanliness" Section.
- B. Verify HVAC system cleanliness after mechanical cleaning.
- C. Surface-Cleaning Verification: Perform visual inspection for cleanliness. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.
- D. Prepare a written cleanliness verification report. At a minimum, include the following:
 - 1. Written documentation of the success of the cleaning.
 - 2. Site inspection reports, initialed by supervisor, including notation on areas of inspection, as verified through visual inspection.
 - 3. Surface comparison test results if required.
 - 4. Gravimetric analysis (nonporous surfaces only).
 - 5. System areas found to be damaged.

3.4 RESTORATION

- A. Restore and repair HVAC air-distribution equipment, ducts, plenums, and components according to NADCA ACR, "Restoration and Repair of Mechanical Systems" Section.
- B. Replace fibrous-glass materials that cannot be restored by cleaning or resurfacing. Comply with requirements in Section 233113 "Metal Ducts" and Section 233116 "Nonmetal Ducts."
- C. Replace damaged insulation according to Section 230500.
- D. Ensure that closures do not hinder or alter airflow.
- E. New closure materials, including insulation, shall match opened materials and shall have removable closure panels fitted with gaskets and fasteners.
- F. Restore manual volume dampers and air-directional mechanical devices inside the system to their marked position on completion of cleaning.

3.5 PROJECT CLOSEOUT

- A. Post-Project Report:
 - 1. Post-cleaning laboratory results if any.
 - 2. Post-cleaning photo images.
 - 3. Post-cleaning verification summary.
- B. Drawings:

1. Deviations of existing system from Owner's record drawings.
2. Location of service openings.

END OF SECTION

SECTION 23 0500

HEATING AND AIR CONDITIONING

230501 GENERAL

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. The Heating and Air Conditioning Contractor shall cooperate with the contractors of other trades and shall install his work as fast as the progress of the balance of the work will permit.
- C. See Section 013100 for requirements for Coordination Drawings.
- D. The Heating and Air Conditioning Contractor shall install all work in accordance with the requirements of the latest edition of the North Carolina State Building Code. Codes to be a part of these specifications: North Carolina State Building Code, National Fire Protection Association Codes Section 54, 70, 90A, 91, and other applicable sections.
- E. Inspection by local authorities will be required.
- F. The drawings accompanying these specifications indicate diagrammatically the general location of the ducts, piping, and equipment and do not show all offsets, supports, fittings, bolts, connections, etc., required for a complete system. While the drawings are to be followed as closely as possible, if it is found necessary to change the location of same to accommodate the conditions at the building, such changes shall be made without additional cost to the Owner, and as directed by the Engineer. Any detail which is omitted, and which is necessary for the proper operation of any system included under the contract, shall be supplied and installed by the Heating and Air Conditioning Contractor without extra cost to the Owner. All pipes and ducts shall be run as high as possible to maintain ceiling and head clearance. All equipment shall be installed in such a manner as to allow proper maintenance access.
- G. Equipment and Materials shall be delivered to the site and stored in original containers, suitably sheltered from the elements, but readily accessible for inspection by the Engineer until installed. All items subject to moisture damage shall be stored in dry spaces.
- H. Conditions shall be checked at the building before placing orders for apparatus and such apparatus shall be of such dimensions as to fit the spaces allotted. The Heating and Air Conditioning Contractor shall not scale mechanical plans, but rather refer to architectural plans for dimensions.
- I. By signing the Contractor's Proposal, it is understood and agreed that the Heating and Air Conditioning Contractor has, by careful examination, satisfied himself with the quantity, quality, and location of all excavation materials to be encountered in his contract. No additional payment will be approved for well pointing or any other existing conditions encountered. Refer to Division 31 for site work requirements.
- J. All debris resulting from heating and air conditioning work shall be removed from the premises daily or as directed by the Engineer. Trash and rubbish shall not be allowed to accumulate either within or outside the building. Materials and debris, which in the opinion of the Engineer cannot practicably be removed from the site the same day, may be temporarily stacked or stored in a designated location on the site as directed by the Engineer.
- K. Guards shall be provided for all moving equipment, motor couplings, pump shafts, belt drives and similar exposed reciprocating or rotating components.
- L. All HVAC and refrigeration equipment shall be labeled in accordance with Section 301 of the North Carolina Mechanical Code and as required by the Authority having jurisdiction.

Labeling shall be a permanent factory-applied nameplate affixed to the equipment on which shall appear in legible lettering, the manufacturer's name or trademark, the model, serial number, and the seal or mark of the testing agency.

230502 SCOPE

- A. The Heating and Air Conditioning Contractor shall provide labor and materials required for a complete system ready for operation as shown on the drawings and hereinafter specified. This includes all equipment, ductwork, necessary plumbing, and all other services necessary whether they are specifically mentioned herein or not. The entire installation shall be installed in a first-class, neat, professional manner to the satisfaction of the Engineer and shall conform to all applicable codes and laws.

230503 DEMOLITION

- A. General Requirements: The work includes the demolition or removal of all construction indicated, specified, or necessary to accomplish the work under this contract. All items not to be reused shall become the property of the Heating and Air Conditioning Contractor. The drawings define the scope of work, but it is not intended that all items of demolition work be specifically indicated. After carefully reviewing the drawings and specifications to determine intent, and prior to bidding, the Heating and Air Conditioning Contractor shall visit the site and determine the extent of demolition work required to properly complete the work under his contract.
- B. Protection of Materials and Work: Before beginning any cutting or demolition work, the Heating and Air Conditioning Contractor shall carefully survey the existing work and examine the drawings and specifications to determine the extent of work required. The Heating and Air Conditioning Contractor shall take all necessary precautions to insure against damage to existing work to remain in place, to be reused, or to remain the property of the Owner, and any damage to such work shall be repaired or replaced at no additional cost to the Owner.
- C. The Contractor shall notify the Owner immediately in the event that any asbestos is encountered during demolition.
- D. Refrigerant in Demolished Equipment: Recover all refrigerant in approved refrigerant containers and in compliance with section 608 of the EPA Clean Air Act. Removal must be conducted under supervision of an EPA certified technician.

230504 SHOP DRAWINGS AND SUBMITTAL DATA

- A. The Heating and Air Conditioning Contractor shall submit within 10 days after award of the contract a list of materials and the manufacturer to be used on this project. He shall submit within thirty days after award of the contract at least five copies of submittal data in written form for the Engineer's use in approving materials and equipment. One copy will be returned. If the Heating and Air Conditioning Contractor desires the return of more than one copy, additional copies shall be provided to the Engineer at the time of the original submission. It is requested that all submittal data be sent to the Architect at one time. Unless special consideration is given, none of the submittal data will be checked until it has all been received by the Architect. Where called for, the Heating and Air Conditioning Contractor shall submit five sets of shop drawings showing the detailed arrangement or connections that are shown schematically on the drawings. Data certified for the specified project and indicated manufacturer, type, or size, capacity, etc., shall be submitted for the following equipment items:
 - 1. Packaged Gas/Electric Air Conditioning Units
 - 2. Dedicated Outside Air Units

3. Split System Heat Pumps
4. Power Ventilators and Louvered Penthouses
5. Diffusers, Grilles, and Registers
6. Controls with Complete Diagram
7. Fire, Manual, and Motorized Dampers
8. Access Doors
9. Spiral Ductwork
10. Insulation
11. Testing and Balancing
12. Seismic Restraints
13. Coordination Drawings per Section 013100

230505 APPROVED EQUAL EQUIPMENT, ETC.

- A. Manufacturers listed are to establish a standard of quality and not intended to limit the selection to these manufacturers. All materials and equipment which are essential and have not been specified or shown shall be new and of the highest grade and quality, free from defect or other imperfections. It should be understood that where the word "provide" is used, it is intended that the Heating and Air Conditioning Contractor shall purchase and install all materials required. Approval of equipment will not relieve the Contractor of compliance with the specifications even if such approval is made in writing, unless the attention of the Engineer is called to the non-complying features by letter accompanying the submittal data. Approval of submittal data by the Engineer shall not be construed as a complete check of approval of detailed dimensions, weights, gauges, and similar details with the proposed articles. The conformance with the necessary coordination between the various other contractors and suppliers shall be solely the responsibility of the Heating and Air Conditioning Contractor.

230506 PACKAGED GAS/ELECTRIC AIR CONDITIONING UNITS

- A. Units shall be downflow with cooling performance rated in accordance with AHRI standards. Unit shall be factory assembled, piped, internally wired, fully charged with R-410A and 100% run tested to check full operation, fan and blower rotation and control sequence before leaving the factory. Wiring internal to the unit shall be numbered for simplified identification. Unit shall be UL listed and labeled, classified in accordance to UL 1995/CAN/CSA No. 236-M90 for Central Cooling Air Conditioners.
- B. Units shall have the following characteristics:
 1. High efficiency DX cooling.
 2. Natural gas heat.
 3. Downflow airflow.
 4. Constant volume supply airflow or two-speed supply airflow as indicated on the drawings.
 5. Dual compressors where indicated on the drawings.
 6. High pressure control.
 7. Factory installed 0-100% outside air dry bulb economizer with fan and gravity damper for relief.
 8. Factory installed hot gas reheat - dehumidification control.

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9. Gas heating section, multi-stage where indicated on the drawings.
10. Phase monitor.
- C. Unit casing shall be such that all components are mounted in a weather resistant steel cabinet with a painted enamel finished exterior. Service panels shall be provided for unit controls, indoor coils and fans with a water and air tight seal. Indoor air section shall be completely insulated with fire resistant, permanent, odorless, foil faced glass fiber material. Access doors shall be hinged.
- D. Compressors shall be hermetically sealed, direct drive, scroll type with internal over current and over temperature protection, crankcase heaters, and high pressure control. Cooling shall be multi-stage where indicated on the drawings.
- E. Condenser coils shall have tubes mechanically bonded to spine aluminum fins. Evaporator coils and hot gas reheat coils shall be copper tubes mechanically bonded to high performance aluminum plate fins. All coils shall be leak tested to 200 psig and pressure tested to 450 psig. Provide guards on units to fully protect condenser coils from hail and vandalism.
- F. Condenser, evaporator, and hot gas reheat coils shall be coated with a field-applied, third-party non-metallic, non-bridging corrosion barrier material by a factory trained and authorized applicator. Coating shall meet ASTM B117 3000-hour accelerated salt spray test and shall have negligible (less than 1%) impact on equipment's capacity/performance.
- G. Units shall have forward curve, centrifugal indoor fans with permanently lubricated motor bearings. Motors shall be EISA 2007 NEMA premium efficiency with 1.15 service factor and shall be Model J ball bearing with minimum NEMA design "B" for 40°C ambient. Efficiency rating shall be stamped on motor nameplate. Motors shall have thermal overload protection. Motor/blower assemblies shall be isolated from the unit via rubber mounts. Where available from factory, motors shall be direct drive ECM type. If not, direct drive fans shall have factory VFD. Belt drive fans shall have adjustable variable pitch selected at a minimum service factor of 1.2. Heating and Air Conditioning Contractor shall provide one new set of drive belts installed in units at final inspection and provide a spare drive belt set for each unit. Belt set shall be secured inside each unit. After final assembly, the entire unit shall be given final vibration test.
- H. The outdoor fan shall be direct-drive statically and dynamically balanced, draw through in the vertical discharge position. The fan motors shall be permanently lubricated and have built-in thermal overload protection.
- I. Units shall be completely factory wired with necessary controls and terminal block for power wiring. Units shall have a single point through base power entry with HACR circuit breaker. Unit protection shall include phase monitoring.
- J. Heating section shall be indirect fired heat exchanger with stainless steel heat exchanger and burner, multi-stage where indicated on the drawings, and forced draft combustion via direct spark ignition. Gas connection to unit shall be through roof curb base. Heat exchanger shall have factory 10-year warranty.
- K. Filters shall be 2" thick UL Class 1 pleated panels with Minimum Efficiency Reporting Value of MERV 8 per ASHRAE Standard 52.2-1999. Contractor shall supply complete sets of filters to protect his equipment during construction, another change of filters at completion, and leave one additional complete set of filters at the school for the next change. Provide factory supplied fixed filter blockoffs to prevent air bypass around filters.
- L. Unit's dampers shall have metal compressible jamb seals and extruded vinyl blade edge seals. Units shall have motorized outside air intake and return air dampers to modulate open and

provide the specified outside air. Where indicated on the drawings, units shall have outside air economizers capable of providing 100% outside air even if additional mechanical cooling is required to meet the cooling load of the building. Relief fan and gravity dampers shall provide means to relieve excessive outdoor air during economizer operation to prevent over pressurizing the building. Outside air intake opening shall have rain hood with moisture eliminator and bird screen.

- M. Condensate drain pan shall be insulated positively sloped of durable, long-lasting and corrosion resistant construction.
- N. Curbs shall be custom made from 12 gauge or heavier as required galvanized steel with welded construction, vibration isolation type where indicated on the drawings, and 1-1/2" thick rigid insulation. Curb height shall be a minimum of 16" high above finished roof height. Secure curb to roof structure and unit to curb per manufacturer's recommendations for site's seismic and wind zone loading.
- O. Startup and testing shall be by factory authorized service representative.
- P. Coordinate space controls with BAS, including sensors, etc. to be provided in the unit by the unit manufacturer. Units will be controlled by the DDC BAS system.
- Q. Units shall have a two-warranty on entire unit and five-year warranty for parts and compressors. Warranty shall also include refrigerant, labor, and freight for five-years.
- R. Units shall be Trane, Carrier, York or approved equal.

230507 DEDICATED OUTSIDE AIR UNITS

- A. Units shall be 100% outside air DX cooling type with natural gas heat, return/recirculating as indicated on the drawings.
- B. Units shall be downflow or horizontal discharge as indicated on the drawings, with cooling performance rated in accordance with AHRI standards. Unit shall be factory assembled, piped, internally wired, fully charged with R-410A and 100% run tested to check full operation, fan and blower rotation and control sequence before leaving the factory. Wiring internal to the unit shall be numbered for simplified identification. Unit shall be UL listed and labeled, classified in accordance to UL 1995/CAN/CSA No. 236-M90 for Central Cooling Air Conditioners.
- C. Unit casing shall be double wall constructed of zinc coated, heavy gauge, galvanized steel with 2" thick insulation between walls. Exterior surfaces shall be cleaned, phosphatized, and finished with a weather-resistant baked enamel finish. Unit's surface shall be tested 1000 hours in a salt spray test in compliance with ASTM B45. The unit's base pan shall have no penetrations within the perimeter of the curb other than the raised downflow supply/return openings. Top cover shall be one piece construction or, where seams exist, shall be double-hemmed and gasket-sealed. Access doors shall be hinged.
- D. Compressors shall be direct-drive, hermetic, scroll type, digital primary, with centrifugal type oil pumps. Motor shall be suction gas-cooled and shall have a voltage utilization range of plus or minus 10 percent of unit nameplate voltage. Internal overloads shall be provided with the scroll compressors. Crankcase heaters shall be included. Digital primary compressor shall be able to fully modulate from 20%-100%. Provide multi-stage capability as indicated on the drawings.
- E. Evaporator coil shall be four row interlaced internally finned, 5/16" copper tubes mechanically bonded to a configured aluminum plate fin. Coils shall be leak tested at the factory. The evaporator coil shall be leak tested to 500 psig and pressure tested to 500 psig.

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- F. Hot gas reheat coil shall be modulating type located on the leaving air side of the evaporator coil prepped and circuited with a low pressure switch.
 - G. Condenser coil shall be 5/16" copper tubes mechanically bonded to a configured aluminum plate fin. Coils shall be leak tested at the factory. The evaporator coil shall be leak tested to 500 psig and pressure tested to 500 psig. Provide guards on units to fully protect condenser coils from hail and vandalism.
 - H. Condenser, evaporator, and hot gas reheat coils shall be coated with a field-applied, third-party non-metallic, non-bridging corrosion barrier material by a factory trained and authorized applicator. Coating shall meet ASTM B117 3000-hour accelerated salt spray test and shall have negligible (less than 1%) impact on equipment's capacity/performance.
 - I. Condensate drain pan shall be insulated positively sloped of durable, long-lasting and corrosion resistant construction.
 - J. Indoor supply fan shall be a high efficiency backward curved plenum type with ECM motor with integrated power electronics or VFD, but will be constant volume supply air. Provide with fan airflow monitoring piezo ring and tap. Integrate airflow cfm signal to DDC system.
 - K. Outdoor fans shall be direct drive vertical discharge design with low-noise corrosion resistant glass reinforced polypropylene props, powder coated wire discharge guards and electro-plated motor mounting brackets. Fans shall be statically and dynamically balanced with VFD control for head pressure control, reheat capacity, and low ambient control.
 - L. Heating section shall be indirect fired with stainless steel heat exchanger and burner, forced draft combustion via direct spark ignition, and 8:1 minimum turndown for firing natural gas. Gas connection to unit shall be through roof curb base. Heat exchanger shall have factory 10-year warranty.
 - M. Filters shall be 2" thick UL Class 1 pleated panels with Minimum Efficiency Reporting Value of MERV 8 per ASHRAE Standard 52.2-1999. Contractor shall supply complete sets of filters to protect his equipment during construction, another change of filters at completion, and leave one additional complete set of filters at the school for the next change. Provide factory supplied fixed filter blockoffs to prevent air bypass around filters.
 - N. Unit's dampers shall have metal compressible jamb seals and extruded vinyl blade edge seals. Units shall have motorized outside air intake, and return air dampers where indicated on the drawings, to open and provide the specified outside air. Outside air intake opening shall have rain hood with moisture eliminator and bird screen.
 - O. Units shall be completely factory wired with necessary controls and terminal block for power wiring. Units shall have a single point through base power entry with external location for mounting fused disconnect device. Unit protection shall include anti-short cycle timing and phase monitoring.
 - P. Curbs shall be custom made from 12 gauge or heavier as required galvanized steel with welded construction, vibration isolation type where indicated on the drawings, and 1-1/2" thick rigid insulation. Curb height shall be a minimum of 16" high above finished roof height. Secure curb to roof structure and unit to curb per manufacturer's recommendations for site's seismic and wind zone loading.
 - Q. Startup and testing shall be by factory authorized service representative.
 - R. Coordinate controls with BAS, including sensors, etc. to be provided in the unit by the unit manufacturer. Units will be controlled by the DDC BAS system.

- S. Units shall have a two-warranty on entire unit and five-year warranty for parts and compressors. Warranty shall also include refrigerant, labor, and freight for five-years.
- T. Units shall be Trane, Carrier, York or approved equal.

230508 SPLIT SYSTEM HEAT PUMPS

- A. Air handling unit section shall be UL or ETL labeled draw-thru design complete with centrifugal fans, condensate drain pan, refrigerant coil, insulated cabinet, electric resistance auxiliary heaters, and filters. Coil shall be dual circuit where indicated with non-ferrous tubes mechanically bonded to plate fins. The fan section shall have direct driven forward-curved fans with variable speed adjustment. The cabinets shall be internally insulated and shall be constructed of 16-gauge galvanized steel with baked enamel finish. Auxiliary electric strip heaters shall be by the heat pump manufacturer and shall be UL or ETL approved to be installed in the unit in the reheat position or at the unit's discharge. Unit shall rest on pad-type vibration isolators.
- B. Filters shall be 2" thick UL Class 1 pleated panels with Minimum Efficiency Reporting Value of MERV 8 per ASHRAE Standard 52.2-1999. Contractor shall supply complete sets of filters to protect his equipment during construction, another change of filters at completion, and leave one additional complete set of filters at the school for the next change. Provide factory supplied fixed filter blockoffs to prevent air bypass around filters.
- C. Outdoor section shall be UL labeled and AHRI rated and certified with its air handling unit and bear the AHRI seal. The fans shall be permanently lubricated, direct drive, propeller type. The compressors shall be hermetic using R-410A refrigerant with suction and discharge stop valves, crankcase heaters, automatically reversible oil pump, oil filter, internal thermostat, and controls for low ambient temperature operation. The unit controls shall include compressor staging, a high and low pressurestat of the automatic reset type, a positive acting five minute timer to prevent short cycling and a motor starting and protecting equipment. Units shall be furnished with coil guards.
- D. Refrigerant piping systems shall be sized, pitched, and furnished with all specialties as recommended by the unit manufacturer to accommodate refrigerant piping lengths. Specialties shall include suction line accumulators, liquid line solenoid valves, thermal expansion valves, refrigerant sight glass, removable core filter drier, and any other item deemed necessary or recommended by the unit manufacturer.
- E. Units shall have a two-warranty on entire unit and five-year warranty for parts and compressors. Warranty shall also include refrigerant, labor, and freight for five-years.
- F. Indoor and outdoor sections shall be by the same manufacturer and shall be Trane, Carrier, York, or approved equal.

230509 POWER VENTILATORS AND LOUVERED PENTHOUSES

- A. Power ventilators shall be tested and rated in accordance with the standards of AMCA 210 and shall carry the AMCA seal. All fans shall be UL labeled. Fans shall be Cook, Greenheck, Carnes, PennBarry, or approved equal.
- B. Power roof ventilators shall be centrifugal, direct or belt driven and upblast or downblast as indicated on the drawings with factory aluminum finish. All units shall be provided with bird screen, and back draft dampers. Disconnect switches shall be by the Heating and Air Conditioning Contractor. Power roof ventilators shall have spun aluminum hood. Motors shall be EISA 2007 NEMA premium efficiency with efficiency rating stamped on motor nameplate. Belt drive units shall have adjustable V-drive. Provide spare belts for belt drive units. Direct drive units shall have solid state motor speed controllers with an "OFF" position.

- C. Louvered penthouses shall have the top panel insulated with 1-1/2" fiberglass rigid insulation and shall be reinforced and removable. Bird screen shall be 1/2" x 1/2" PVC coated wire or wire cloth stainless steel. Louvered penthouses shall be aluminum with mitered corner waterproof louvers and factory aluminum finish. Provide vertical snow and storm baffle at base to protect against storm driven rain and snow.
- D. Roof curbs for roof-mounted equipment shall be provided by the Heating and Air Conditioning Contractor. It shall be the responsibility of the Heating and Air Conditioning Contractor to give the General Contractor the proper locations and sizes required for all roof openings. Opening will be framed and cut by the General Contractor. Roof curbs shall be insulated. Equipment shall be attached to roof curbs with a minimum of two stainless steel fasteners and EPDM washers on each side of roof curb.

230510 DIFFUSERS, GRILLES, AND REGISTERS

- A. Diffusers, Grilles, and Registers shall be as manufactured by Carnes, Metal Aire, Titus, Krueger, Price, or approved equal unless otherwise noted.
- B. All diffusers, grilles, and registers shall have a maximum NC level of 25 in the space for the specified airflow, and shall have factory applied white baked enamel finish. Where indicated on drawings to be field painted, white factory finish shall be as necessary to receive field finish painting.
- C. Lay-In Supply Air Diffusers: Shall be aluminum or aluminized steel construction, fixed flat panel face, 4-way blow, panel border to drop in 24" x 24" "T" bar ceiling grid, formed backpan, and high induction inner core assembly. Diffusers shall be Metal Aire Series Phenomenator or approved equal.
- D. Regular Ceiling Supply Air Diffusers: Shall be aluminum or aluminized steel construction square, fixed flat panel face, 4-way blow, panel border, formed backpan, high induction inner core assembly, and opposed blade damper. Diffusers shall be Metal Aire Series Phenomenator or approved equal.
- E. Sidewall Supply Air Grilles and Registers: Shall be aluminum with adjustable front vertical and back horizontal airfoil vanes on 2/3" centers. Registers shall have opposed blade dampers.
- F. Spiral Duct Linear Slot Supply Air Diffuser: Shall be extruded aluminum with curved frame for mounting in round spiral ductwork via concealed mounting yoke. Coordinate curvature radius dimension with actual spiral ductwork diameter size. Quantity, width, and length of slots shall be as defined on the Schedule on the drawings. Diffusers shall include inverted T extruded aluminum controllers for adjusting air pattern and air volume.
- G. Lay-in Ceiling Return Air Grilles: Shall be aluminum 1/2" x 1/2" egg crate with removable face and channel for 1" filter, aluminum frame, and designed to lay in an inverted "T" bar ceiling grid. Grilles shall be full flow across the entire face of grille and tapered up to neck size.
- H. Ceiling Return Air Registers: Shall be aluminum 1/2" x 1/2" egg crate with removable face and channel for 1" filter, aluminum frame and opposed blade dampers. Registers shall be full flow across the entire face of register and tapered up to neck size.
- I. Side Wall Return Air Grilles and Registers: Shall be aluminum with fixed 40° horizontal face bars. Face bars shall be 1/8" thick with rounded edges. Face shall be hinged with channel for 1" filter. Registers shall have opposed blade dampers.
- J. Exhaust Registers: Shall be aluminum construction with fixed blades on 1/2" centers set at 35° angles and opposed blade dampers.

230511 CONTROLS

- A. See Sections 230913, 230923, and 230993.

230512 FIRE, MANUAL, AND MOTORIZED DAMPERS

- A. Fire dampers shall be provided in the duct systems in accordance with NFPA Standard No. 90A and shall conform to NFPA Standard No. 90A for materials and workmanship. The dampers shall be spring loaded dynamic rated multi-leaf type UL approved and labeled for installation into the rated assembly (a 1-1/2 hour damper for a 2 hour rated assembly and two 3 hour dampers for a 4 hour rated assembly) and shall be installed according to the manufacturer's recommendations. Dampers shall be Ruskin, Pottorff, Prefco, Air Balance, United Enertech, or approved equal.
- B. Manual and Motorized dampers shall be low leakage type provided in the duct systems as indicated on the drawings in accordance with NFPA Standard No. 90A and shall conform to NFPA Standard No. 90A for materials and workmanship. Blades shall have extruded vinyl double edge seals. Jambs shall have flexible metal compression type seals. Maximum damper leakage at 1.0 in w.g. shall be 10 cfm/sf of damper area for motorized dampers. For manual dampers, maximum damper leakage at 1.0 in w.g. shall be 40 cfm/sf of damper area for dampers smaller than 24 inches in either dimension, and shall be 20 cfm/sf for larger manual dampers. Leakage ratings shall be when tested in accordance with AMCA Standard 500. The dampers shall have electric operators and shall be normally closed. Wiring to operators shall be by the Heating and Air Conditioning Contractor. To facilitate service access and insulation installation, manual damper handles shall be on 2" stand-off brackets. Handles shall be spray painted red. Dampers shall be installed according to the manufacturer's recommendations. Dampers shall be Ruskin, Pottorff, Prefco, Air Balance, United Enertech, or approved equal.

230513 ACCESS DOORS

- A. Access doors shall be provided for access to all fire and motorized dampers, duct mounted smoke detectors, and duct systems.
- B. Duct mounted access doors shall be constructed of No. 22 US gauge zinc-coated sheet steel and shall be gasketed, air tight and provided with not less than two (2) cam-type latches. Doors shall be square and shall be 12" x 12" or two inches less than the height of the duct. Doors shall be two-piece with 1" rigid insulation between the metal sides. Doors shall have engraved plastic laminated labels with 1/2" tall letters indicating item accessed through door.
- C. Wall and ceiling access doors shall be provided as specified in Section 083113.
- D. Provide 3/4" diameter red dot on ceiling grid below all duct access doors.
- E. Provide laminated schedule in Mechanical Room(s) with item accessed, item location, and area served indicated in schedule.

230514 ELECTRICAL

- A. Electrical circuit sizes are based on capacities of the drawings and it shall be the responsibility of Heating and Air Conditioning Contractor to change any and all electrical work in order to fit mechanical equipment. Heating and Air Conditioning Contractor shall coordinate with Electrical Contractor to assure that all units are properly connected and shall check wiring prior to starting units. Any damage to units resulting from improper wiring or connections shall be the responsibility of Heating and Air Conditioning Contractor. Flexible electrical conduits shall be 18 inches in length maximum. All electrical work shall be installed in accordance with codes having jurisdiction and the Electrical Division, Division 26, of these specifications.

1. Heating and Air Conditioning Contractor shall provide means at each new unit for fire alarm shutdown of equipment whether or not equipment is in auto or manual mode of operation. Wiring from fire alarm system will be by the Electrical Contractor. Power wiring to equipment shall be through the starter.

230515 DUCTWORK

- A. Mechanical drawings are schematic only and do not show all offsets etc. required. Heating and Air Conditioning Contractor shall familiarize himself with the complete contract documents and site conditions before fabricating ductwork. Any changes to ductwork found necessary to accommodate the conditions at the building shall be made without additional cost to the Owner, and as directed by the Engineer.
- B. During construction, interior of ductwork shall be protected. All open ends of ductwork shall be covered with self-adhesive 3 mil polyethylene film.
- C. Ductwork shall be of galvanized steel with standard gauges and construction in accordance with the recommendations of SMACNA HVAC Duct Construction Standards, Metal and Flexible, Third Addition, 2005 for appropriate pressure class. Elbows shall be long radius type or have airfoil turning vanes with 1-1/8" spacing and rail support system in all 90° square throat elbows. Ductwork shall be cross broken on all sides and shall be supported at both ends of each joint and at 10'-0" intervals maximum with galvanized angles supported by galvanized threaded rods of sizes and spacing in accordance with SMACNA. Ductwork to be exposed shall be constructed in a first class, neat, professional manner and exposed ductwork with excessive hammer marks shall be replaced. Round supply takeoffs from trunk ducts shall be made with factory 45° entry branch rectangular to round type fittings. Provide dampers in takeoff fittings where indicated on drawings. Damper handles shall be on 2" stand-off brackets. Handles shall be spray painted red. Splitter dampers shall be provided where indicated with adjustment quadrant locking device and shall be constructed of two thicknesses of 24-gauge-galvanized steel. All dimensions on the drawings are free inside dimensions. All components of the air distribution system shall be mechanically fastened with at least three equally spaced sheet metal screws with screws not more than on 12" centers. All duct joints shall be sealed in accordance with SMACNA Seal Class A before insulation is applied. All sealants shall meet the provisions of UL181. Sealant shall be Sonolastic NP1.
- D. Final 8'-0" of the runout to the air outlet may be factory fabricated flexible ducts complying with NFPA Standard No. 90A, UL 181, and shall be UL Class 1 R-6 insulated type with foil vapor barrier. The flexible duct shall be air tight for factory test when bent to full recommended radius and under not less than 10" water gauge internal pressure and shall be limited to 8'-0" maximum length. Flexible ducts shall be supported by galvanized steel straps in accordance with SMACNA at intervals not exceeding 4'-0" and at each change of direction. Flexible ducts shall have a minimum of one support.
- E. Spiral ductwork shall be round spiral lockseam with gauges per SMACNA, flanged joints, paint-grip finish to receive painting by the General Contractor, double wall, and internally insulated at the factory. Inner wall shall be perforated. Provide factory angle trim ring at wall penetrations. Duct shall be fastened using sheetmetal screws only and no duct tape. Dents in ductwork will not be acceptable and ductwork shall be replaced by the Heating and Air Conditioning Contractor. Diffuser, register, and grille openings shall be double wall internally insulated and made at the factory ready for the air distribution device.

230516 PIPING

- A. The Heating and Air Conditioning Contractor shall furnish all piping and supports necessary to provide a complete system as shown or intended by the plans and specifications. All piping

shall be inspected, tested, and approved before being insulated or concealed. Piping 2" and smaller shall be welded or have screwed fittings with extra heavy nipples, unless otherwise noted. Piping 2-1/2" and larger shall have welded fittings of the same material and weight as the piping in which they are installed. Pipe shall be clean, run generally parallel to the building and have all open ends closed with iron caps at all times. Eccentric reducers shall be used in horizontal runs and concentric reducers in vertical runs. All piping and fittings shall have manufacturer's identification and ASTM designation incorporated thereon.

- B. Drain pan condensate and pumped condensate piping above slab shall be Type M copper with all joints soldered with 95-5 solder where interior. Piping shall have dielectric union at connection to ferrous pipe. On building's exterior, condensate piping shall be Schedule 40 PVC with solvent cemented joints. Drain pan condensate piping shall have a minimum slope of 1/4" per linear foot, and shall be at least as large as unit condensate connection.
- C. Refrigerant piping shall be capped and dehydrated Type "L" hard drawn copper with wrought fittings. All joints shall be brazed with silver brazing alloys according to manufacturer's published recommendations.
- D. Welding material and labor shall be in accordance with welding procedures of the American Standards Code for Pressure Piping ASA B31.9. Welders shall be fully qualified in above specified procedure, tested, and so certified by an approved Welding Bureau of Locally Recognized Testing Authority. Welding shall be electric arc or oxyacetylene welding method as approved using electrodes and rods that comply with ASTM specifications.
- E. Swing joints or loops shall be provided wherever necessary to allow for expansion of piping. Broken piping or fittings shall be removed and replaced at the Heating and Air Conditioning Contractor's expense.

230517 PIPE HANGERS

- A. All piping shall be neatly and securely supported by hangers from fire resistance rated structural elements of the building spaced in the following manner:
 - 1. Steel Piping 1-1/4" and smaller - 7'-0" O.C.
 - 2. Steel Piping 1-1/2" and larger - 10'-0" O.C.
 - 3. Copper Piping 1-1/4" and smaller - 6'-0" O.C.
 - 4. Copper Piping 1-1/2" and larger - 10'-0" O.C.
 - 5. PVC Piping - 4'-0" O.C.
 - 6. Provide 2 hangers at each change in direction.
- B. Hangers shall be the Clevis type as manufactured by Modern Fig. 590, B-Line Fig. B 3100, or Grinnell Fig. 260 complete with hanger rods of size to conform to the type of hanger and pipe supported. Hangers shall be attached to the building by beam clamps or bolted to bar joist. At hangers provide 16" long 16 gauge galvanized sheet metal protection saddle three times the nominal pipe diameter. Under no condition shall hangers be connected directly to insulated pipe. Saddles shall be Modern Type A, B-Line Fig. B 3151, or Grinnell Fig. 167.
- C. Hangers for vertical piping shall be riser clamp design as manufactured by Modern Fig. 500, B-Line Fig. B3373 or Grinnell Fig. 261. Riser clamps shall be installed on top of each floor penetration.
- D. Condensate and refrigerant piping on roof shall be supported by EPDM rubber bases with integral pipe securement. Support shall be OMG PGM, PGS, PGTS -BK or approved equal. Walk pads under each support shall be appropriate for roof per roof's warranty requirements.

230518 INSULATION

- A. All piping and ductwork shall be inspected and tested before insulation is applied. All insulation shall meet UL 723 and ASTM-E84 flame spread and smoke developed requirements of 25/50 and shall comply with NFPA 90A and the latest edition of the NC Building Code. Insulation shall be Certainteed, Owen Corning, Knauf, and Johns-Manville.
- B. All air conditioning supply, return, relief/exhaust, and outside air ducts concealed above a ceiling and the back of all diffusers and grilles shall be externally insulated with 2" thick 1 lb. density foil scrim kraft jacketed insulation. Adhere insulation to duct with fire retardant adhesive in sufficient quantities to prevent sagging. Ducts with a width over 30" shall be further secured on all sides with mechanical fasteners on 18" maximum centers. Insulation shall be butted with facing overlapping all joints at least 2" and sealed with fire retardant vapor barrier adhesive. Tape all joints, breaks, punctures, and any penetrations with SMACNA foil faced kraft duct tape.
- C. Where externally insulated ductwork is supported by angles, provide 6" long x duct width x 1-1/2" thick 6.0 pound density board insulation on bottom of duct at hanger support. External duct insulation shall be continuous around ductwork and board insulation at duct hanger. On round ducts, duct hanger shall be outside duct insulation.
- D. Air handling unit drain pan condensate piping on interior, pumped condensate piping, make-up water piping, and all refrigerant piping shall be insulated with tubular closed cell elastomeric insulation with all joints butted and cemented tight. Insulation shall have two coats of exterior protective coating on all insulation exposed on exterior. Insulation on make-up water piping and interior condensate piping shall be 1" thick. Insulation on refrigerant piping shall be 1-1/2" thick.

230519 SPECIALTIES

- A. Floor, wall and ceiling plates or escutcheons of size to fit pipe covering shall be installed where pipes pass thru finished areas and shall be chromium plated spring type as manufactured by Kenney, Connecticut Stamping and Bending Company, Dearborne or approved equal.
- B. Unions or flanges shall be provided throughout the piping system to facilitate the removal and servicing of all valves, equipment, items, etc.

230520 VIBRATION ISOLATION

- A. Pad type isolators shall be 3/4" thick bridge bearing quality neoprene ribbed or waffled on both sides. Pads shall be selected for a maximum durometer of 50 and designed for 15% deflection. Where required, steel load-spreading plates shall be incorporated between the equipment and the neoprene pad.
- B. Flexible duct connections, both at inlet and discharge of units, shall be made of 30 oz. working glass fiber coated with neoprene, sewn together at edges and joints. These flexible connections shall withstand the operating air-pressure, shall not permit air leakage, and shall not transmit vibration.

230521 OPENINGS

- A. The Heating and Air Conditioning Contractor shall furnish all blockouts, sleeves, and openings required for his work. Pipe sleeves, where firestop penetration system allows, shall be standard weight black steel pipe and shall be provided where pipes pass through walls and floor. Sleeves through walls shall butt flush with the wall finish and shall be of sufficient size to permit passage of pipe covering through the area where pipe is installed. Sleeves through floors shall extend 3/4" above the finished floor and sealed watertight. Any penetrations of

ducts through floor shall be curbed 3" high x 6" wide with concrete. Specifically inform the General Contractor as to the correct size and location of openings and sleeves to insure that they shall be cast in their proper location. Sleeves and duct opening frames shall be furnished and installed by the Heating and Air Conditioning Contractor. Failure to indicate such openings in time to avoid delaying the General Contractor shall result in the Heating and Air Conditioning Contractor providing all cutting and repairing at his own expense. Repairing shall include sealing tight around pipe sleeves and duct frames in a neat and professional manner and in accordance with the "Cutting and Patching" section of this specification.

- B. All penetrations in rated floors, firewalls and any other rated separations shall be protected using a through-penetration firestopping method with an "F" rating equivalent to the rating of the membrane being penetrated for particular piping materials used and membrane construction type. Floor penetrations shall additionally have a "T" rating equivalent to the rating of the floor being penetrated. Through-penetration firestop systems shall be installed and tested in accordance with ASTM E814 or UL 1479.

230522 COLOR CODING/PAINTING

- A. All exposed mechanical equipment in finished areas including ductwork, piping, hangers, etc., shall be painted the same color as the adjacent ceiling and walls by the General Contractor. Heating and Air Conditioning Contractor shall treat all items as necessary to receive paint.

230523 PIPE MARKERS

- A. Markers shall have wording, wording colors, and wording background in accordance with ANSI A13.1. Markers shall have letters approximately 1" high on appropriate background, flow arrows, and shall be located on the pipe at intervals not exceeding 10'-0" where in mechanical spaces and 25'-0" intervals where above ceilings. Markers shall be plastic with markers on piping completely encircling the pipe with overlap and permanent tension in the marker to grip the pipe firmly with the need of adhesives. Provide markers on all piping in the building. Wording of markers shall be as follows:
 - 1. Refrigerant.
 - 2. Condensate.

230524 NAMEPLATES

- A. All new and existing packaged gas/electric air conditioning units, DOAS units, split systems, heaters, and power ventilators shall be furnished with engraved plastic laminated labels permanently attached to the equipment. Lettering shall be ½" tall. Label shall include equipment number, area served, final acceptance date, number and size of filters, number and size of belts, and capacities. Final acceptance date shall be on a separate label so as to allow equipment nameplates to be installed prior to final acceptance.
- B. Provide engraved plastic laminated or plastic tape label on ceiling grid below power ventilators located above ceilings. Label text shall match the piece of equipment's identifier/symbol noted on the drawings.
- C. Provide master list for all new and existing HVAC equipment:
 - 1. Equipment listing shall be identified with same mark and number as on the drawings.
 - 2. Listing shall include location of equipment by room number.
 - 3. Listing shall include area served by each piece of equipment.
 - 4. Listing shall include size, quantity, and location of filters for each piece of equipment.

5. Include in listing schedule for access doors with item accessed, item location, and area served indicated in schedule, see Article 230513 Access Doors.
6. Provide drawing showing equipment and location on roof plan(s) and separate plan(s) with rooms, including room names and numbers.
7. List and drawings shall be printed single-sided and shall be laminated.
8. Install listing and drawings in main Mechanical Room(s).

230525 CUTTING AND PATCHING

- A. The Heating and Air Conditioning Contractor shall do all cutting and patching necessary to install all equipment as required under his contract in accordance with the General Conditions of these specifications and shall re-establish all finishes where cutting and patching occur to their original condition. All cutting of the structure, where unavoidable, must be approved by the Engineer and be done by the General Contractor, but shall be paid for by the Heating and Air Conditioning Contractor.

230526 SEISMIC RESTRAINTS

- A. The Heating and Air Conditioning Contractor shall be responsible for providing restraints to resist the earthquake effects on mechanical system components per the requirements found in Section 1613 of the North Carolina Building Code. All tables and references shall conform to building's location. Restraints shall be per Seismic Design Category C. Coordinate all requirements with the Structural documents for this project.
- B. The Heating and Air Conditioning Contractor shall refer to the latest edition of the "Seismic Restraints Manual Guidelines for Mechanical Systems" published by SMACNA for guidelines to determine the correct restraints for sheet metal ducts, piping and conduit, etc. This manual refers to Seismic Hazard Level (SHL).
- C. The anchorage of the equipment and machinery for this project shall be an integral part of the design and specification of such equipment and machinery. Manufacturers of all equipment including unit ventilators, chiller, air handling units, pumps, boilers, tanks, compressors, etc. shall provide anchorage details, isolators, seismic mounts and restraints, etc. necessary to comply with Section 1613 to the Heating and Air Conditioning Contractor for installation. It shall be the Heating and Air Conditioning Contractor's responsibility to provide and install the equipment, machinery, systems, and assemblies, etc. for this project that satisfy these requirements. Where seismic restraints are required, the Heating and Air Conditioning Contractor shall provide restraints per details and instructions included in SMACNA's Seismic Restraints Manual. The Heating and Air Conditioning Contractor shall include shop drawings of the specific methods of seismic restraint to be used for this project before installation of piping, ductwork, and equipment.
- D. The Heating and Air Conditioning Contractor shall retain the services of a Professional Engineer registered in the State of North Carolina to design seismic restraint elements required for this project. The Engineer's computations, bearing his professional seal, shall accompany shop drawings that show Code compliance including certification that the seismic system components comply with the testing requirements of North Carolina Building Code Chapter 17. Computations and shop drawings shall be submitted for review prior to the purchasing of materials, equipment, systems, and assemblies.
- E. Internal seismic restraint elements of manufactured equipment shall be certified by a professional engineer retained by the manufacturer. Such certificate applies only to internal elements of the equipment. All equipment anchorage requirements shall be coordinated with

the building structure and shall be compatible thereto. All such anchorage shall be reviewed by the project's structural engineer.

- F. The Professional Engineer retained by the Heating and Air Conditioning Contractor for seismic restraint calculations shall visit the job site as necessary to comply with the Special Inspections requirement of the Code. This engineer shall provide in writing verification of compliance of the installation with the approved seismic submittal. This verification shall be submitted as a Special Inspections Report and shall bear the Engineer's professional seal. Job site inspections by other than this engineer are not acceptable.
- G. Review of the seismic design and shop drawings by the Engineer/Architect or his agent shall not relieve the Heating and Air Conditioning Contractor of his responsibility to comply with the seismic or any other requirements of the North Carolina Building Code.

230527 PIPING PRESSURE TESTING

- A. The Heating and Air Conditioning Contractor shall make the following tests before the systems are insulated or covered by construction. The systems shall have no decrease in pressure during the test periods. All system components shall be protected from test pressures that exceed manufacturer's design limits.
- B. Notify Architect, Engineer, and Commissioning Authority 48 hours in advance of all tests.
- C. Heating and Air Conditioning Contractor shall provide written report of each test.
- D. Refrigerant piping shall be tested in accordance with Chapter 11 of the North Carolina Mechanical Code and split system unit manufacturer's recommendations.
- E. New condensate piping shall be tested by applying a hydrostatic pressure of 100-psig for a period of two hours.
- F. No caulking of joints shall be permitted. Any joint found to leak under this test shall be broken, remade, and a new test applied. Welded joint pinhole leaks shall be repaired by welding; however, welds that show numerous pinholes shall be replaced.

230528 TESTING AND BALANCING

- A. Testing and balancing of the heating, ventilating, and air conditioning systems shall be performed by an AABC certified Test and Balance Company as a subcontractor to the Heating and Air Conditioning Contractor. All instruments used shall be accurately calibrated and in good working order. The tests shall be in strict accordance to the Standards of AABC. Test and Balance Contractor shall submit TAB plan to the Engineer and Commissioning Authority for their review and approval prior to starting any TAB work.
- B. Air balance and testing shall not begin until the systems have been installed in full working order and shown to be operating satisfactory on both heating and cooling. The Contractor shall place all heating, ventilating, and air conditioning systems into full operation and shall continue operation of the system until balancing is completed. All operational cost shall be borne by the Heating and Air Conditioning Contractor. The Architect and Engineer shall be given three weeks advance notice of when tests are to be made.
- C. Upon completion of the heating, ventilating, and air conditioning systems, the Test and Balance Contractor shall compile the test data and submit four copies of the completed test data to the Engineer for evaluation and approval. At final inspection and prior to final commissioning verification, Heating and Air Conditioning Contractor shall have a copy of test and balance report and all necessary personnel and equipment to facilitate spot-checking of test and balance data by the Engineer or his representative. Final payment to the Contractor shall be withheld until the complete test and balance data has been approved.

- D. Once the Contractor certifies to the Owner that the systems are balanced, and the Engineer has approved the report and submitted it to the Owner, the Owner may have an AABC certified TAB agency (within 30 days) confirm that the systems are balanced. If the Owner's TAB agency discovers discrepancies of more than 10% than the values called for on the construction documents, the Heating and Air Conditioning Contractor shall be required to rebalance the system and the Owner's TAB agency will re-test the system. Any re-testing by the Owner's TAB agency shall be paid for by the Heating and Air Conditioning Contractor. Heating and Air Conditioning Contractor and BAS Controls Contractor shall cooperate as necessary with the TAB agency employed by the Owner and to have qualified representatives present during balancing verification.
- E. Testing Procedure (AIR):
1. Test and adjust air handling unit fan's RPM and CFM to design requirements. Record all data.
 2. Test and record motor full load amperes on all motors.
 3. Adjust all main supply, exhaust, return, relief, and outside air ducts to proper design CFM when air handling systems are in normal operating mode, DCV mode, and in outside air economizer mode. Record exhaust, relief, and outside air data.
 4. Test and adjust each diffuser, grille, and register for supply, exhaust, or return systems to within 10% of design requirements. Record all data.
 5. All adjustments to air diffusing devices where possible shall be made in trunk or run out dampers, not at diffuser volume control.
 6. Exhaust fans shall be tested and balanced for the requirement as shown on the plans. Record all data.
 7. The Heating and Air Conditioning Contractor shall make any changes in the pulleys, belts, filters, dampers, or valves necessary or as recommended by the Engineer for correct balance at no additional cost to the Owner.

230529 INSTRUCTIONS/TRAINING

- A. The Heating and Air Conditioning Contractor shall give an instruction and training period in the operation of the apparatus to the persons who will be in charge of the system. See Section 017900 for listing and training requirements.

230530 MAINTENANCE DATA

- A. For all new or renovated items requiring maintenance, the Heating and Air Conditioning Contractor shall furnish two weeks prior to Final Acceptance and deliver to the Owner's representative on the job multiple copies of complete data as prepared by the manufacturer covering the details of operation and maintenance and complete parts list for all equipment specified. Each copy of the maintenance data shall be assembled into a 3-ring hardback binder with indexing and label on cover and spine. Data shall include:
1. Index with page numbers.
 2. List of all subcontractors and suppliers with names, addresses, and phone numbers.
 3. Contractor's certificate of Final Acceptance.
 4. Copy of all warranties.
 5. Equipment model numbers, etc. indicated and referenced with the same mark as shown on equipment on the drawings.

6. Filter schedules of sizes and quantities for all equipment requiring filters referenced by mark on the drawings.
7. Equipment summary showing all capacities and ratings.
8. Certified test and balance report.
9. Start-up and test reports for equipment.
10. Complete start-up, operation, and shut-down procedures for each system.
11. Lubrication schedules and types of lubricates.
12. All submittal data and shop drawings, unless included in a separate manual.
13. See Section 017823 for additional requirements.

230531 RECORD DRAWINGS

- A. In accordance with Section 017839 Project Record documents, the Heating and Air Conditioning Contractor shall maintain “during the course of the work” a set of specifications and drawings marked up to show the work as installed, **including a minimum of two dimensions to indicate locations and elevations of buried work**. Upon completion of the work, return this set of drawings to the Architect.

230532 GUARANTEE

- A. The Heating and Air Conditioning Contractor shall guarantee the entire heating and air conditioning system subject to the General Conditions of these specifications, two-years for entire system, except where additional or extended warranty requirements are noted elsewhere in the articles within Section 230500.

END OF SECTION

SECTION 230913

INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

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 the work of this section.
- B. Section 230923, which specifies the DDC system that utilizes sensors, devices, actuators, and final control elements specified in this section.

1.2 SUBMITTALS

- A. General: Submittals shall demonstrate compliance with technical requirements by reference to each subsection of this specification. Where a submitted item does not comply fully with each and every requirement of the Specifications, the submittal shall clearly indicate such deviations. Identification requirements for non-complying features of items are very specific.
- B. Manufacturer's Data: Submit manufacturer's technical product data and installation instructions for all components including the following to demonstrate compliance with the contract documents:
 - 1. Catalog cut sheets of all equipment used. This includes, but is not limited to sensors, actuators, valves, and dampers.
 - 2. Catalog cut sheets of air measuring stations used for the volumetric control system. Include as a separate volumetric control section velocity transmitters, static pressure transmitters, and flow chart for sequence of operation.
 - 3. Control air supply components, and sizing computations for compressors, receivers and main air piping.
- C. Operation and Maintenance (O/M) Manuals: O/M manuals shall include the following, at a minimum, elements:
 - 1. General description and specifications for all sensors and final control elements.
 - 2. Complete troubleshooting procedures and guidelines for all sensors and final control elements.
 - 3. Documentation of all required maintenance and repair/replacement procedures.

PART 2 -PRODUCTS

2.1 ELECTRONIC SENSORS

- A. General: Provide all remote sensors and instrumentation as required for the control system. All sensors shall have accuracies as stated hereinafter. Electronic sensors shall include integral transmitter and provide input analog input signal as either 4-20 mA or 0-10 VDC over the full range specified below.
- B. Sensor Accuracy and Range: Each sensor, as hereinafter specified, shall have accuracy and range as follows:

Sensed/Measured Variable	Sensor Characteristics Required	
	Measurement Accuracy	Range
Space Temperature	±1°F	+50°F- +85°F
Outside Air Temperature	±2°F	-30°F- +130°F
Relative Humidity (indoor air)	±5% RH	20% - 80% RH
Relative Humidity (outdoor air)	±2% RH	10% - 95% RH
Ducted Air Temperature	±1°F	+40°F- +140°F
Airflow (terminal)	±10% of full scale	
Airflow (duct measuring stations)	±5% of full scale	
Airflow (fan total)	±5% of full scale	
Air Pressure (ducts)	±0.1 in. w.g.	0 - 5.0 in. w.g.
Air Pressure (space)	±0.01 in. w.g.	-0.25 - 0.25 in. w.g.

1. Temperature Sensors:
2. Space Sensors: Space sensors shall RTD type with integral transmitter within wall-mounted enclosures with blank covers and no temperature display. No setpoint adjustment by occupants shall be provided **unless specifically indicated on the Drawings**. Where setpoint adjustment is required, range of adjustment shall be limited to +/- 2 deg F from setpoint defined by control sequences.
3. Duct- or Plenum-Mounted Dry Bulb Sensors:
 - a. Sensors located within AHUs or ductwork/plenums attached thereto and used as part of a temperature control sequence shall be RTD type averaging sensors with integral transmitter and a sensing element incorporated in a copper capillary with a minimum length to provide 1 ft of capillary per square foot of airflow area. Where the airflow area exceeds 20 sf, provide multiple sensors and average inputs from sensors as AI point.
 - b. Sensors located within BCUs, FCUs, or TUs or in ductwork/plenums attached thereto and used only for temperature monitoring, shall be one of the two following types, as applicable:
 - 1) When airflow area is 2 sf or less, provide probe type 10k ohm NTC, Type II or Type III, thermistor sensor with all metal enclosure that includes mounting bracket with insulation stand-offs, as required. Probe shall be 1/4" diameter, stainless steel construction, and have length sufficient to monitor at least 60% of the dimension in the plane of installation.
 - 2) When airflow area exceeds 2 sf, provide averaging type 10k ohm NTC, Type II or Type III, thermistor sensor with all metal enclosure that includes mounting bracket with insulation stand-offs, as required. Capillary shall be of sufficient length to provide 1 ft of capillary per square foot of airflow area and capillary brackets shall be included.

4. Duct-Mounted Dew Point Sensors: Provide sensor/transmitters designed for duct installation to provide both dewpoint and dry bulb temperature output. Sensors shall incorporate both an RH sensor and an RTD temperature sensor, with a microprocessor that computes the dew point temperature. Humidity sensor shall utilize a platinum or ceramic capacitive sensing element that is impervious to damage by (1) humidity levels exceeding 95% RH and (2) wetting by surface condensation. Measurement range shall be 10 - 95% RH within a temperature range of 40°F to 140°F. Provide a linear 4-20mA output signal for dewpoint temperature and a 4-20 mA output signal for dry bulb temperature. Sensor shall be Vaisala Model HMS82TD or equivalent.
- C. Indoor Air Relative Humidity Sensors: Analog type with polymer element for comfort conditions monitoring and platinum element for critical areas including laboratories, hospital procedure rooms, etc. Space sensors shall have blank covers and no humidity display and no setpoint adjustment unless specifically indicated on the drawings. Duct sensors shall meet the requirements specified below for outdoor relative humidity sensors.
- D. Outdoor Air Relative Humidity Sensors: Relative humidity sensors installed outdoors or in HVAC ductwork shall utilize a ceramic capacitive sensing element that is impervious to damage by (1) humidity levels exceeding 95% RH and (2) wetting by rain or surface condensation. Measurement range shall be 10 - 95% RH within a temperature range of -40°F to 140°F. Sensors installed in outdoors shall include a weatherproof enclosure and have dip switches to select sensor analog output signal as 4-20 mA or 0-10 VDC.
- E. Occupancy/Vacancy Sensor: Sensor shall be passive infrared type with daylight sensor lockout and manual adjustments for time-on delay and sensitivity. Sensor shall have 180-degree field of view with vertical sensing adjustment. Sensor shall be designed for flush mounting. Sensor shall be user-adjustable for the following alternative modes of operation:
 1. Occupancy Mode: Sensor shall automatically energize controlled elements when the space becomes occupied and de-energize them when the space becomes unoccupied.
 2. Vacancy Mode: Controlled elements shall be energized by manual occupant control when the space is occupied and de-energized by the sensor when the space becomes unoccupied.
- F. "Event" Occupancy Ventilation Initiation Switches: Where indicated, provide tubular key operated momentary contact ON/shunt OFF, SPST switch mounted in recessed wall receptacle box with plate to match adjacent space sensors. Switch shall have maintained OFF, springing back from ON when activated. Switch shall be Seco-Larm Model SS095 or equivalent. Provide switch label engraved "EVENT VENTILATION."
- G. Carbon Dioxide (CO₂) Sensors: Sensors shall be non-dispersive infrared (NDIR) type, ether single-lamp single-wavelength or single-lamp dual wavelength configuration, designed specifically for air diffusion measurement of CO₂ in the range of 0 to 2000 ppm. Sensors shall provide output, 0-10 VDC or 4-20 mA, in direct proportion to CO₂ concentration.
 1. Sensor accuracy shall be within +/- 60 ppm (10%) across the range of 400 to 1000 ppm at 25°C, 50%RH, and 14.7 psia air conditions.
 2. Sensor shall have test gas inlet port and be provided with manufacturer's detailed, *written* calibration procedures for using CO₂ calibration gas samples.
 3. Sensors shall be calibrated at the factory prior to shipment using a minimum of two calibration gas samples, one a 950-1050 ppm and one at either 0 ppm or 450-550 ppm, with the concentration of the calibration gas known to within +/- 2%. Provide factory sensor test/calibration reports for review by the A/E.

4. **Sensors shall *not* incorporate "automatic baseline adjustment" logic.**
5. Sensor sensitivity to atmospheric conditions shall not exceed the following:

Humidity	+/- 0.3 ppm/%RH
Temperature	+/- 0.1 ppm/°C
Pressure	+/- 5.0 ppm/ in. Hg
- H. Motor Status Sensor: Status of pumps and fans shall be proven by adjustable current sensing relays. Provide user adjustable time delays (10 seconds default) to prevent false alarms during starting/stopping of motor.
- I. Flow status of pumps and fans, 1/2 hp and larger, shall be proven by adjustable current sensing relays. Provide software resident time delays to prevent false alarms during starting/stopping, including printout and application programs.
- J. Pressure and Differential Pressure Sensors/Switches:
 1. Pressure sensing elements shall be corrosion resistant Bourdon tubes, bellows diaphragm or piezoelectric type and shall have the following features:
 - a. Adjustable high and low limits.
 - b. Suitability for operation in an ambient temperature range of 30-140 degrees F.
 - c. Accuracy within 5 percent of full scale.
 2. Pressure and differential pressure switch type units shall consist of a SPDT switch with adjustable setpoint high/low settings. Switches shall be snap action type contacts designed for the application. For switches serving as binary input to the DDC system, contacts shall be short radius gold or rhodium plated. For switches serving as an element of interlock wiring circuits, contacts shall be rated suitable for the load. Switch type units shall operate automatically and, unless indicated to have manual reset, reset automatically when conditions return to normal.
 3. Pressure and differential pressure sensors:
 - a. Air differential pressure sensors shall be rated for up to 12" WG high pressure; direct acting linear output 4 to 20 mA.
 - b. Pressure sensors for gas, liquid, or steam service shall be direct acting; range suitable for system; linear output 4 to 20 mA.
- K. Fan Inlet Airflow Measuring Station:
 1. Airflow monitoring device is integral within the inlet cone of centrifugal fans or inlet bell of tubeaxial/vaneaxial fans where indicated on the Drawings. Air monitoring device shall communicate to the DDC.
- L. Condensate Level Sensor: Provide a plenum-rated water level detection device, conforming to UL 508, consisting of one or more moisture sensors and a NC dry contact to serve as a binary input point connected to the building control system to disable mechanical cooling and initiate an alarm in the event the condensate drain is blocked. Device shall include adjustable 1-3 minute time delay before opening to reduce short term nuisance shutdowns. Device shall be mounted on the unit, with remote sensor(s) installed in the equipment's factory-installed primary drain pan, located at a point higher than the pan's primary drain line connection and below the overflow rim of the pan. Sensor(s) shall be retained by clips and/or adhesive tape.
 1. Exceptions:

- a. Where the primary drain pan is too shallow or otherwise designed so that sensor(s) cannot be located as required, a drain pan overflow sensor, installed in the pan's secondary drain line connection, may be used.
- b. Where an auxiliary drain pan is required, as indicated on the Drawings, provide water level detection device with sensor(s) installed at the lowest possible level in the auxiliary drain pan.

2.2 UTILITIES MONITORING

- A. Electrical Power Monitoring: Where available, facility electrical energy consumption information should be obtained via pulse output from utility-owned kWh meter. Where utility metering is unavailable or for required sub-metering, provide electrical power monitoring where indicated on the Drawings, as follows:
 1. Current sensing: Current transformers, coupled with a current transmitter, shall be used to provide an output directly proportional to the current amperage:
 - a. Current transformers shall be split core type, UL/CSA Recognized, and completely encased in non-conductive material. Select transformer to provide appropriate current ratio with 99% accuracy at 5 A full-scale output.
 - b. Current transmitters shall be self-powered with built-in rectifier and high-gain servo amplifier with 4-20 mA two-wire output. Unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A full scale, with internal zero and span adjustment and 99% full-scale accuracy at 500 ohm maximum burden. Unit shall meet ANSI/ISA S50.1 requirements and be UL listed.
 2. Voltage Sensing: Voltage transformers, coupled with a voltage transmitter, shall be used to provide an output directly proportional to the voltage:
 - a. Voltage transformers shall be totally enclosed, UL/CSA Recognized, 600 VAC rated, and complete with built-in fuse protection. Units shall be 99.5% accurate over full scale at 24 VAC and a 5 VA load.
 - b. Voltage transmitters shall be self-powered single-loop (two wire) type, 4-20 mA output with zero and span adjustment. Ranges shall include 100-130 VAC, 200-250 VAC, 250-330 VAC, and 400-600 VAC full scale with 99% accuracy with 500 ohm maximum burden. Units shall be UL listed, 600 VAC rated, and meet ANSI/ISA S50-1 requirements.
 3. Power Monitoring: Units shall be three-phase type furnished with three-phase disconnect/shorting switch assembly, UL listed voltage transformers, and UL listed split core current transformers. Provide selectable rate pulse output for kWh reading and a 4-20 mA output for kW reading. Monitors shall operate with 5 A current input with a maximum error of 2% at 1.0 power factor or 2.5% at 0.5 power factor.
- B. Natural/Propane Gas Flow Monitoring: Where available, facility gas consumption information shall be obtained via pulse output from utility-owned gas meter. Where pulse output from existing utility-owned meter is not available or for required sub-metering, provide inline diaphragm type gas meter where indicated on the Drawings, as follows:
 1. Meter accuracy shall be rated within +/- 2.0% of full flow.
 2. Support one of the two following methods to communicate flow rate to the DDC system:

- a. Pulse output at 50ms or slower in direct proportion to gas flow in cubic feet for interface to facility direct digital control system for flow monitoring and totalization.
- b. Analog output consisting of 0-10 VDC or 4-20 ma signal in direct proportion to gas flow rate in cubic feet for interface to facility direct digital control system for flow monitoring and totalization.

2.3 ELECTRIC CONTROLS ELEMENTS

- A. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.
- B. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.
 1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.
- C. Selector Switch: Integral, manual on-off-auto.
- D. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature; with copper capillary and bulb, unless otherwise indicated.
- E. Bulbs in water lines with separate wells of same material as bulb.
 1. Bulbs in air ducts with flanges and shields.
 2. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit; adequately supported.
 3. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
 4. On-Off Thermostat: With precision snap switches and with electrical ratings required by application.
 5. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.
- F. Hydronic Surface-Mounted Thermostat ("Aquastat"): Snap-acting, single-pole, single-throw, auto-reset switch that opens if temperature rises above adjustable high temperature setpoint or falls below adjustable low temperature setpoint, as indicated by the application.
- G. Electric, Low-Limit Duct Thermostat ("Freezestat"): Snap-acting, single-pole, single-throw, manual-reset switch that opens if temperature sensed across any 12 inches of bulb length is equal to or below set point of 40°F.
 1. Bulb Length: Minimum 20 feet.
 2. Quantity: One thermostat for every 20 sq. ft. of coil surface.
- H. Where multiple low-limit thermostats are required, they shall be wired in series so that any one thermostat will result in the system shutdown as indicated on the Drawings.

- I. Electric, High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual-reset switch that opens if temperature sensed across any 12 inches of bulb length is equal to or above set point.
 - 1. Bulb Length: Minimum 20 feet.
 - 2. Quantity: One thermostat for every 20 sq. ft. of coil surface.
 - J. Where multiple high limit thermostats are required, they shall be wired in series so that any one thermostat will result in the system shutdown as indicated on the Drawings.
 - K. Twist Timers: 0 to 2 hour timer without hold.
- 2.4 FINAL CONTROL ELEMENTS AND OPERATORS
- A. Control Dampers:
 - 1. Provide dampers with parallel blades for 2-position control, opposed blades for modulating control.
 - a. Outdoor Air Dampers: Dampers shall be constructed for coastal environment (salt water) corrosion resistance of Type 316 stainless steel (blades, frame, shafts, and linkage) or aluminum with clear anodized finish (blades and frame) with Type 316 stainless steel shafts and linkage. Dampers shall be rated Leakage Class I at 250-deg F according to ANSI/AMCA 500-D. When flow velocity is less than 2000 fpm, blades may be single thickness or airfoil type. When the flow velocity exceeds 2000 fpm, blades shall be airfoil type.
 - b. Return, Relief, Exhaust Air Dampers: Dampers shall be constructed of 0.108-inch-minimum thick G90 galvanized steel or 0.125-inch-minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch-thick steel with maximum blade width of 8 inches and maximum length of 48 inches. Secure blades to 1/2-inch-diameter axles with oil-impregnated sintered bronze blade bearings, blade-linkage hardware, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of each blade. Dampers shall be constructed with zinc-plated shafts and hardware exposed to the airstream.
 - c. Operating Temperature Range: From minus 40 to plus 250 deg F.
 - d. Edge Seals: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for Leakage Class I according to ANSI/AMCA 500-D.
 - 2. Damper Sizing:
 - a. Two-position dampers shall be sized to match duct or opening size, as applicable.
 - b. Modulating dampers utilized as part of an airside economizer cycle shall be sized in accordance with ASHRAE *Guideline 16*.
 - B. Damper Operator/Actuators: Unless indicated otherwise on the Drawings, all actuators shall have fail-safe operation via a mechanical, spring-return mechanism. Provide external, manual gear release on non-spring-return actuators.
 - 1. Electronic Damper Operator/Actuator: Shall be direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque. For dampers, size actuator for running torque calculated as follows:
 - a. Parallel-Blade Dampers: 7 inch-lb/sq. ft. of damper.

- b. Opposed-Blade Dampers: 5 inch-lb/sq. ft. of damper.
 - c. Dampers with Face Velocities exceeding 1000 fpm: Increase running torque by 2.0.
- 2. Couplings shall be V-bolt and V-shaped, with toothed cradle.
- 3. Provide electronic overload or digital rotation-sensing circuitry.
- 4. Actuator shall operate with proportional input signal of 2-V to 10-V dc or 4 to 20 mA
- 5. Rated temperature operating range for actuators shall be -20 deg F to +120 deg F for conventional applications and -20 to +250 deg F for smoke or fire/smoke damper application.
- 6. Actuator shall have the following operational characteristics:
 - a. Actuator full stroke time requirement shall not exceed 12 seconds to open or 5 seconds to close when applied to control smoke dampers or cooling tower bypass valves less than 6" NPS.
 - b. Actuator full stroke time requirement shall not exceed 30 seconds to open or close when applied to control cooling tower bypass valves 6" NPS or large size.
- 7. Electric Two-Position Damper Operator/Actuator: Provide a bi-directional, 120-V operator with spring return, size actuator for running torque calculated as follows:
 - a. Parallel-Blade Dampers: 7 inch-lb/sq. ft. of damper.
 - b. Opposed-Blade Dampers: 5 inch-lb/sq. ft. of damper.
 - c. Dampers with Face Velocities exceeding 1000 fpm: Increase running torque by 2.0.
- 8. Position Indicator: Actuators shall be provided with a compact, adjustable visual position indicator attached to the actuator. As a damper or valve is cycled, the position indicator shall rotate, causing a cylinder to rotate inside a second cylinder with "display windows." When the damper or valve is open, the word "OPEN" shall be displayed in the two windows located 180° apart. When the damper or valve is closed, the word "CLOSED" shall be displayed. Between the two extremes, the display shall be scaled in degrees (0-90).

PART 3 -EXECUTION

3.1 INSTALLATION

A. Sensors and Controls:

- 1. Permanently mark terminal blocks for identification. Protect all circuits to avoid interruption of service due to short-circuiting or other conditions. Line-protect all wiring that comes from external sources to the site from lightning and static electricity.
- 2. Label or code each field wire at each end. Permanently label or code each point of all field terminal strips to show the instrument or item served. Color-code cable with cable diagrams may be used to accomplish cable identification.

B. Temperature Sensors:

- 1. Install all sensors and instrumentation according to manufacturer's written instructions. Temperature sensor locations shall be readily accessible, permitting quick replacement and servicing of them without special skills and tools.

2. Low-limit thermostats ("freezestats") shall be located at an elevation at or above the top of the coil being protected and the capillary element installed in a serpentine arrangement across the face of the coil starting at the top and ending at the bottom.
 3. Mount sensors rigidly and adequately for the environment within which the sensor operates.
 4. Sensors used in mixing plenum or in air-handling unit hot and cold decks shall be of the averaging of type. Averaging sensors shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip.
 5. Pipe-mounted temperature sensors shall be installed in wells completely filled with thermal conducting material.
 6. All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor reading.
- C. Duct Pressure/Airflow Sensors/Switches:
1. Sensors shall be connected to pressure or airflow monitoring stations.
- D. Duct, Plenum, and Outdoor Air Intake Airflow Monitoring Stations.
1. Each airflow measuring station shall be installed as located and detailed on the Drawings in accordance with the manufacturer's minimum installation conditions for the indicated application and shall not amplify the sound level. **Install duct-mounted airflow monitoring stations or sensors a minimum of 5 duct diameters up stream and 8 duct diameters downstream or 6 feet, whichever is greater, from fittings and other obstructions.**
- E. Actuators:
1. Mount damper and valve actuators according to manufacturer's written instructions.
 2. Damper actuators shall be located outside of the airstream.
 3. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed position.
 4. Check operation of valve/actuator combination to confirm that actuator modulates valve smoothly in both open and closed position.
- F. Pipe Flow Meters/Sensors:
1. Install flow meters according to manufacturer's written instructions.
 2. **Mount flow meter a minimum of 5 pipe diameters up stream and 10 pipe diameters downstream or 2 feet, whichever is greater, from fittings and other obstructions.**
 3. Assure correct flow direction and alignment.
- 3.2 FIELD TEST AND INSPECTIONS
- A. Upon completion of installation of each sensor or final control element, field inspect and mechanically and electrically test for proper function.

END OF SECTION

SECTION 230923

DIRECT DIGITAL CONTROL SYSTEM FOR HVAC

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 the work of this section.
- B. Section 230913, which specifies the requirements for sensors, devices, actuators, and final control elements utilized by the DDC system.
- C. Section 230993, which specifies the required I/O points and sequences of operation for systems and components.

1.2 QUALITY ASSURANCE

- A. Single Source Responsibility of Supplier: The controls system vendor shall be responsible for the complete installation and proper operation of the control system. The vendor shall be in the regular and customary business of design, installation and service of computer-based building environmental control systems similar in size and complexity to the system specified. **The vendor shall be the manufacturer of the primary DDC system components.** The vendor must be licensed as an “unlimited electrical contractor” in the state of North Carolina, shall have a factory-certified trainer on staff, and provide 5 day per week technical support.

Acceptable vendors and DDC systems are limited to the following:

- 1. Johnson Controls, Inc. (395 North Green Meadows Drive, Wilmington, NC 28443)
“Metasys” architecture.
 - a. Exceptions:
 - 1) Controllers shall have the capability of utilizing any non-proprietary sensor and operator complying with Section 230913.
 - 2) Use of “adaptive control” algorithms for automatic PID “loop tuning” is prohibited.
 - b. See 2.1.A for requirements of new controls connecting to existing controls within the building.
- 2. Schneider Electric (2600 Perimeter Park Drive, Suite 150, Morrisville, NC 27560)
“SmartStruxure” architecture.
 - a. Exceptions:
 - 1) Controllers shall have the capability of utilizing any non-proprietary sensor and operator complying with Section 230913.
 - 2) Use of “adaptive control” algorithms for automatic PID “loop tuning” is prohibited.
 - 3) **“Sensor Link” (S-Link) sensors and communications is prohibited unless specifically approved by NHCS prior to bid.**
 - 4) Seven (7) levels of access security, in lieu of the eight (8) levels hereinafter specified is acceptable.
 - b. See 2.1.A for requirements of new controls connecting to existing controls within the building.

3. Siemens Building Technologies (215 Southport Drive, Suite 900, Morrisville, NC 27560) “Apogee” architecture with “Desigo CC” workstation software.
 - a. Exceptions:
 - 1) Controllers shall have the capability of utilizing any non-proprietary sensor and operator complying with Section 230913.
 - 2) Use of “adaptive control” algorithms for automatic PID “loop tuning” is prohibited.
 - 3) Application of “ATEC” controllers is prohibited.
 - 4) “User Licences” shall be provided as required for support full system utilization by New Hanover County Schools maintenance and operations staff. See 2.3 for additional requirements.
 - b. See 2.1.A for requirements of new controls connecting to existing controls within the building.

B. **See Section 012300 – Alternates for description of Alternate M-1, provide DDC system by Johnson Controls, Inc. as hereinbefore and hereinafter specified.**

C. Equipment and Materials: Equipment and materials shall be catalogued products of manufacturers regularly engaged in production and installation of HVAC control systems. Products shall be manufacturer's latest standard design and have been tested and proven in actual use.

1.3 GUARANTEE PERIOD SERVICES

- A. Maintenance of Control Hardware: The Contractor shall inspect, repair, replace, adjust, and calibrate, as required, the file server/workstation(s), associated peripheral equipment, and control units. The Contractor shall then furnish a report describing the status of the equipment, problem areas (if any) noticed during service work, and description of the corrective actions taken. The report shall clearly certify that all software is functioning correctly.
- B. Maintenance of Control Software: The Contractor shall maintain all software. In addition, all factory or sub-vendor upgrades to software shall be added to the systems, when they become available, at no additional cost to the Owner.
- C. Service Period: Routine system service shall be provided on a monthly basis for the first six (6) months of the guarantee period and at least every three months during the second six (6) months. Calls for service by the Owner shall be honored within 24 hours and are not to be considered as part of routine maintenance.
- D. Service Documentation: A copy of the service report associated with each routine service visit or Owner-initiated service call shall be provided to the Owner and the A-E with 10 days after the date of each service call.

1.4 SUBMITTALS

- A. General: Submittals shall demonstrate compliance with technical requirements by reference to each subsection of this specification. Where a submitted item does not **comply fully** with each and every requirement of the Specifications, the submittal shall clearly indicate such deviations.
- B. Submittals required by this sub-section, and the required dates for each submittal, shall be finalized at a pre-submittal meeting, to be scheduled within 30 days of the date of the Notice to Proceed, and shall be provided in three phases:

1. Phase I submittals shall consist of DDC engineering shop drawings, including valve and damper schedules with sizing calculations, control system schematics, and sequences of operation, including setpoints, alarm limits, and schedules; product data for all control devices required under Section 230913; DDC system hardware and software as required below; and any other submittals determined during the pre-submittal conference. **Phase I submittals must be submitted and reviewed as early in project schedule as possible to avoid delays in actual installation.**
 2. Phase II submittals shall consist of the graphic displays as required below. Phase II submittals are required at least 30 days prior to the date of the Substantial Completion inspection.
 3. Phase III submittals shall be the close-out submittals as required below. Phase III submittals are required before the date of Final Completion inspection.
- C. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
- D. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
- E. DDC System Software:
1. Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
 2. List of graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
- F. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.
- G. Shop Drawings:
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. Bill of materials of equipment indicating quantity, manufacturer, and model number.
 3. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
 4. Details of control panel faces, including controls, instruments, and labeling.
 5. Written description of sequences of operation.
 6. Schedule of dampers including size, leakage, and flow characteristics.
 7. Schedule of valves including flow characteristics.
 8. DDC System Hardware:
 - a. Wiring diagrams for control units with termination numbers.
 - b. Schematic diagrams and floor plans for field sensors and control hardware.

- c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
 - d. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
- H. Graphic Displays: Include color prints or "screen shots" of each proposed graphic display proposed, complete with clear indication of (1) static components and dynamic components and (2) "on"/"off"/"alarm" condition designation convention.
- I. Samples for Initial Selection: For each color available for each type of thermostat, sensor, etc. cover exposed to view with factory-applied color finishes.
- J. Data Communications Protocol Certificates: **Certify that each proposed DDC system component complies with ASHRAE Standard 135-2012 and is BACnet Laboratory tested and certified.**
- K. Closeout Submittals:
 - 1. Operation and Maintenance Data: Include the following:
 - a. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.
 - b. Interconnection wiring diagrams with identified and numbered system components and devices.
 - c. Keyboard illustrations and step-by-step procedures indexed for each operator function.
 - d. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
 - e. Calibration records and list of set points.
 - f. Software and Firmware Operational Documentation: Include the following:
 - 1) Software operating and upgrade manuals.
 - 2) Program Software Backup: On a magnetic media or compact disc, complete with data files.
 - 3) Device address list.
 - 4) Printout of software application and graphic screens.
 - 5) Software license.

PART 2 -PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. **Existing DDC in the building is Johnson Controls N2 system. Replace existing with new BACnet DDC system:**
 - 1. **Existing Johnson Controls NAE Metasys building controller to remain and be reused as the DDC building controller.**
 - 2. **Provide new communications bus throughout the building to connect new programmable BACnet controllers to the existing NAE building controller.**

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3. Under Base Bid, the existing N2 communications bus shall remain to maintain connection of existing JCI UNT controllers in the Gym and Locker Area to the existing NAE building controller.
 4. Under Alternates No. G-2 and M-2, extend new communications bus to connect new programmable BACnet controllers in the Gym and Locker Area to the to the existing NAE building controller.
- B. Provide a peer-to-peer networked, stand-alone, distributed processing global Direct Digital Control (DDC) System utilizing flat communications scheme. DDC system shall be BACnet MS/TP based, complying with ANSI/ASHRAE Standard 135-2012 protocol, and communicating using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
 - C. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected by a Local Area Network (LAN) to distributed processing, standalone control units (CUs) operating in a multiuser, multitasking environment and programmed to control HVAC and other systems, as shown on the Drawings.
 - D. The system shall include at least one Building Level Control Unit (BLCU) to provide interface to the Owner's file server and network located at the NHCS Maintenance Office and/or to a remote user using a standard Web browser as hereinafter specified.
 - E. DDC system shall use ANSI/ASHRAE Standard 135-2012 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol. Comply with ANSI/ASHRAE Standard 135-2012 for all controls hardware and software.
- 2.2 MAINTENANCE OFFICE FILE SERVER AND WORKSTATIONS
- A. The Owner maintains a controls systems file server, network, and client workstations located at the NHCS Maintenance Office, 2418 Carolina Beach Road, Wilmington, NC. The DDC system, through a site Building Level Control Unit as hereinafter specified, shall be connected to the Owner's wide area network (WAN) with a compatible communications interface as a client to the Owner's server. Communications between the any operator and the DDC system over the Owner's WAN shall be accomplished through either of the following:
 1. PC or laptop workstations directly connected to the WAN.
 2. Laptop, notebook, tablet, or other remote device connected to the WAN through a browser-based Internet connection using Barracuda SSL VPN Agent, a Java client that provides secure access to the WAN from remote locations.
 - B. Access to the Owner's WAN by the DDC system vendor, except via supervised access using Join.me Basic, is **prohibited**.
 - C. Via either access method specified above, the following functions shall be provided:
 1. Global Data Access: The server shall provide complete access to distributed data defined anywhere in the system.
 2. Distributed Control: The server shall provide the ability to execute global control strategies based on control and data objects in any control unit.
 3. Server shall include a master clock service for its subsystems and provide time synchronization for all network components.
 - D. Network Software: Software shall include the following capabilities:
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1. I/O capability from any network operator workstation. The system operator interface shall be an easy to use, self-guiding, menu-penetration, windowing approach. Key features that shall be included in the interface are as follows:
 - a. Full English language data addressing and presentation: BACnet objects/points shall be identified within a particular BACnet device by a 32-bit numeric "object identifier" defined in accordance with ANSI/ASHRAE Standard 135-2012. Each object/point shall also be referenced by individual writable "object name" of 50 characters or less assigned by the Contractor utilizing the following naming convention:
 - 1) Format object/point names in terms of **"FACILITY.SYSTEM.POINT."** "Facility" shall be the name or identifying abbreviation for the facility as provided by the Owner. "System" shall be the name or identifying abbreviation for the HVAC system, subsystem, or component matching **exactly the system, subsystem, and component identifier used within the Contract Documents.** "Point" name abbreviations shall be as follows:

Point Description	Point Name
Air Flow	AirFlow
Air Static Pressure	AirSP
Air Velocity Pressure	AirVP
Differential Temperature	DTemp
Mixed Air Temperature, Humidity, Enthalpy	MATemp MAHum MAEnt
Outdoor Air Temperature, Humidity, Enthalpy	OATemp OAHum OAEnt
Percent Open	PctOpn
Percent Output	PctOpt
Power	kW
Return Air Temperature, Humidity, Enthalpy	RATemp RAHum RAEnt
Space Temperature, Humidity, Enthalpy	SpaceTemp SpaceHum SPEnt
Speed	RPM
Status, Alarm or Failure	Alarm
Status, Occupied/Unoccupied	Occ or Unocc

Point Description	Point Name
Status, On/Off	On or Off
Status, Open/Closed	Open or Closed
Supply Air Temperature	SATemp

- 2) Where a required point name abbreviation or identifier is not readily show within the Contract Documents, the Contractor shall submit a Request for Information to the A/E.
 - 3) Object/point descriptions used for applications such as graphics, reports, alarms, etc. shall be same as the object/point name as specified above.
 - 4) Engineering units shall be the English ("inch-pound") system.
- b. Interactive operation and help messages.
 - c. Organization of points into logical groups or "systems" and an information penetration scheme that provides quick and simple method for maintenance staff to determine HVAC conditions and problems at any school, as follows:
 - 1) Initial facility information display will be one or more "floor plans" that include basic site information and specific room by room data. Each of these data points are displayed as "hot buttons" so that selecting any data display takes the user to next, more detailed information level. The floor plan display(s) shall provide display of temperature and humidity conditions in each space. Designation of the HVAC unit or system serving each space shall also displayed and selecting that hot button shall take the operator to the detailed system points display for that unit or system.
 - 2) At the HVAC system, subsystem, or component level, a graphical display or "tree structure" structure display may utilized, as selected by the user. Typically, since all graphical displays tend to be less detailed and slower to respond than tree structure displays, graphics tend to be rarely used by experienced operators (but, graphics play an important role for educating less experienced operators).
 - 3) Site information shall include direct hot button links to primary heating and cooling systems. (For example, selecting "CHWSTemp" shall take the operator immediately to the graphic or tree structure display of the facility chilled water cooling system, while selecting "HWSTemp" shall lead to the facility hot water heating system.)
 - d. Fill-in-the-blanks programming.
 - e. On-line data file programming.
 - f. Multi-level system access for security, as follows:

Level	Access Privileges
1	View only.
2	Same as Level 1, plus acknowledge alarms
3	Same as Level 1, plus allow temporary schedule modifications.
4	Same as Level 2, plus temporary or permanent schedule modifications, establish and view trend logs.
5	Same as Level 4, plus space temperature setpoint adjustment
6	Not assigned.
7	Not assigned.
8	Unlimited.

- g. Pictorial representation of data on color graphic terminals with dynamic data.
 - h. Capability to alternate between graphic and text displays for the same logical group.
- 2. Automatic system diagnostics; monitor system and report failures of both controlled equipment and control system components.
 - 3. Database creation and support.
 - 4. Automatic and manual database save and restore.
 - 5. Dynamic color graphic displays with multiple screen displays at once.
 - 6. Custom graphics generation and graphics library of HVAC equipment and symbols.
 - 7. Alarm and event processing.
 - a. Provide audible, visual, and printed means of alarm indication. The alarm dialog box shall always become the top dialog box upon receipt of an alarm irrespective of the foreground application. Alarms assigned for printout shall be routed to the destination printer. In addition, alarms shall be capable of being routed to specified personnel by means of pager or mobile telephone.
 - b. User-defined alarm messages shall be generated and delivered in conjunction with the alarm notification.
 - c. Alarms shall be routed to the appropriate destination device(s), based on time and other conditions. An alarm shall be able to initiate sequences, print, be logged in the event log, generate custom messages, and automatically display an associated system graphic.
 - d. Any object in the system shall be configurable to generate alarms on transition in and out of normal state. The operator shall be able to configure the alarm category, alarm limits, alarm limit differentials, states, alarm message, states and reporting actions for each alarm in the system.
 - e. Minimum alarm categories required are notification, maintenance, critical and security.

8. BACnet object and property status and control.
9. Automatic restart of field equipment on restoration of power.
10. Data collection, reports, and logs. Include standard reports for the following:
 - a. Current values of all objects.
 - b. Current alarm summary.
 - c. Disabled objects.
 - d. Alarm lockout objects.
 - e. Logs:
 - 1) Retrieve and display default logs, including "all points log", "system points log", "alarm log", etc.
 - 2) Create, retrieve, and display trend logs, in real time, of historical object data stored in remote CUs.
 - 3) Maintain trend log files saved to hard disk for subsequent use in spreadsheet or database programs.
 - 4) Dynamically graph the trend logged object data by creating two-axis (x, y) graphs that simultaneously display values relative to time for up to eight objects in different colors.
 - 5) It shall be possible to trend log any number of points at least equal to twice the number of connected physical points. Any object in the system (physical or calculated) may be logged.
 - 6) Once established, trend logs shall continue until deleted by user. Data storage sufficient for at least 30 days shall be provided for each trend log.
 - f. Custom report development.
 - g. Utility and weather reports.
11. Application editors for controllers and schedules.

2.3 WEB BROWSER CLIENT ACCESS

- A. In addition to networked workstation access as specified above, provide access to all data at the facility site and allow a remote user to operate the site control system using any Java-enabled browser (e.g., Firefox, Internet Explorer, Google Chrome, etc.) without requiring proprietary interface and/or configuration. The system shall be capable of supporting multiple clients using a standard Web browser.
- B. **DDC system provided shall include 10 additional new site licenses for web browser client access.**
- C. Web browser shall provide the same view of the system, in terms of graphics, schedules, logs, etc., and provide the same interface methodology as provided by a workstation directly connected to the file server network.
- D. Web browser client access shall support the following functions, at a minimum:
 1. User log-on identification and password shall be required as hereinbefore specified. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.

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2. Graphical screens developed for direct system access shall be the same screens used for the web browser client. Any animated graphical objects supported by the control system shall be supported by the Web browser interface.
 3. HTML/XML programming shall not be required to display system graphics or data on a web page. HTML editing of the web page shall be allowed if the user desires a specific look or format.
 4. Real-time values displayed on a web page shall update automatically without requiring a manual “refresh” of the web page.
- E. Provide the capability to specify a user’s home page as determined by the log-on user identification. Provide the ability to limit a specific user to just the defined home page. From the home page, links to other views or pages in the system shall be possible.
- F. *Graphic screens on the web browser client shall support hypertext links to other locations on Internet sites by specifying the Uniform Resource Locator (URL) for the desired link.*
- 2.4 JOB CONDITIONS (ENVIRONMENTAL CONDITIONS OF OPERATION)
- A. LAN hardware shall be designed to operate in ambient conditions of 65 to 90 degrees F at 20 to 80 percent RH, non-condensing.
- B. Digital control equipment shall comply with the following:
1. Digital control equipment shall be designed to operate in ambient conditions of 35 to 120 degrees F at a relative humidity of 0 to 95 percent non-condensing.
 2. Control units as hereinafter specified shall operate properly with power fluctuations of plus 15 percent to minus 10 percent of nominal supply voltage.
- C. Electric and electronic equipment shall be properly mounted and organized in a grounded and Listed NEMA 1 cabinet (panel). Cabinets or enclosures shall protect equipment from dust, liquids or accidental blows.
- 2.5 DIRECT DIGITAL CONTROL UNITS
- A. General: Multiple digital control units (CUs), including at least one site BLCU, shall be provided. ***CUs shall be fully field programmable and the use of firmware-based application specific controllers (ASCs) is prohibited.*** All control functions shall be resident in the CUs, including those involved in facility-wide strategies.
1. **Exception:** When approved by NHCS for a specific application, an ASC may be utilized, provided the ASC programming, including firmware, enables the proposed ASC to fully comply with the specified I/O points and sequence of operation specified in Section 230993 for that application. ***When use of an ASC is desired by the DDC system vendor, product data and other information necessary to evaluate its use shall be submitted at the pre-submittal conference hereinbefore specified.***
- B. Control Units: Modular, comprising processor board with programmable, non-volatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.
1. Control units shall fully comply with the system architecture and communication requirements specified hereinbefore.
 2. Units shall monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.

3. Stand-alone mode control functions shall operate regardless of network status. Functions include the following:
 - a. Global communications.
 - b. Discrete/digital, analog, and pulse I/O.
 - c. Monitoring, controlling, or addressing data points.
 - d. Software applications, scheduling, and alarm processing.
 - e. Testing and developing control algorithms without disrupting field hardware and controlled environment.
- C. Building Level Control Unit (BLCU): Provide one or more BLCUs, as required, meeting the general requirements for control units specified above and incorporating communication interface between the control system peer-to-peer network and the Owner's WAN.
- D. Control Modes: Control loops shall be able to utilize any of the following control modes:
 1. Two position (e.g., on-off, slow-fast)
 2. Proportional (P), proportional plus integral (PI), or proportional plus integral plus derivative (PID), applied as follows:

Controlled Variable	Control Mode
Space Temperature	P
Mixed Air Temperature	PI
Coil Discharge Temperature	PI (cooling), P (heating)
Hot Water Supply Temperature	P
Airflow	PI (with wide proportional band and fast reset rate) or PID
Fan Static Pressure	PI
Humidity	P (PI throttling range is less than 5%)
Dewpoint Temperature	P (PI throttling range is less than 2 F)

3. For any unlisted application, the control mode shall be as approved by the A-E.
- E. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
 1. Binary Inputs: Allow monitoring of on-off signals without external power.
 2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
 3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
 4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation with three-position (on-off-auto) override switches and status lights.
 5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA) with status lights, two-position (auto-manual) switch, and manually adjustable potentiometer.

6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
7. Universal I/Os: Provide software selectable binary or analog outputs.
- F. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
 1. Output ripple of 5.0 mV maximum peak to peak.
 2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
 3. Built-in over-voltage and over-current protection and be able to withstand 150 percent overload for at least 3 seconds without failure.
- G. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:
 1. Minimum dielectric strength of 1000 V.
 2. Maximum response time of 10 nanoseconds.
 3. Minimum transverse-mode noise attenuation of 65 dB.
 4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.
- H. Diagnostic Devices:
 1. Each CU shall be supplied with connections to which maintenance personnel can connect a portable laptop computer for data display, setpoint modification, and reloading and modification of controller programs.
 2. Provide software installed on Owner's laptop computers required to troubleshoot local HVAC equipment operation and control. It shall be possible for the user to completely operate the controller via the laptop and completely exercise all valves and dampers via the laptop, display values in complete engineering units for setting analog control values, reading digital status, setting control parameters, commanding digital loads, and setting analog alarm limits. Full read-write capability shall be provided.
- I. Spare Equipment: Provide spare control unit boards and spare I/O boards as required. It shall be possible for trained Owner personnel to replace CU boards and load software as required.
 1. Provide two spare control unit boards. If power supplies are separate, supply separate power supplies and other parts to make at least two complete sets of DDC control equipment spares.
 2. If I/O boards are separate from the CU boards, provide four spare I/O boards for each spare CU board provided above.
- J. Control Functions: All control functions shall execute within the standalone control units via DDC algorithms. The operator shall be able to customize control strategies and sequences of operations defining the appropriate control loop algorithms and choosing the optimum loop parameters. Each CU shall include the following standalone functions:
 1. Direct Digital Control algorithms and control sequences are to be CU resident and be capable of standalone operation. All DDC programs shall be custom written as required to meet the performance criteria spelled out in the sequence of operation paragraphs for

each controlled mechanical system. PID control mode shall be employed as appropriate to the application and per sequences or operation.

2. Enable/Disable: All CU resident DDC programs shall be capable of being enabled or disabled from any workstation. In the enable mode all DDC loops shall be active and output signals shall be routed to the final control elements. In the disable mode all DDC loop calculations shall continue but outputs to actuators shall be suppressed. (When disabled, control outputs shall stay in the same state or position as commanded from the central or until they are manually set to automatic.)
3. Integral Windup Prevention: To eliminate integral windup, all PID programs shall automatically invoke integral windup prevention routines whenever the controlled unit is off, under manual control or under control of a system or time initiated program, or when the controlled unit is in the process of starting or stopping.

- K. Default Value Operation: All CU's shall be capable of being programmed to utilize stored default values for assured fail-safe operation of critical processes. Default values shall be invoked upon sensor failure or, if the primary value is normally provided by the central or another CU, by loss of communication between CUs. Individual application software packages shall be structured to assume a fail-safe condition upon loss of input sensors. Loss of an input sensor shall result in output of a sensor-failed message at the central control and command station. Each CU shall have capability for local readouts of all functions.

2.6 APPLICATION SOFTWARE

- A. Provide the following programs in addition to control algorithms defined on the drawings:
- B. Scheduled Start/Stop: Provide a calendar format for schedules required under Section 230993 for annual time-of-day scheduling for equipment operation, trending, logging and reports, etc.
- C. Provide the following minimum features:
1. Day-type schedules (Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday, Holiday, Pre-Holiday day, Vacation day, Special Day, etc., 24 hours per day)
 2. Monthly schedules (allow individual assignment of day types to each day of the month).
 3. Yearly schedules (allow schedules to be applied on an annual basis and be edited and re-applied to a following year).
 4. Temporary override of schedules shall be allowed by operators with access levels as specified above. A temporary override shall (1) extend hours of use of HVAC systems, subsystems, and/or components up to midnight on weekdays and (2) allow use of HVAC systems, subsystems, and/or components during scheduled "off" periods for a maximum of 12 hours. When an override use period terminates, the temporary override time(s) shall be voided and affected HVAC elements shall return to their normal schedules.
- D. Optimum Start: Optimum start program shall automatically delay equipment startup based on outdoor temperature, space temperature, and system response to assure that comfort conditions are reached exactly at scheduled occupancy time. The program is to operate in both heating and cooling cycles. An adaptive algorithm is to be employed which automatically adjusts according to past experience. Algorithm shall be tested and updated every day. The program shall automatically assign longer lead times for weekend and holiday shutdowns. Space temperature input is to be the highest value of zones served in the cooling mode and the lowest of zones served in the heating mode. It shall be possible to assign occupancy start times on a

per air handler unit basis. Modification of assigned occupancy start times shall be possible via the central operator's terminal.

- E. Event Initiated Programs (EIP): Event initiators may be any digital data point in the system, real time values, or any analog alarm limit. The EIPs shall be structured so that one initiator may set and reset the EIP as it goes from normal to off-normal and back to normal, or one initiator may set the program and a second initiator reset the program, or reset may be manual via the console keyboard. Setting an EIP shall cause a series of start or stop commands to assigned loads to be executed to EIP's points. EIP's shall have priority assignments to allow them to override other programs in the set mode when desired. The operator shall have read-write capability for initiator load and priority assignment.
- F. Alarm Initiation and Response:
1. All AI points shall have user-defined upper and/or lower condition limits. If user-defined limits are not defined, **default limits shall be initially set as follows:**

Space temperature	5°F below low setpoint of comfort zone or 5°F above high setpoint of comfort zone
Space humidity	≥70% RH
AHU mixed air low limit	≤38°F
Cooling coil leaving air	≥60°F
Heating coil leaving air	≤90°F
 2. Monitor and display "status" (on/off, high/low, open/closed, etc.) of each DI point. Motor on/off status shall be indicated by current sensing relays with field-adjustable trigger point to provide DI "switch", as hereinafter specified. Monitor and display "position" of an AO point (valve or damper percent open, motor speed percent of full speed, etc.)
 3. An alarm shall be initiated whenever any of the following conditions occur:
 - a. Any AI point high or low limit alarm setpoint is exceeded.
 - b. Any DI status condition does not correspond to the DDC command condition (i.e., damper is closed when occupied/unoccupied schedule requires damper to be open, motor is operated in "hand" rather than "auto" mode, etc.)
 - c. Any AI or DI device fails or goes "out of range".
 - d. Any AO device fails to respond to DDC command condition.
 - e. If any AO control loop continues to cycle its output more than 40% of its range (user adjustable) 3 or more times in any 60 minute interval.
 - f. For variable air volume AHUs, if any supply fan or return/relief fan speed AO output signal remains above 95% for more than 8 hours (user adjustable) accumulated per "on" period for 3 or more consecutive "on" periods.
 - g. If any AHU coil control valve(s) AO output signal remains above 95% for more than accumulated 8 hours (user adjustable) per "on" period for 3 or more consecutive "on" periods.
 - h. If any humidifier valve AO output signal remains above 85% for more than accumulated 8 hours (user adjustable) per "on" period for 3 or more consecutive "on" periods.

- i. During "on" periods, if any cooling coil chilled water return temperature is greater than design for more than 4 hours during which coil chilled water supply temperature was at or below design setpoint temperature.
- G. Automatic Restart Programming:
 1. When a power failure is detected in any phase, the DDC system shall command all electrical equipment served by the failed power source "off".
 2. If the associated CU is powered by normal or emergency power, it may monitor its own power source as an indication of power status.
 - a. If the CU is powered by uninterruptible power supply (UPS), or if it is not capable of monitoring its own power for use in sequences, Contractor shall provide at least one voltage transformer (three phase when applicable) for each facility for the DDC system to monitor for power status.
 3. When the DDC system detects normal or emergency power has been restored to the failed power source, all equipment served by that source that was commanded "off" shall be automatically restarted. Restart shall be sequenced by the CU network restart program with a 5 second interval between starts to minimize inrush current.
- H. Preventive Maintenance Instruction (PMI) programming: A preventive maintenance alarm shall be printed indicating maintenance requirements based on run time. The log shall include all equipment listed in the runtime schedule data base that have reached limit criteria of calendar-date (month-day-year) or high accumulation of totalized run-time (for points with start/stop or run status indication). Each PMI message shall include point descriptions, limit criteria and preventive maintenance instruction assigned to that limit. PMI shall be provided for each component of units such as air handling units. All limit criteria, PMI and reset-to-zero assignments shall be operator programmable, on-line at the keyboard. Stagger initial alarms to distribute maintenance throughout the year. Program initial PM alarms as follows:
 1. Fans and pumps, run time 4000 hours
 2. Refrigerators/freezers, converters, cooling tower system, water treatment, calendar time 3 months
 3. Emergency generator oil samples, calibration of instrumentation and controls, calendar time 12 months
 4. All other, calendar time 4 months
- I. Air Flow and Pressure Control:
 1. Air flow and static pressure shall be controlled via CUs with inputs from air flow control measuring stations and static pressure inputs as specified in Section 230913. Controller outputs shall be true analog output signals. Pulse width modulation outputs are not acceptable. The airflow control programs shall be standard factory tested programs that are documented in the literature of the control manufacturer.
 2. Duct Static Pressure Control: Systems shall consist of one or more static pressure sensors as specified in Section 230913 and transmitters, along with relays or auxiliary devices as required to produce a complete functional system. The span of the transmitter shall not exceed two times the design static pressure at the point of measurement. The output of the transmitter shall be true representation of the input pressure with plus or minus 0.1-inch wg of the true input pressure.

- a. For systems with multiple major “trunk” supply ducts, furnish a static pressure transmitter for each trunk duct. The transmitter signal representing the lowest static pressure shall be selected as the input signal to the CU.
 - b. The CU shall receive the static pressure transmitter signal and shall provide a control output signal to the supply fan capacity control device using control modes hereinbefore specified.
 3. Constant Volume Control: Systems shall consist of a static/total pressure sensor as specified in Section 230913 and a differential pressure transmitter, along with such relays and auxiliary devices as required to produce a complete functional system. The transmitter shall receive its primary total pressure and static pressure signal from the flow measuring station and shall have a span not exceeding three times this differential pressure at the design flow rate. The CU shall receive the transmitter signal and shall provide an output to the fan volume control device to maintain a constant flow rate. Overall system accuracy shall be plus or minus 0.008-inch velocity pressure as measured by the flow station.
 - J. Ventilation Air Flow Control for VAV Systems: The airflow rate of return or relief/exhaust fan(s) of variable air volume systems shall be controlled in response to the supply airflow rate, resulting in a constant ventilation airflow rate and a positive building pressure. An airflow monitoring station, as specified in Section 230913 and as indicated on the Drawings, shall be utilized to determine the flow rates at each fan.
 - K. Additional application control requirements shall be met as required by the DDC control logic diagrams on the Drawings.
- 2.7 CABLING AND WIRING
- A. DDC Cabling: Cabling between buildings shall be fiber optic. Network cabling within buildings shall be shielded twisted pair or fiber optic. Cabling or wiring between control units and I/O point devices shall be as follows:

Application	Cable/Wire Type and Min. Gauge (AWG)
Digital Input Wiring	24 gauge, twisted pair
Analog Input Wiring	24 gauge, shielded twisted pair
Digital Output Wiring	24 gauge stranded for 24V 18 gauge stranded for 120V
Analog Output Wiring	24 gauge, twisted pair

- B. Data Cable:
 1. Twisted shielded cables shall have FFEP insulation in thermoplastic jacket, with #24 AWG stranded conductors, minimum. Shield shall be tinned, soft-copper strands formed into a braid or equivalent foil. Shielding coverage on conductors shall not be less than 100 percent.
 2. Multimode fiber optic cables shall be 62.5/125 micron Class Ia Graded Index Multimode Optical Fiber, OFNR, OFNP, Outdoor or Indoor / Outdoor (I/O) NEC Rating, FDDI Compliant.
 - a. Coating Diameter: 250 Microns
 - b. Core Eccentricity: 7.5% maximum (1.5% typical)

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- c. Numerical aperture: .275 plus or minus .015
 - d. Attenuation: 3.5 dB/km @ 850 NM / 1.50 dB/km @ 1300 NM
 - e. Bandwidth: 160 MHz at 850 NM / 500 MHz @ 1300 NM
 - f. Fiber connectors: ST .75 dB maximum insertion loss
 - g. Cable bend radius: 10 times diameter
 - 3. Single mode fiber optic cables shall be 8.3/125 micron Class IVa Dispersion-Unshifted Single-mode Optical Fiber, OFNR, OFNP, Outdoor or Indoor / Outdoor (I/O) NEC Rating, FDDI Compliant.
 - a. Coating Diameter: 250 Microns
 - b. Core Eccentricity: 7.5% maximum
(1.5% typical)
 - c. Attenuation: 0.5 dB/km @ 1310 NM/1550 NM
 - d. Zero dispersion wavelength 1300 -1320 NM
 - e. Cable bend radius: 10 times diameter
 - C. Control and Interlock Wiring: All 24V-120V control and interlock wiring shall comply with the following:
 - 1. Conductors:
 - a. All wire and conducting components shall be THWN stranded copper.
 - b. Conductors shall be continuous from device to device and no splices shall be made except within device or junction boxes. **Wire nuts and crimp slices are prohibited.** Junction boxes may be utilized where required.
 - c. Control wiring shall be color-coded in accordance with reviewed submittals.
 - d. Where conductors pass through a junction box or connect to a device, the conductor and the box shall be tagged to indicate the circuit and/or terminal number shown on the submittal drawings.
 - 2. Raceway: Provide electrical metallic tubing (EMT), minimum 3/4" size. Fittings shall be steel insulated throat compression type. **Set screw fittings, fittings constructed of alloys of aluminium or fittings of the indenter type are prohibited.** Flexible metallic raceway may be utilized for the last 24" up to the connection point for devices, sensors, etc.
 - 3. Routing of Raceway: Exposed raceway shall line up work true to adjacent surfaces and be placed in a workmanlike manner. Raceway shall be run at right angles to building lines; this requirement does not apply to raceway located below concrete placed as a part of this project. Raceway shall be sturdily supported and separated in a manner satisfactory to the A/E; raceway shall not be supported by the ceiling grid or ceiling grid support wires. In general, all raceway is to be concealed and routed overhead, below the floor, or in walls except in electrical or mechanical equipment rooms. Raceway in such rooms may be surface mounted.
 - 4. Device Boxes: Device boxes for use in sheetrock or paneled surfaces shall be of galvanized steel, 4 inches square of a depth necessary to contain the intended device(s) and associated conductors. Boxes shall be sized to have no less than the minimum volume as required by the NEC. Boxes must be flush mounted and accommodate

device(s) and all wires and connections without crowding. Boxes shall be furnished with a suitable plaster ring of the depth required to match the wall (or ceiling) material.

Where the surface material or covering is combustible the front edge of the plaster ring shall be absolutely flush with the surface. Where the wall material is non-combustible, the front of the plaster must be recessed into the wall no further than 3/16 inch. Device boxes for flush mounted use in masonry walls shall be of the concrete tight masonry type sized for the number of device(s) and conductors. In locations where surface mounting of device boxes is permitted on masonry walls, provide 1/2 inch raised cover and suitable plaster ring.

5. Junction Boxes: Junction boxes shall be of galvanized steel of size, type, and shape for intended use and having adequate volume as required by NEC. All junction boxes shall be concealed unless specifically permitted elsewhere in these Specifications or on the Drawings. Boxes must be supported from the building structure without dependence on support of conduit, fixture support wires, ceiling support wires, or similar items.
6. Device and/or Junction Box Wall Penetrations: All wall penetrations at device or equipment locations must be protected in such a manner that the fire rating of the wall is maintained. ***It is the responsibility of the Contractor to assure that fire and smoke integrity of all walls is maintained at all penetration points.***

PART 3 -EXECUTION

3.1 EXISTING DDC SYSTEM/COMPONENTS DEMOLITION

- A. Where an existing DDC system is required to be removed to provide for installation of a new DDC system, careful attention to demolition and salvage is required. All existing DDC components, including but not limited to controllers, sensors, valve and damper operators, etc. ***shall be removed without damage and turned over to the Owner.***
- B. Thermostats and sensors containing mercury shall be disposed in accordance with EPA Resource Conservation and Recovery Act (RCRA). Contractor shall refer to EPA web site for handling procedures for disposal and spill management of projects containing mercury.
- C. Remove all abandoned wiring, raceway, and any related items, both exposed and concealed. Where existing raceway is concealed in concrete or masonry, remove wiring as required above and abandon in place. Cut abandoned raceway off 1/2" into wall, ceiling, or floor to allow patching to completely cover cut off end of raceway.
- D. Repair surfaces and finishes to match existing surrounding surfaces or finish in all areas where items are removed. After repairs are made no evidence of previous use of surfaces shall be visible.
- E. Provide touch-up painting as required where new items are installed adjacent to existing items to remain.
 1. Clean new, damaged, and/or disturbed areas and apply primer, intermediate, and finish coats at each location.
 2. Surface preparation and timing of application of successive coats of paint shall be in accordance with paint manufacturer's instructions.
 3. Use zinc-rich paint to repair damage to galvanized finishes. Follow written instructions of paint manufacturer.
 4. Repair paint finishes for other items, surfaces, or equipment as necessary. Follow written instructions of paint manufacturer.

- F. Provide blank cover plates to match device plates used in the adjoining areas where outlet, device, junction, or other boxes are to remain,

3.2 INSTALLATION

- A. Provide skilled technicians, properly trained and qualified for the work and directed by experienced engineers.
- B. Except for short apparatus connections, run raceway parallel to or at right angles to the building structure. Conceal raceway and tubing in finished spaces. Do not run raceway concealed under insulation or inside ducts. Mount control devices, tubing and raceway located on ducts or apparatus with external insulation on standoff supports to avoid interference with insulation.
- C. Run wire connecting devices on or in control cabinets parallel with the sides of the cabinet neatly racked to permit tracing. Rack connections bridging a cabinet door along the hinge side and protect from damage. Provide grommets, sleeves or vinyl tape to protect plastic tubing or wires from sharp edges of panels, raceway, and other items.
- D. Cabling and Wiring Installation:
1. All control cabling and interlock wiring shall be installed in raceway.
 - a. Exception: Where Class 2 wiring is located in concealed and accessible locations, including supply or return air plenums, plenum-rated cables complying with NFPA 262 may be installed without raceway, provided that:
 2. Circuits meet NFPA 70 Class 2 (current-limited) requirements.
 3. All cables shall be UL-listed for the application.
 4. **Do not install Class 2 wiring in raceway containing Class 1 wiring.** Boxes and panels containing high voltage (120 V+) may not be used for low voltage wiring except for the purpose of interfacing the two via relays, transformers, etc.
 5. Shielded, twisted pair cable shielding shall be grounded at each connection point.
 6. Fiber Optic Cable:
 - a. Route all interior cables in raceway within walls and inaccessible ceiling spaces.
 - b. Use nylon bushings at top of conduit where stubbed in accessible ceiling spaces.
 - c. Support all cables using J type hooks where open cable is permitted.
 - d. Route all fiber optic cable in raceway with innerducts. The innerducts shall contain a pull string, if no fiber is pulled at the time of the installation of the duct.
 - e. All conduit where fiber optic cable is installed shall be sized to maintain the manufacturer's recommended bend radius of fiber optic cables. As a minimum, conduit shall be provided with long radius elbows.
 - f. All cables shall be terminated using appropriate termination equipment.
 - g. Fiber Termination Panels: Provide a rack mountable, modular cabinet capable of terminating up to 24 type ST multimode fiber cables. Panels shall be as manufactured by Ortronics, Amp, Siecor, or Superior.
 - h. Fiber Optic Testing: Upon completion of the passive optical cable system, the system must be tested to ensure compliance with the design and link loss specifications. The tests include:
 - 1) Power Meter Tests: For building risers, power meter tests are required.

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- 2) End-to-End Attenuation Testing: Tests shall be completed on each fiber span at both operational wavelengths:
 - 850/1310 nm multimode
 - 1550 nm single mode
 - 3) Testing in one direction is required. Link attenuation does not include any active devices or passive devices other than cable, connectors and splices (e.g., link attenuation does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers. Test results should be retained for inclusion into the documentation package.
 - 4) Connector loss readings of each completed connector should be recorded using an OTDR at 850 and 1310 nm in one direction.
 - 5) Optical time domain reflectometer (OTDR) signature traces of each terminated fiber should be recorded at 850 nm and 1310 nm for fiber continuity purposes. OTDR testing is mandatory for runs longer than 2 km.
 - 6) Final report shall be compiled which records system configuration, fiber labels, cable routes and “as built” details. Loss measurements with calibrated light source and power meter shall be included. OTDR traces shall also be included when requested in advance.
- E. Smoke detectors and/or fan shutdown relays initiated by a fire alarm system shall be integrated into the control system and sequence of operation as indicated and/or required.
- 3.3 FIELD QUALITY CONTROL
- A. Perform the following field tests and inspections and prepare test reports after completion of DDC system installation:
1. After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
- B. Test and adjust controls and safeties.
1. Test calibration of control units by disconnecting input sensors and stimulating operation with compatible signal generator.
 2. Test each control point through its full operating range to verify that safety and operating control set points are as required.
 3. Test each control loop to verify stable mode of operation and compliance with sequence of operation.
 4. Test each system for compliance with sequence of operation.
 5. Test software and hardware interlocks.
- C. DDC Verification:
1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
 2. Check instruments for proper location and accessibility.
 3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
 4. Check instrument tubing for proper fittings, slope, material, and support.
 5. Check installation of air supply for each instrument.

6. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
7. Check temperature instruments and material and length of sensing elements.
8. Check control valves. Verify that they are installed for flow(s) in the correct direction(s).
9. Check DDC system as follows:
 - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
 - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
10. Verify that spare I/O capacity has been provided.
 - a. Verify that DDC controllers are protected from power supply surges.
11. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.4 CALIBRATION AND ADJUSTMENT

A. General:

1. Make two-point calibration test for both linearity and accuracy for each analog instrument.
2. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.

B. Control System Inputs and Outputs:

1. Check analog inputs at 50 and 100 percent of span.
2. Check analog outputs using milliampere meter at 50 and 100 percent output.
3. Check digital inputs using jumper wire.

C. Check digital outputs using ohmmeter to test for contact making or breaking.

1. Check resistance temperature inputs at 0 and 100 percent of span using a precision-resistant source.

D. Flow:

1. Set differential pressure flow transmitters for 0 and 100 percent of span.
2. Manually operate flow switches to verify that they make or break contact.

E. Pressure:

1. Calibrate pressure transmitters at 0 and 100 percent of span.
2. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.

F. Temperature:

1. Calibrate resistance temperature transmitters at 0 and 100 percent of span using a precision-resistance source.
2. Calibrate temperature switches to make or break contacts.

- G. Stroke of valves and dampers: Follow the manufacturer's recommended procedure, so that valve or damper is 0 and 100 percent closed.
- H. Provide diagnostic and test instruments for calibration and adjustment of system.
- I. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.
- J. Adjust initial pressure, temperature, humidity, etc. setpoints in coordination with TAB sub-contractor.

3.5 HVAC SYSTEMS OPERATION VERIFICATION

- A. After installation, calibration, and adjustment of DDC system, the DDC system vendor shall verify the performance of the DDC as follows:
 - 1. Verify Gas Sensor Accuracy: Select 100% of the installed gas concentration sensors for testing:
 - a. Carbon Dioxide (CO₂): Prior to placing the DDC system in operation, sensors shall be tested and recalibrated as needed in accordance with the manufacturer's written procedures. Calibration shall use a minimum of two calibration gas samples, one a 950-1050 ppm and one at either 0 ppm or 450-550 ppm, with the concentration of the calibration gas known within +/- 2%. *Sensors that cannot be calibrated to within +/- 60 ppm of calibration gas CO₂ concentrations at each test point shall be replaced.* The replacement sensor shall then be calibrated. Provide sensor test/calibration reports for review by the A/E.
 - 2. Verify Non-Gas Sensor Accuracy: Select at least 10% of the installed temperature, humidity, pressure, airflow, etc. sensors, including at least one of each sensor type, for testing. If calibration of 10% or more of this sample is found to be incorrect, select an additional 10% of the installed sensors for testing. **If calibration of 10% or more of this second sample is found to be incorrect, test/calibrate all sensors.**
 - a. Sensor calibrating instruments shall be used in checkout of the overall performance. The sensors of these instruments shall be placed at the proximity of DDC system sensors to indicate the conditions of the controlled media (air, water, etc.). A preliminary evaluation shall be made as to the suitability of having the DDC system sensors checked in-place or they may be placed in simulated environment. If the response times of the two sensors (DDC system sensor and calibration sensor) are similar, testing may be performed with the sensors in place. If the conditions of the controlled media change slowly, testing may also be performed with the sensors in place. However, if the conditions of the controlled media change rapidly and the time responses of the two sensors vary considerably, testing shall be done with the sensors placed in a known environment such as a temperature bath.
 - b. Verification procedures: Verification of sensor accuracy shall be made using the following procedures. Compare readings for each sensor from the calibration instrument and the DDC system to determine if the measurement accuracy meets the requirements of Section 230913.
 - 1) Temperature: Use a multi-point verification check at various points in the operating range (including minimum, typical, and maximum), utilizing a calibrated thermometer and Dewar flask or a calibrated portable drywell ($\pm 0.5^{\circ}\text{F}$) temperature probe calibrator.

- 2) Relative Humidity: Use a single point calibrator or portable environmental chamber that has been lab calibrated with a NIST traceable dew point monitor ($\pm 3\%$ RH).
 - 3) Air Flow: Utilize calibrated pitot tube or propeller anemometer traverses in at least two planes upstream of the air flow monitoring station. For VAV systems, test airflows over a range of at least five flow rates between 20% and 100% of design flow.
 - 4) Pressure: Use a multi-point verification check at various points in the operating range (including minimum, typical, and maximum) with a calibrated dead weight tester or an electronic pressure calibrator for ranges above atmosphere, or an accurate digital pressure gage for ranges below atmosphere.
 - 5) Differential pressure: Use a dead weight tester or electronic calibrator or a Magnehelic gauge with a pressure bulb to their high-pressure side to apply a known pressure at various points in the operating range (including minimum, typical, and maximum).
 - 6) Very Low Differential Pressure: Use a micromanometer or digital manometer of narrow range to spot check pressures at various points in the operating range (including minimum, typical, and maximum). The manometer must be zeroed. A hand pump/bleed valve set-up can be used to apply the small pressures required to the high sides. The manometer is adjusted and the instrument readings are compared at the high and low point. The temperature of the manometer fluid should be used to adjust its readings to the standard temperature conditions of the transmitter.
3. Verify Final Control Element Functionality: Test each final control element operator to ensure performance in accordance with Section 230913 and the control sequences defined on the Drawings. Test shall include full range of movement, stability through that range, and power and/or control signal failure performance. Operators found to be non-functional in any way shall be replaced.
 4. Verify Operator and System Functionality:
 - a. Verify DDC system command software by issuing commands at the operator's console and via browser interface and observing display, printer output, or HVAC equipment responses. The following software operation shall be verified:
 - 1) Software for checking input commands and issuing error messages. Enter various correct and incorrect commands.
 - 2) System and point addressing check. Enter command to display I/O data. Verify all data points defined on the drawings and/or required by the specifications.
 - 3) Start-stop or enable-disable of HVAC equipment or DDC system control points. Enter commands to start/stop selected HVAC equipment, and to disable and enable selected points.
 - 4) Operator override/automatic mode. Enter command to change selected automatic control under DDC system to manual and vice versa.

- 5) Display format. Enter commands to display data and graphics on terminal and graphic display. Check display content for adequacy and clarity as specified.
 - 6) Ability to modify, cancel and confirm operator's commands. Verify by entering commands.
 - 7) Set-point adjustment and limiting. Enter commands to adjust set points of controllers and range limits of the controlled media. Verify by display. Also enter commands to adjust set-points outside their range limits. DDC system shall display error messages.
 - 8) System access and access level control. Try to log on to system with both incorrect and correct ID codes. Try to enter different commands with different access level of the operators. The responses of the DDC system shall be as specified.
 - 9) Start/stop equipment. Enter command to start or stop selected equipment. Also reset time to initiate automatic mode. Verify responses by observation of equipment and DDC system display.
 - 10) Change parameter of points. Enter commands to change parameters of selected points such as high and low limit alarms, scale factor, etc. to test the adequacy of software.
- b. Verify graphic display of each HVAC system and component. Confirm that the graphic is in accordance with the design data and reviewed submittals, includes all data points required, displayed data is correct and in the correct format and units, and changes in point conditions or status are accurately updated. Evaluate the refresh rate of data display.
 - c. Verify report generation (status, profile, energy, etc.) by entering commands to generate reports such as all points, trend, total display of a system, timed display, and other specified reports. Examine the report content for general format, system/point code, time interval of reporting, point status/value/unit, energy amount/rate/unit, status of control and set time (manual or automatic), and other specification required information.
 - 1) Check for proper operation of system status reports, including point status reviews which would include information such as points currently in alarm, points removed from alarm checking, points off of scan, etc.
 - 2) Test alarm reporting by initiating alarm conditions of different points at different alarm levels in sequence to examine alarm reports. The reports shall show alarm location and device, alarm time, cause of alarm, current status of the point, etc. as required in the specifications. When alarm conditions are removed the printer shall print updated status report. Also verify audible alarm operations in accordance with specification requirements. Then initiate alarm conditions at different levels at the same time to check alarm priority.
 - d. Trending performance shall be tested by creating trend logs for each control sequence and monitoring the trend reports throughout the period that each control sequence is tested.
5. Test Control Sequences: The test procedures described below do not check the details of the software, rather, they try to verify the final output as indicated by the field equipment.

Before testing, each program the required input and output of the program and those listed in the contract specifications shall be compared to make sure that the program covers the specified operations. Verification of HVAC equipment operation (such as equipment status or temperature of space air) may be done by either (1) actual observation of equipment status and test instruments, or (2) obtaining DDC system reports if the accuracy of these reports has been verified previously.

- a. Basic Functional Tests: Through the user interface conduct the following series of tests:
 - 1) Raise/lower space temperature setpoints in software to verify if the system responds in accordance with design requirements.
 - 2) Raise/lower AHU discharge temperature setpoints and verify control valve and damper positions.
 - 3) Raise/lower static pressure setpoints and verify variable speed drive or vortex damper control.
 - 4) Initiate a high priority, off-hours alarm and verify that the remote notification procedures are carried out correctly.
 - 5) Verify that the interface with system safeties allow operation of dampers, etc., if safety conditions are met.
 - 6) Conduct an emergency start-up after power failure test. Verify that all systems return to automatic control.
 - 7) Verify DDC system maintains required outside air requirements under low airflow conditions.
 - 8) Disconnect communication cable to the DDC system and verify if the DDC panel can control the respective system (stand-alone control).
 - 9) Disconnect a sample of DDC space-temperature sensors and verify control sequence default.
- b. Test HVAC Systems Sequences of Operation: Through the user interface verify control of HVAC systems as follows:
 - 1) Scheduled on/off and occupied/unoccupied control. Verify that input includes start/stop times and days for specified equipment. As applicable, verify that input includes occupied/unoccupied times and days. Verify input for time delays of specified equipment. Check holiday/vacation effect. Log operations for at least three days to confirm that systems and components start and stop in accordance with defined schedules.
 - 2) Optimum start-stop control. Verify that the required input includes space temperature, outdoor temperature, occupied time and days of the week, and the response time of the air handling equipment, on an individual system by system basis. For each air handler, log space temperature for at least three days to confirm that space is at required temperature by the start of the occupied period.
 - 3) Occupied-Unoccupied control. Confirm that required input data is provided. To test control, change the setback time from occupied to unoccupied time and confirm that HVAC systems respond to the setback mode. If system is

an air-handling system, the outside air damper should close and the fan should cycle to maintain the setback temperature setpoint.

- Change the setback temperature setpoint to 5°F higher than the actual space temperature. The system should operate to increase the space temperature to the new setpoint condition. For air-handlers, the outside air damper should remain closed.
- c. Economizer cycle control: If the outdoor air temperature is above the discharge air temperature setpoint, but below the defined 100% outdoor air changeover temperature setpoint, verify that the outside air damper is fully open, the return air damper is fully closed, and that the air-handler discharge air temperature is maintained by modulation of the chilled water control valve.
- d. Heating/cooling coil discharge temperature reset: Verify that the required input points are provided and that the coil discharge air temperature setpoint is in accordance with the input conditions and the sequence of operation defined on the control drawings.

3.6 OWNER INSTRUCTION AND TRAINING

- A. General: The Contractor is responsible for instructing Owner's personnel, including the following:
 - 1. Instruction in the operation of HVAC systems, subsystems, and equipment via new DDC system
 - 2. Training in operation, maintenance, and trouble-shooting of new DDC system.
- B. Program Structure: Develop an instruction and training program that includes both classroom instruction and "hands-on" demonstrations.
- C. Training Modules: Develop a learning objective and teaching outline for each instruction and training module, taking into consideration the level of proficiency of Owner's maintenance staff. Include a description of specific skills and knowledge that each participant is expected to master.
 - 1. **Exception:** Training is required to be accomplished onsite. However, at the option of NHCS, some of or all the training required below may be accomplished for selected NHCS personnel at the DDC system vendor's offsite training facility. The cost for offsite training shall be the responsibility of NHCS.
 - 2. For each instruction and training module, include instruction for the following, as applicable to the system, subsystem, equipment, or component:
 - a. Documentation: Review the following items in detail:
 - 1) Operations manuals.
 - 2) Maintenance manuals.
 - 3) Project record documents.
 - 4) Warranties, bonds, and guarantees.
 - 5) Maintenance service agreements and similar continuing commitments.
 - b. Emergencies: Include the following, as applicable:
 - 1) Instructions on meaning of warnings, trouble indications, and error messages.
 - 2) Shutdown instructions for each type of emergency.

- 3) Operating instructions for conditions outside of normal operating limits.
 - 4) Sequences for DDC system.
 - 5) Special operating instructions and procedures.
 - c. Operations: Include the following, as applicable:
 - 1) Start-up procedures.
 - 2) Equipment or system break-in procedures.
 - 3) Routine and normal operating instructions.
 - 4) Regulation and control procedures.
 - d. Control sequences:
 - 1) Safety procedures.
 - 2) Normal start-up and shutdown instructions.
 - 3) Operating procedures for emergencies.
 - 4) Operating procedures for system, subsystem, or equipment failure.
 - 5) Required sequences for electric or electronic control systems.
 - 6) Special operating instructions and procedures.
 - e. Adjustments: Include the following:
 - 1) Alignments.
 - 2) Routine adjustments, tightening, etc.
 - 3) Noise and vibration adjustments.
 - 4) Economy and efficiency adjustments.
 - f. Maintenance and Repairs: Demonstrate the following:
 - 1) Inspection procedures.
 - 2) Troubleshooting and diagnostic instructions.
 - 3) Test and inspection procedures.
 - 4) Repair instructions.
 - 5) Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - 6) Review of spare parts needed for operation and maintenance.
- D. Training Execution:
 - 1. Owner will furnish an instructor to describe Owner's operational philosophy.
 - 2. Owner will furnish Contractor with names and positions of participants to attend instruction and training, not to exceed 10 individuals.
 - 3. Provide instruction at mutually agreed on times scheduled at least four (4) weeks in advance through the A/E. For systems, subsystem, and/or equipment that requires seasonal operation, provide required instruction at start of each season.
 - 4. Conduct training on-site in the completed and fully operational facility in classroom/conference space provided by the Owner and using the actual systems, subsystems, and equipment installed.

5. Conduct training using final operation and maintenance data submittals as the training reference material. If additional training materials are utilized, they shall be incorporated as an appendix to the operation and maintenance data submittals.
6. Provide documentation that Owner instruction and training has taken place. Provide record of dates, topics, and duration of each training session, the names of Owner's staff who participated, and a signed review form by each participant.

END OF SECTION

SECTION 230993

SEQUENCES OF OPERATION

PART 1 - GENERAL

1.1 SCOPE

- A. This section includes basic requirements for sequences of operation for Division 23 equipment, as well for equipment furnished under other Divisions.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to the work of this section.
- B. **The requirements of Sections 230913 and 230923 apply to the work of this section.**

1.3 SUBMITTALS

- A. General: Submittals shall demonstrate compliance with technical requirements by reference to each subsection of this specification. Where a submitted item does not **comply fully** with each and every requirement of the Specifications, the submittal shall clearly indicate such deviations. Identification requirements for non-complying features of items are very specific. See Section 019913 for exact requirements.
- B. Sequences of Operation: Provide complete documentation of the sequences of operation required by this project, as hereinafter specified. Include narrative sequence of operation for each HVAC system, subsystem, and component as defined herein, within other specification sections referenced herein, and/or defined on the project Drawings.
 - 1. ***Narratives shall not be verbatim copies of the sequences provided herein, but shall reflect the actual sequence of operation as applied by the contractor.***
 - 2. ***Sequences of operation must include setpoints and/or control ranges, digital alarms, analog alarm setpoints (both high and low), time delays, I/O point names, hardware/software interlocks, analog control mode (e.g., proportional [P] or proportional plus integral [PI]), and any other specifics needed for the user to fully understand and utilize the DDC system for operation of each HVAC system and its individual components in compliance with the design intent.***
- C. Control Schematics: Provide schematic diagrams of each HVAC system/subsystem sufficient to define the location of all control sensors, final control devices, etc. that are utilized as part of any sequence of operation and that confirm all input and output points required by any sequence of operation.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Sequences of operation specified herein, which indicate the functional intent of HVAC systems, subsystems, and/or components operation, are general in nature and may not fully define every aspect of programming that may be required to fulfill the design intent.
Contractor shall provide all programming necessary to obtain the sequences/system operation indicated, resulting in stable HVAC system operation in accordance with the design intent.
- B. The following standard abbreviations, along with abbreviations defined on the Drawings, shall apply to all control schematics and sequences:

Abbreviation	Definition	Abbreviation	Definition
<i>I/O Points</i>		<i>HVAC Components/Conditions</i>	
AI	Analog Input	ACWS, ACWR	Air-Conditioning Water Supply, Return
AO	Analog Output	AHU	Air-Handling Unit
AV	Analog Value	BCU	Blower Coil Unit
DI	Digital (Binary) Input	CAV	Constant Air Volume
DO	Digital (Binary) Output	CC	Cooling Coil
DV	Digital (Binary) Value	CDWS, CDWR	Condenser Water Supply, Return
<i>Control Conditions/Actions</i>		CHWS, CHWR	Chilled Water Supply, Return
BP	Barometric Pressure	FCU	Fan Coil Unit
BTU	British Thermal Unit	HC	Heating Coil
DA	Direct Acting	HX	Heat Exchanger
DB	Dry Bulb	HWS, HWR	Hot Water Supply, Return
DP	Differential Pressure	OA	Outdoor Air
DPT	Dew Point Temperature	OEM	Original Equipment Manufacturer
DT	Differential Temperature (Range)	PHC	Preheat Coil
NC	Normally Closed	RA	Return Air
NO	Normally Open	RF	Return Air Fan
P	Pressure; Proportional	SA	Supply Air
RA	Reverse Acting	SF	Supply Fan
SP	Static Pressure	VA	Ventilation Air
T	Temperature	VAV	Variable Air Volume
TP	Total Pressure	XA	Relief Air
VP	Velocity Pressure	XF	Relief Air Fan
WB	Wet Bulb		

- C. Sequences of operation shall incorporate the following control point/object requirements, as applicable:

Point Description	Hardware Point				Software Point				GRAPHIC
	AI	AO	DI	BI	AV	DV	SCHED	TREND	
BTU	X							X	X
Damper End Switch			X						X
DP	X							X	X

Point Description	Hardware Point				Software Point				GRAPHIC
	AI	AO	DI	BI	AV	DV	SCHED	TREND	
DPT					X			X	X
DT					X			X	X
Drain Pan Water Level Sensor			X						X
Electrical Power	X							X	X
Enthalpy					X			X	X
Flow (Air, Water, Steam, etc.)	X							X	X
Gas Concentration	X							X	X
Humidity	X							X	X
Occupancy/Vacancy			X					X	X
Occupied/Unoccupied				X			x	X	X
On/Off				X			x	X	X
Open/Close				X				X	X
Output (Percent)		X						X	X
Position (Percent from Normal)					X			X	X
P	X							X	X
Speed (% setpoint)		X						X	
Speed (% feedback)	X							X	X
Status			X					X	X
T	X							X	X

- D. All sequences of operation are based on one or more sensed variables, with an associated controlled variable, changing in one direction. **Each sequence shall operate in reverse when the sensed variable(s) changes in the opposite direction.**
- E. HVAC control setpoints are defined or implied within the sequences of operation specified hereinafter and/or elsewhere on the Drawings.
- Where a setpoint is not explicitly defined or implied, determine the appropriate setpoint based on scheduled performance data for HVAC equipment. **Confirm setpoint with A-E.**
 - Defined or implied setpoints and setpoint reset requirements shall, as necessary, be adjusted based on test data provided by the testing/adjusting/balancing (TAB) subcontractor and control system calibration and verification testing as required by Section 230923 to provide stable, satisfactory HVAC systems operation in compliance with the design intent.
 - AO setpoints and control ranges shall be user-adjustable.**
 - DO points that depend on a specific analog value to change shall be user-adjustable.**

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- F. The minimum speed setting for each pump and fan under VFD control shall be as low as possible, while avoiding inertial stalling. Adjust each VFD minimum speed and ramp-up and -down times based on test data provided by the TAB subcontractor. Default times for acceleration/deceleration shall be 30 seconds for motors less than 40 hp and 60 seconds for motors 40 hp and larger.
- G. Two independent schedules for HVAC system operation and control are required by Sequence 1.14, established as follows:
1. "ON/OFF" schedule(s) shall determine HVAC systems and/or equipment start/stop times, define applicable operating setpoints, and define when specific sequences of operation are to be utilized.
 - a. "ON" hour is defined as the estimated latest hour at which the HVAC system/equipment may be "ENABLED" and commanded "ON" so that setpoint conditions are maintained within the space(s) served at the "OCCUPIED" start hour. This "ON" hour shall be adjusted by the "Optimum Start" application specified in Section 230923.
 - b. "OFF" hour is defined as the hour at which the HVAC system/equipment shall be "DISABLED."
 2. "OCCUPIED/UNOCCUPIED" schedule(s) shall determine ventilation modes.
 3. These schedules define 5 specific operating periods for the HVAC systems to which they are applied:
 - a. "On" period is the elapsed time between the scheduled "On" hour, defined as the latest allowable hour at which the HVAC system must be "On," and the "Off" hour, during which the HVAC operates to maintain the spaces served at the defined "On" period temperature and/or humidity setpoints.
 - b. "Off" period is the elapsed time between the scheduled "Off" and "On" hours during which the HVAC system does not operate unless it is required to cycle "On" to maintain the spaces served at the defined "Off" period high and low limit temperature and/or humidity setpoints.
 - c. "Occupied" period is the elapsed time between the scheduled "Occupied" start and end hours during which people, to a greater or lesser extent, are expected to be present and required ventilation air.
 - d. "Unoccupied" period is the elapsed time between the scheduled "Occupied" end and start hours during which people, except at *de minimis* levels, are not expected to be present and, therefore, no ventilation air is required.
 - e. "Pre-Occupied" period is the elapsed time between the scheduled "On" hour and the actual "On" hour computed by the Optimum Start algorithm so that setpoint conditions are maintained within the space(s) served at the beginning of the "Occupied" period. (This period typically overlaps the "Unoccupied" period by 1-3 hours depending on input schedules.)
 4. For each of type, provide specific schedules for "Holidays," "Vacation Days," and multiple "Special Events" as defined by the Owner.
- H. Provide operator-defined maintenance "lockout" for each HVAC component. When initiated, any component defined to be locked out for maintenance shall be deleted from any applicable control sequence of operation.

3.2 SEQUENCES OF OPERATION

Index to Sequences of Operation

Section	ID	Description
GENERAL		
	1.10	Emergency Stop Control
	1.14	Schedules of Operation
	1.18	Input Point Monitoring and Alarm Initiation
	1.20	Output Point Control
	1.21	Constant Speed Single-Phase or Polyphase Motor Control
	1.22	Two-Speed Polyphase Motor Control
	1.23	Variable Speed Single-Phase Motor Control
	1.24	Variable Speed Polyphase Motor Control
	1.25	Single-Phase and Polyphase Motor Status Monitoring
	1.27	Exhaust Air Fan Start/Stop
	1.33	Final Control Element Operators (Valves and Dampers)
	1.39	Electric Resistance Heating Control
SITE CONDITIONS AND UTILITIES		
	2.01	Outdoor Air Conditions
	2.03	Cooler or Freezer Temperature Alarm
	2.07	Utilities Consumption
AIR-HANDLING SYSTEMS		
4.0 Air-Handling Systems Operations and Monitoring		
	4.00	Start/Stop Control
	4.01	Space Temperature/Humidity Setpoints and Monitoring
	4.05	Drain Pan Condensate Level Alarm
4.1 Single Zone Air-Handling Systems		
	4.11	Space Temperature and Humidity Control, Single Zone System
	4.11.1	CAV
	4.12	Minimum Outdoor Air Control, Single Zone System
	4.12.1	CAV
	4.12.2	VAV
	4.14	Demand Control Ventilation Control (DCV) Enable/Disable, Single Zone System
	4.14.1	DCV Based on Occupancy Schedule + Occupancy/Vacancy Sensing
	4.14.2	DCV Based on Occupancy Schedule + Operator/Manual Schedule Override

Section	ID	Description
		4.14.4 DCV Based on Occupancy Schedule + People Counting/Sensing
	4.15	Airside Economizer Control
PACKAGED DX COOLING SYSTEMS		
	5.10	Packaged/Split Air-Cooled DX Unit, CAV or VAV Single Zone System
	5.11	Space Temperature and Humidity Control, Single Zone Heating and Cooling System
	5.13	Space Temperature and Humidity Control, Single Zone Air Source Heat Pump System
	5.30	Packaged/Split Air-Cooled DX Unit, Outdoor Air Preconditioning System
SERVICE HOT WATER HEATING		
	6.10	Service Hot Water Heater
LIGHTING		
	9.10	Exterior Lighting

3.3 GENERAL DDC SEQUENCES

A. 1.10 **Emergency Stop Control:**

- The following elements shall be incorporated into sequences of operation, **whether specifically defined in individual sequences of operation hereinafter or not**, and shall initiate an alarm upon occurrence of any emergency stop:

Application	Configuration	Emergency Stop Requirements
FCU/BCU/AHU/PGAC/DOAS supply air fan(s) and return/relief air fan(s).	Unit serves single or multiple spaces.	Duct smoke detectors not required due to coverage of detection system. Emergency stop of all unit fans by fire alarm system shutdown relay/software interlock.

B. 1.14 **Schedules of Operation:**

System(s)	Hours (1-24) Each Day of the Week						
	MON	TUE	WED	THR	FRI	SAT	SUN
Admin Area and Lobby	6:00 am	6:00 am	6:00 am	6:00 am	6:00 am	Setback	Setback
	6:00 pm	6:00 pm	6:00 pm	6:00 pm	6:00 pm		
300, 400, and 500 Classrooms	6:00 am	6:00 am	6:00 am	6:00 am	6:00 am	Setback	Setback
	6:00 pm	6:00 pm	6:00 pm	6:00 pm	6:00 pm		
600 and 700 Classrooms	6:00 am	6:00 am	6:00 am	6:00 am	6:00 am	Setback	Setback
	6:00 pm	6:00 pm	6:00 pm	6:00 pm	6:00 pm		
Media Center Area	6:00 am	6:00 am	6:00 am	6:00 am	6:00 am	Setback	Setback
	6:00 pm	6:00 pm	6:00 pm	6:00 pm	6:00 pm		
Gymnasium and Lockers	6:00 am	6:00 am	6:00 am	6:00 am	6:00 am	Setback	Setback
	6:00 pm	6:00 pm	6:00 pm	6:00 pm	6:00 pm		
Cafeteria and Platform	6:00 am	6:00 am	6:00 am	6:00 am	6:00 am	Setback	Setback

System(s)	Hours (1-24) Each Day of the Week						
	MON	TUE	WED	THR	FRI	SAT	SUN
	6:00 pm	6:00 pm	6:00 pm	6:00 pm	6:00 pm		
Kitchen	05:00 am	05:00 am	05:00 am	05:00 am	05:00 am	Setback	Setback
	02:00 pm	02:00 pm	02:00 pm	02:00 pm	02:00 pm		
Occupied Damper Schedule	8:30 am	8:30 am	8:30 am	8:30 am	8:30 am	Unoccupied	Unoccupied
	2:30 pm	2:30 pm	2:30 pm	2:30 pm	2:30 pm		
Occupied Period Start Hour							
Occupied Period Stop Hour							

C. 1.18 **Input Point Monitoring and Alarm Initiation:**

1. Digital inputs (DI or DV):
 - a. MONITOR each DI and DV point for alarm condition.
 - 1) MONITOR each motor status and initiate alarms in accordance with Sequence 1.25.
 - b. Set digital point alarm condition the basis of field adjusted differential setpoints.
 - 1) Where start/stop or other two-position control sequence is based on a digital input status condition or input sensed variable value(s) (AI or AV), set time delays or digital filters to prevent any equipment item or final control element from "short-cycling" in response to small changes of the sensed variable(s).
 - 2) Incorporate user-adjustable time inhibit alarm(s) to prevent nuisance alarms and/or "tripping" under normal operation and during equipment start-up and shut-down.
 - c. For devices that have Form "C" relay contacts available for alarm monitoring, use NC contacts for the "Off" or "Normal" condition and NO contacts on "Alarm" condition.
2. Analog inputs (AI or AV):
 - a. Set high and/or low alarm setpoints for each point.
 - 1) The following default values shall be used if alarm setpoints are not defined within a specific sequence operation or indicated on the Drawings:

Space temperature	5°F below low setpoint of comfort zone or 5°F above high setpoint of comfort zone
Space humidity	≥ 70% RH
AHU mixed air low limit	≤ 38° F
Cooling coil leaving air	≥ 60° F
Heating coil leaving air	≤ 90° F

D. 1.20 **Output Point Control:**

1. Set each control loop to utilize one of the following control modes:
 - a. Digital (binary) output: Two position (e.g., on-off, slow-fast)
 - b. Analog output: Proportional (P) or proportional + integral (PI) function control, as follows:

Controlled Variable	Control Mode
Space Temperature	P
Mixed Air Temperature	PI
Coil Discharge Temperature	PI (cooling), P (heating)
Airflow	PI (with wide proportional band and fast reset rate)
Fan Static Pressure (Fan Speed)	PI
Humidity	P
Dewpoint Temperature	P
Other (not listed above or indicated on the Drawings)	Consult A-E

2. Analog output proportional band and gain setpoints:
 - a. Set on basis of actual sensor span, zero bias, and minimum proportional bands/throttling ranges, as follows, for all analog control loops to prevent "hunting:"
 - 1) Set proportional bands/throttling ranges to provide stable control around setpoints and as determined on an individual point basis **based on test data provided by the TAB subcontractor.**
 - 2) Default deadbands/throttling ranges are as follows:

Space temperature (cooling)	$\pm 1.5^{\circ}\text{F}$
Space temperature (heating)	$\pm 2.0^{\circ}\text{F}$
Space humidity	$\pm 5\% \text{ RH}$
Mixed/discharge air temperature	$\pm 0.25^{\circ}\text{F}$
Airflow (cfm) and water flow (gpm)	$\pm 2\% \text{ of design flow}$
3. Analog output integral gain setpoint:
 - a. Set to bring the measured variable to its setpoint without abrupt changes to HVAC equipment operation and, with the exception of condenser water bypass valve control, to limit every control loop output signal to a maximum rate of change of 25% per minute.
 - 1) **Only if this found to be impossible, may the proportional gain, as determined above, be adjusted.**
4. Analog output derivative gain setpoint:
 - a. **Derivative function for any control loop is prohibited unless reviewed by the A-E for each specific point. Set derivative gain to 0.**
5. Setpoint reset: For air or water systems in which the sequence of operation requires temperature, pressure, etc. setpoint to be reset based on valve or damper position of the zone(s) requiring cooling or heating, the following method shall be employed:
 - a. A floating reset algorithm shall be used that increments the secondary variable (e.g., temperature, pipe or duct pressure) setpoint on a periodic basis to maintain primary variable (e.g. cooling valve, heating valve, damper position) setpoint of 85% open. The reset increment shall be calculated based on the average position of the quantity of the worst (most open valve/damper) zone(s) as specified. **The recalculation time, reset increment and control device position influence shall**

be chosen to maintain the primary variable within the specified maximum allowable variance while minimizing overshoot and settling time.

6. Final control element operation:

- a. Normally open/normally closed: Two-way final control element position in response to 0% control loop output signal. Except as otherwise specified herein or indicated on the Drawings, "OFF" or "NORMAL" position of final control elements shall be as follows:

<u>Final Control Element</u>	<u>Off/Normal Position</u>
Outside air damper	closed
Return air damper	open
Exhaust/relief air damper	closed

- b. Direct acting/response: 0% to 100% change of final control element state or position in response to 0% to 100% control loop output signal.
- c. Reverse acting/response: 100% to 0% change of final control element state or position in response to 0% to 100% control loop output signal.

E. 1.21 **Constant Speed Single-Phase or Polyphase Motor Control:**

1. Motor shall be commanded "ON/OFF" via DO point.
2. MONITOR motor status as DI point in accordance with Sequence 1.25.
3. Emergency stop:
 - a. Hard-wired contact(s) shall "STOP" motor in accordance with motor emergency stop requirements defined hereinbefore.
 - b. Initiate alarm upon emergency stop.

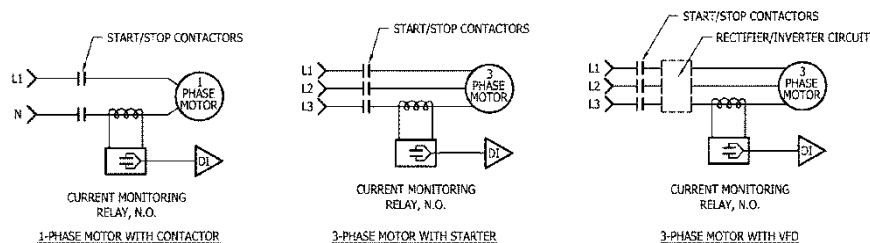
F. 1.22 **Two-Speed Polyphase Motor Control:**

1. Motor shall be commanded "ON" at low speed, commanded to switch from one speed to the other (high to low or low to high), and commanded "OFF" via two (2) DO points.
2. MONITOR motor status as DI point in accordance with Sequence 1.25.
3. Emergency stop:
 - a. Hard-wired contact(s) shall "STOP" motor in accordance with motor emergency stop requirements defined by Sequence 1.10.
 - b. Initiate alarm upon emergency stop.

G. 1.23 **Variable Speed Single-Phase Motor Control:**

1. Provide interface between DDC system and manufacturer-provided electronically commutated motor (ECM) integral speed controller.
2. Command motor "ON/OFF" via DO point.
 - a. MONITOR motor status as DI point in accordance with Sequence 1.25.
3. Emergency stop:
 - a. Hard-wired contact(s) shall "STOP" motor in accordance with motor emergency stop requirements defined by Sequence 1.10.
 - b. Initiate alarm upon emergency stop.
4. Modulate motor speed from minimum speed to 100% speed in direct response to AO point.

-
- a. ***Adjust minimum speed setpoint to value, as reviewed by A-E, using the following procedure:***
 - 1) Manually set ECM controller minimum speed output to 6 Hz (10% of maximum) unless (1) dictated otherwise by the equipment manufacturer or (2) defined otherwise by sequence(s) of operation.
 - 2) Observe driven equipment to ensure that it is visibly rotating.
 - 3) If not, increase controller minimum speed output in increments of 2 Hz until the unit driven equipment is visibly rotating.
 - 4) Ensure that the current sensing relay required by Sequence 1.25 confirms operation at the minimum speed setting.
 - 5. Initiate alarm via DI point if ECM controller status/fault contact closes.
- H. 1.24 **Variable Speed Polyphase Motor Control:**
- 1. Provide interface between DDC system and manufacturer-provided variable frequency drive (VFD) for motor speed control.
 - 2. Command motor “ON/OFF” via DO point.
 - 3. MONITOR motor status in accordance with Sequence 1.25.
 - 4. Emergency stop:
 - a. Hard-wired contact(s) shall “STOP” motor in accordance with motor emergency stop requirements defined by Sequence 1.10.
 - b. Initiate alarm upon emergency stop.
 - 5. Modulate motor speed from minimum speed to maximum speed in direct response to AO point.
 - a. ***Set minimum speed setpoint to value, as reviewed by A-E, using the following procedure:***
 - 1) Manually set VFD minimum speed output to 6 Hz (10% of maximum) unless (1) dictated otherwise by the equipment manufacturer or (2) defined otherwise by sequence(s) of operation herein defined.
 - 2) Observe driven equipment to ensure that it is visibly rotating. If not, increase controller minimum speed output in increments of 2 Hz until the unit driven equipment is visibly rotating.
 - 3) Ensure that the current sensing relay required by Sequence 1.25 confirms operation at the minimum speed setting.
 - b. ***Set maximum speed setpoint to value determined during TAB operations in order to obtain design flow.***
 - c. MONITOR motor speed feedback from VFD via AI point.
 - 6. Initiate alarm via DI point if VFD status/fault contact closes.
- I. 1.25 **Single-Phase and Polyphase Motor Status Monitoring:**



1. Motor "ON" or "OFF" status shall be determined via DI point contact closure by current monitoring relay as illustrated above.
 - a. Adjust current monitoring relay "trip" setpoint to 5% above the minimum operating motor amperage.
 - b. For variable speed motors, coordinate "trip" setpoint with minimum motor speed.
 - c. Monitor motor status anytime motor has been commanded "ON."
 2. Inhibit motor status monitoring for the first 10 seconds after motor is commanded "ON."
 3. If motor status DI point indicates motor failure:
 - a. For single pump or fan configurations, command motor "OFF," terminate associated start sequence, and initiate pump/fan failure alarm.
- J. 1.27 **Exhaust Fan Start/Stop:** Exhaust fan start/stop control methods shall be as indicated on the Drawings, in accordance with the following:

Indicated Control Method	Exhaust Fan Start/Stop Control Method
DDC	Start/stop exhaust fan(s) in accordance with (1) associated air-handling system "OCCUPIED/UNOCCUPIED" schedule or (2) operator command in compliance with Sequence 1.21.
Independent Thermostat	Start/stop exhaust fan(s) based on stand-alone, wall-mounted line-voltage thermostat; no DDC connection required. On a rise in space temperature to above setpoint, exhaust fan shall be energized to maintain space temperature at setpoint. See control schematic below.
Manual	Start/stop exhaust fan(s) via manual switches or breakers. See Division 26 Drawings, as applicable.

- K. 1.33 **Final Control Element Operators (Valves and Dampers):**
1. **Two-position** control operator shall "OPEN" or "CLOSE" final control element (valve/damper), as indicated on the Drawings, in direct response to DO point.
 - a. MONITOR final control element position as DI point equal to the DO point.
 - b. Final control element position shall be confirmed by visual inspection during the calibration and verification procedures required by Section 230923.
 2. **Modulating** control operator shall modulate 0% to 100% from its Normal state, as indicated on the Drawings, in direct response to AO point.
 - a. MONITOR final control element position as AI point whose value (percent) is equal to the AO point value (percent).

-
- b. Final control element position shall be confirmed as equal to the AO point value (percent) during the calibration and verification procedures required by Section 230923.
 - L. 1.39 **Electric Resistance Heating Coil Control:**
 - 1. **Mechanical Relay/Contactor Control:** Energize each circuit ("stage") of heating capacity, as scheduled on the Drawings, via DO point(s) in accordance with indicated sequence of operation.
- 3.4 SITE CONDITIONS AND UTILITIES
- A. 2.01 **Outdoor Air Conditions:**
 - 1. MONITOR ambient outdoor air conditions as AI points:
DB Temperature (°F)
RH (%)
 - 2. Compute DPT (°F) as AV point as a function of monitored DB and RH.
 - 3. Compute WB temperature (°F) as AV point as a function of monitored DB and RH.
 - 4. AI and AV point values shall serve as global inputs to any sequence of operation requiring an ambient outdoor air condition as a control or computational variable.
 - B. 2.03 **Cooler/Freezer Temperature Alarm:**
 - 1. MONITOR and display cooler or freezer temperature, as indicated on the Drawings, as AI point.
 - a. Initiate high temperature alarm if cooler or freezer temperature rises above high limit temperature setpoint.
 - C. 2.07 **Utilities Consumption:**
 - 1. MONITOR facility **primary** utilities consumption where indicated on the Drawings:
 - a. **Electricity:**
 - 1) Provide utility electrical power voltage monitor (three phase where applicable) for each building or indicated area of each building to determine availability of utility power status as DI.
 - a) In absence of utility power in any phase, command all equipment/components "OFF" within 7 seconds.
 - b) If utility power is recovered within 5 seconds, command all equipment/components "ON" as defined by each system/component sequence of operation.
 - c) When utility power has been restored after a period exceeding 7 seconds, all affected equipment/components shall be automatically commanded "ON" in sequence at 5 second intervals.
 - 2) Utilize one of the following methods for monitoring electrical energy via AI point for consumption computation(s):
 - a) Pulse output provided from power metering.
 - b) Contractor-installed current and voltage transformers.
 - b. **Fuel Gas:** Coordinate with natural gas utility supplier to utilize the following method for monitoring fuel gas consumption via AI point and consumption computation(s):

- 1) Pulse output provided from utility metering.
 2. Archive monitored data every 15 minutes, along with computed hourly, daily, and monthly consumption totals.
- 3.5 AIR-HANDLING SYSEMS
- 3.6.1 **4.0 GENERAL AIR-HANDLING SYSTEMS OPERATIONS AND MONITORING**
- A. **4.00 Start/Stop Control:**
1. Start/stop air-handling system supply air fan(s) and associated return or relief air fan(s), as applicable, in accordance with Sequence 1.21, 1.22, 1.23, or 1.24, as applicable, based on (1) user-defined "ON/OFF" schedule defined by Sequence 1.14, (2) optimum start time computation, or (3) operator command.
 - a. During "ON" periods, command air-handling system "ON" (start) unless inhibited by optimum start time computation, operator command, or an emergency stop interlock.
 - b. During "OFF" periods, command air-handling system "OFF" via DO point unless there is a need for heating, cooling, or dehumidification as evidenced by space temperature or humidity being out of zone "OFF" period low or high limit setpoint(s) defined by Sequence 4.01.
 2. Each exhaust fan associated with an air-handling system, as tabulated below, shall be commanded "ON" via DO point when the air-handling system is "ON" and commanded "OFF" via DO point when the air-handling system is "OFF," in accordance with Sequence 1.27:

Air-Handling System Tag	Exhaust Fan Tag	Area(s) Served
PGAC#6	F-5	Boys 202, Girls 203 and Cust C1
PGAC#9	F-6	Staff Toilets 111 and 112
PGAC#12	F-7	Girls 206, Boys 207 and Cust 2
PGAC#18	F-9	Girls 715, Boys 713, Storage 714
PGAC#28	F-11	Boys 603 & FT
PGAC#24	F-12	Girls 604 and Cust C3
DOAS#2	F-13	Locker Room Area
DOAS#2	F-14	Locker Room Area
DOAS#2	F-15	Locker Room Area

3. MONITOR fan motors(s) status via DI point(s) in accordance with Sequence 1.25.
- B. **4.01 Space Temperature/Humidity Setpoints and Monitoring:**
1. Space temperature and humidity control setpoints:

"ON" Period:	Temperature Range:	70-75°F Comfort Zone
	Max. Humidity:	60% RH High Limit
"OFF" Period:	Max. Temperature:	85°F High Limit
	Min. Temperature:	55°F Low Limit
	Max. Humidity:	70% RH High Limit
 2. Space temperature setpoints shall **not** be adjustable by space occupants.

3. Space humidity setpoints shall not be adjustable by space occupants.
 4. MONITOR each space temperature and humidity as individual AI point.
- C. 4.05 **Drain Pan Condensate Level Alarm:**
1. MONITOR drain pan condensate level sensor integral NO dry contact as a DI point.
 - a. Upon sensor detection of drain pan moisture, and after user-defined time delay (default = 3 minutes), stop air-handling system via DO point and initiate an alarm.

3.6.2 4.1 SINGLE ZONE AIR-HANDLING SYSTEMS

A. 4.11.1 **Space Temperature and Humidity Control, Single Zone System:**

1. In accordance with Sequence 4.01, space comfort setpoint shall be maintained as follows:
 - a. Where an air-handling system serves a single space, provide a single temperature + humidity sensor for the space served.
 - b. Where an air-handling system serves multiple spaces, provide temperature and humidity sensors for each space served as indicated on the Drawings.
2. Temperature control based on multiple space temperature sensors AI points, as indicated on the Drawings, shall be as follows:
 - a. Routinely (at least every 5 minutes) MONITOR and sort AI points from all space temperature sensors to determine which spaces are within the comfort temperature space.
 - b. If **1 or more spaces are above** the maximum comfort zone temperature setpoint **while 1 or more spaces are below** the minimum comfort zone temperature setpoint, compute the "percentage dissatisfied factor" (PDF) for each sensor as follows:
$$R = [-8.6479 + (0.2431 \times C)] + [0.3442 - (0.0073 \times C)] \times T$$
where C = Month of year (1-12)
$$T = \text{Sensor temperature, } ^\circ\text{C}$$
$$PD = 100 - \{95 \text{ EXP } [-(0.03353 \times R^4 + 0.2179 \times R^2)]\}$$
$$PDF = 0.9 \times (PD - 0.1)$$
 - c. Modulate the cooling via AO point to provide cooling or modulate the heating hot final control element(s) along with fan speed, as necessary to minimize the PDF at each space.

B. 4.12.1 **Minimum Outdoor Airflow Control, CAV Single Zone System:**

1. Set the minimum outdoor airflow **OA** setpoint as the greater of **VA** or **(EA + PA)** based on the following:

Variable	Description		"ON" Period	"OFF" Period
VA		Occupied Period	Minimum Required Ventilation Air as Scheduled on the Drawings	

Variable	Description		"ON" Period	"OFF" Period
	Minimum Ventilation Airflow (CFM)	Unoccupied Period	Va (Area Component of Minimum Required Ventilation Air)	0
EA	Sum of Exhaust Fan Airflows (CFM) In Building or Portion of Building Served by Air-Handling System.		As Indicated on Drawings	As Indicated on Drawings
PA	Excess Airflow (CFM) Required to Maintain Positive Pressure in Building or Portion of Building Served by Air-Handling System.		10% of EA	10% of EA

- During "OCCUPIED" periods and during "UNOCCUPIED" periods prior to the air-handling system being commanded "OFF," "ENABLE" minimum outdoor airflow and modulate outdoor air damper to preset "OPEN" positions to maintain OA at setpoint. ***Outdoor air damper positions [percent "OPEN"] for each outdoor airflow required by this sequence shall be determined by the TAB subcontractor.***
- Anytime the air-handling system is "OFF," modulate outdoor air damper 0% "OPEN" via AO point.

C. 4.12.2 **Minimum Outdoor Airflow Control, VAV Single Zone System:**

- Set the minimum outdoor airflow OA setpoint as the greater of VA or (EA + PA) based on the following:

Variable	Description		"ON" Period	"OFF" Period
VA	Minimum Ventilation Airflow (CFM)	Occupied Period	Minimum Required Ventilation Air as Scheduled on the Drawings	0
		Unoccupied Period	Va (Area Component of Minimum Required Ventilation Air)	
EA	Sum of Exhaust Fan Airflows (CFM) In Building or Portion of Building Served by Air-Handling System.		As Indicated on Drawings	As Indicated on Drawings
PA	Excess Airflow (CFM) Required to Maintain Positive Pressure in Building or Portion of Building Served by Air-Handling System.		10% of EA	10% of EA

2. During “OCCUPIED” periods and during “UNOCCUPIED” periods prior to the air-handling system being commanded “OFF,” “ENABLE” minimum outdoor airflow control maintain OA at setpoint, as follows:
 - a. Outdoor airflow rate monitoring and control:
 - 1) MONITOR minimum outdoor airflow **OA** as AI point.
 - 2) Maintain minimum outdoor airflow **OA** at setpoint by modulating the outdoor air damper and, as necessary, the return air damper, via AO point(s) as follows:
 - a) If **OA** falls below the minimum ventilation airflow **VA** and the outdoor air damper is modulated 100% “OPEN,” modulate return air damper from 100% to 0% “OPEN” via AO point.
 - b) If **OA** falls below the minimum ventilation airflow **VA** after the outdoor air damper is modulated 100% “OPEN” and the return air damper is modulated 100% “CLOSED,” reset the minimum supply fan speed setpoint upward.
 3. Anytime the air-handling system is “OFF,” modulate outdoor air damper 0% “OPEN” via AO point.
- D. 4.14 **Demand Control Ventilation (DCV) Enable/Disable, Single Zone System:**
 1. During “OCCUPIED” periods, ENABLE demand control ventilation, as follows:
 - a. Inhibit Sequence 4.14.1 during the first hour after beginning of each "OCCUPIED" period.
 2. During “UNOCCUPIED” periods and anytime the air-handling system is “OFF,” DISABLE demand control ventilation.
- E. 4.14.1 **Demand Control Ventilation (DCV) Based on Occupancy Schedule + Occupancy/Vacancy Sensing, Single Zone System:**
 1. Anytime occupancy/vacancy sensor(s) determine(s) that **all** spaces served by an air-handling system become unoccupied, minimum ventilation airflow, **VA**, setpoint in Sequence 4.12.1 shall be reduced to the greater of (**EA + PA**) or the area component of the design ventilation airflow, **VA**, dictated by ASHRAE *Standard 62.1*.
- F. 4.14.2 **Demand Control Ventilation (DCV) Based on Occupancy Schedule + Operator/Manual Schedule Override, Single Zone System:**
 1. During “NORMAL OCCUPIED” periods, minimum ventilation airflow, **VA**, setpoint in Sequence 4.12.1 or 4.12.2, as applicable, shall be the “NORMAL” ventilation airflow as scheduled on the Drawings.
 2. During “EVENT OCCUPIED” periods defined by (1) manual “event override switch” in accordance with Section 230913 or (2) operator override of Sequence 1.14, minimum ventilation airflow **VA** setpoint in Sequence 4.12.1 or 4.12.2, as applicable, shall be the “EVENT” outdoor airflow as scheduled on the Drawings.
 - a. Maximum length of “EVENT OCCUPIED” period (override) shall be 3 hours.
 - b. If “EVENT OCCUPIED” period extends past midnight, terminate “EVENT OCCUPIED” period override of Sequence 1.14 at 12:01 a.m.
- G. 4.14.4 **Demand Control Ventilation (DCV) Based on Occupancy Schedule + People Counting/Sensing, Single Zone System:**
 1. “People Counting” shall be by sensing space CO₂.

2. Every 5 minutes, MONITOR the total actual population in the space(s) served by an air-handling system.
 - a. If actual population is 0 (zero), the minimum ventilation airflow, **VA**, setpoint in Sequence 4.12.1 or 4.12.2, as applicable, shall be reduced to the greater of (**EA + PA**) or the area component of the design ventilation airflow **Va**, whichever is greater.
 - b. If the actual population is 1 or more, compute the population ratio, **PR**, as follows:

$$\mathbf{PR} = (\text{Actual Population}) / (\text{Design Population})$$
 If computed **PR** exceeds 1.0, reset **PR** to 1.0.
 - c. The minimum ventilation airflow, **VA**, setpoint in Sequence 4.12.1 or 4.12.2, as applicable, shall be reduced to the greater of (**EA + PA**) or the population-adjusted area component of the design ventilation airflow (**Va x PR**).

H. 4.15 **Airside Economizer Control:**

1. During “ON” periods, ENABLE airside economizer control. Each outdoor air damper, return air damper, and relief fan and air damper shall be modulated as an individual AO point, as follows:
 - a. Dry bulb enthalpy control:
 - 1) When the air-handling system is providing cooling, as evidenced by the space temperature being above the maximum comfort temperature setpoint, **and** the outdoor air temperature is at or below 55°F, modulate the cooling “OFF” via AO point and maintain space temperature at setpoint by modulating the outdoor air, return air, and relief fan and air dampers via AO points.
 - 2) When the air-handling system is providing cooling, as evidenced by the space temperature being above the maximum comfort temperature setpoint, **and** the outdoor temperature is above 55°F but at or below 65°F, modulate the outdoor air and relief fan and air dampers 100% “OPEN” and return air damper 100% “CLOSED” via AO points so that the system operates with 100% outdoor air supply. Maintain the space temperature by modulating the cooling via AO point.
 - 3) When the outdoor air temperature is above 65°F, modulate the outdoor air to minimum “OPEN”, relief fan and air dampers 100% “CLOSED” and return air damper 100% “OPEN” via AO point so that the system operates with only minimum outdoor air supply. Maintain space temperature setpoint by modulating cooling via AO point.
 - b. Return air fan control (Flow Tracking):
 - 1) MONITOR supply fan airflow **SA** as AI point.
 - 2) MONITOR return fan airflow **RA** as AI point.
 - 3) Modulate return fan speed through VFD via AO point to maintain building outdoor airflow **OA** at setpoint.
 - 4) Modulate relief air damper via AO point “OPEN” to maintain relief airflow computed as [**RA - (SA - OA)**].
 - c. Relief air fan control (Flow Tracking):

- 1) If $[OA - (EA + PA)] > 0$, relief air fan shall be commanded "ON" via DO point.
 - a) Confirm fan operation based on fan motor status as DI point in accordance with Sequence 1.25.
 - 2) MONITOR relief air fan airflow as AI point.
 - 3) Modulate relief air fan speed through VFD via AO point to maintain relief airflow at $[OA - (EA + PA)]$.
 - 4) Modulate relief air damper 0-100% "OPEN" via AO point in direct proportion to relief air fan speed.
2. During "OFF" periods, modulate all dampers to their "normal" position.
- 3.6 PACKAGED AIR-COOLED DX SYSTEMS
- A. 5.10 **Packaged/Split Air-Cooled DX Unit, CAV or VAV Single Zone System:**
1. **PRIMARY UNIT CONTROL IS PROVIDED BY DDC SYSTEM PROGRAMMABLE CONTROLLER INTERFACED WITH DDC SYSTEM.**
 2. Thermostatic interface between the DDC system and each single zone packaged unit shall be based on the following:

Packaged/Split Single Zone HVAC System		
DDC I/O Point	Control Sequence Function	Controller Thermostatic Interface Terminals
L1	24v power	R, RC, RH
C	24v neutral	C
DO	Indoor fan start/stop	G
DO	First stage of cooling on/off	Y or Y1
DO	Second stage of cooling on/off	Y2
DO	First stage of heating on/off	W or W1
DO	Second stage of heating on/off	W2
DO	Third stage of heating on/off	W3
DO	Heat pump reversing valve actuation	O, B
DO	Hot gas reheat valve	HGV (on/off)
AO	Hot gas reheat valve	HGV (modulating)
DO	Auxiliary/back-up heating on/off	E
DI	Packaged unit internal fault/failure/alarm	Varies

- B. 5.11 **Space Temperature and Humidity Control, Single Zone CAV or VAV Heating/Cooling System:**
1. Space temperature and humidity setpoints shall be in accordance with Sequence 4.01.
 2. CAV System:
 - a. "ON" period temperature and high limit humidity control:
 - 1) On a rise in space temperature to above the maximum comfort zone temperature setpoint, initiate stage 1 of cooling via DO point.

-
- a) On a continued rise in space temperature to above the maximum comfort zone temperature setpoint, initiate stage 2 of cooling via DO point.
 - 2) On a rise in any space humidity to above the high limit humidity setpoint, initiate stage 1 of cooling via DO point to maintain space humidity at high limit setpoint.
 - a) On a continued rise in any space humidity to above the high limit humidity setpoint, initiate stage 2 of cooling via DO point to maintain space humidity at high limit setpoint.
 - b) Modulate hot gas reheat valve via AO point to maintain space temperature at the maximum comfort zone temperature setpoint.
 - 3) On a fall in space temperature to below the minimum comfort zone temperature, modulate the heating coil final control element(s) via AO points to maintain space temperature at the minimum comfort zone temperature, as follows:
 - a) Fuel-Fired Furnace: Modulate stage 1 (low fire) heating "ON" via AO point. On a further fall in space temperature, modulate stage 2 (high fire) heating "ON" via AO point.
 - b) Staged Electric Coil Control: Modulate each stage of the heating coil "ON," in sequence.
 - 4) When the space temperature is within the limits of the minimum and maximum comfort zone temperatures, both cooling and heating coil final control elements shall be modulated "CLOSED/OFF" via AO points.
 - b. "OFF" period high limit temperature and humidity control:
 - 1) On a rise in space temperature to above the high limit setpoint temperature, energize the supply fan via DO point and initiate stage 1 of cooling via DO point to maintain space temperature at the high limit setpoint temperature **minus 5°F**.
 - a) On a continued rise in space temperature to above the high limit setpoint temperature, initiate stage 2 of cooling via DO point to maintain space temperature at the high limit setpoint temperature **minus 5°F**.
 - 2) On a rise in any space humidity to above the high limit humidity setpoint, initiate stage 1 of cooling by DO point and modulate the hot gas reheat valve via AO point to maintain space temperature at the high limit setpoint temperature.
 - a) On a continued rise in any space humidity to above the high limit humidity setpoint, initiate stage 2 of cooling via DO point and modulate the hot gas reheat valve via AO point to maintain space temperature at the high limit setpoint temperature.
 - 3) On a fall in space temperature to below the low limit setpoint temperature:
 - a) Fuel-Fired Furnace Control:

-
- i. Modulate stage 1 (low fire) heating "ON" via AO point to maintain space temperature at low limit setpoint temperature **plus 5°F**.
 - On a further fall in space temperature, modulate stage 2 (high fire) heating "ON" via AO point to maintain space temperature at low limit setpoint temperature **plus 5°F**.
 - b) Staged Electric Coil Control:
 - i. Command air-handling system "ON" via DO point in accordance with Sequence 4.00 with supply airflow modulated to minimum through VFD via AO point.
 - As applicable, command return fan "ON" via DO point and modulate return airflow through VFD via AO point to maintain 0 cfm difference between supply and return airflows.
 - As applicable, command relief fan "OFF" via DO point.
 - ii. Modulate each stage of the heating coil "ON," in sequence, via AO point to maintain space temperature at low limit temperature **plus 5°F**.
 - 4) Once space conditions return to within limit conditions, **± 5°F and/or minus 5% RH as above**, for 5 minutes, de-energize supply fan via DO point.
 - 3. VAV (Two-Speed Fan) System:
 - a. "ON" period space temperature and high limit humidity control:
 - 1) On a rise in space temperature above the maximum comfort zone temperature, provide cooling as follows:
 - a) From 0% to 49% space temperature AI signal, cooling airflow shall be minimum unit airflow. Initiate stage 1 cooling via DO point to maintain space temperature at maximum comfort zone temperature setpoint.
 - b) From 50% to 100% space temperature AI signal, increase fan speed from minimum speed to maximum speed. Cycle stage 2 cooling "ON/OFF" via DO point to maintain space temperature at maximum comfort zone temperature setpoint.
 - 2) On a rise in any space humidity to above the high limit humidity setpoint, provide dehumidification as follows:
 - a) Set dehumidification airflow at maximum unit airflow and initiate stage 1 cooling via DO point to maintain space humidity at high limit humidity setpoint.
 - i. On a continued rise in any space humidity to above the high limit humidity setpoint, initiate stage 2 cooling via DO output to maintain space humidity at high limit humidity setpoint.

-
- ii. Modulate the hot gas reheat valve via AO point to maintain space temperature at the maximum comfort zone temperature.
 - 3) On a fall in space temperature to below the minimum comfort zone temperature setpoint, provide heating as follows:
 - a) From 0% to 49% AI point signal:
 - i. Change supply fan speed via AO point to minimum speed.
 - ii. Modulate the heating coil final control element via AO points to maintain space temperature at the minimum comfort zone temperature, as follows:
 - Fuel-Fired Furnace Control: Modulate stage 1 (low fire) heating "ON."
 - b) From 50% to 100% AI point signal:
 - i. Change supply fan speed via AO point to maximum speed.
 - ii. Modulate heating final control element(s) in sequence with preheat coil control element(s), as applicable, to 100% "OPEN/ON" via AO points, as follows:
 - Fuel-Fired Furnace Control: Modulate stage 2 (high fire) heating "ON."
 - 4) When the space temperature is within the limits of the minimum and maximum space temperature setpoints, both cooling and heating final control elements shall be modulated "CLOSED/OFF" and fan speed shall be set at minimum.
 - b. "OFF" period high limit temperature and humidity control:
 - 1) On a rise in space temperature to above the high limit setpoint temperature, energize the unit fan at maximum speed via DO point and initiate stage 1 of cooling via DO point to maintain space temperature at the high limit setpoint temperature **minus 5°F**.
 - a) On a continued rise in space temperature to above the high limit setpoint temperature, initiate stage 2 of cooling via DO point to maintain space temperature at the high limit setpoint temperature **minus 5°F**.
 - 2) On a rise in any space humidity to above the high limit humidity setpoint, energize the unit fan at maximum speed via DO point and initiate stage 1 of cooling via DO point to maintain space humidity at high limit setpoint **minus 5% RH**.
 - a) On a continued rise in any space humidity to above the high limit humidity setpoint, initiate stage 2 of cooling via DO point to maintain space humidity at high limit setpoint **minus 5% RH**.
 - b) Modulate hot gas reheat valve via AO point to maintain space temperature at the high limit setpoint temperature.
 - 3) On a fall in space temperature to below the low limit temperature setpoint:
 - a) Fuel-Fired Furnace Control:

-
- i. Command air-handling system "ON" via DO point in accordance with Sequence 4.00 with supply airflow modulated to minimum through VFD via AO point.
 - As applicable, command return fan "ON" via DO point and modulate return airflow through VFD via AO point to maintain 0 cfm difference between supply and return airflows.
 - As applicable, command relief fan "OFF" via DO point.
 - ii. Modulate stage 1 (low fire) heating "ON" via AO point to maintain space at low limit temperature **plus 5°F**.
 - On a further fall in space temperature, increase fan speed from minimum speed to maximum speed and modulate stage 2 (high fire) heating "ON" via AO point to maintain space at low limit temperature **plus 5°F**.
 - 4) Once space conditions return to within limit conditions, **± 5°F and/or minus 5% RH as above**, for 5 minutes, de-energize air-handling unit.
 - C. **5.13 Space Temperature and Humidity Control, Single Zone CAV Air Source Heat Pump:**
 - 1. Space temperature and humidity setpoints shall be in accordance with Sequence 4.01.
 - 2. CAV System:
 - a. "ON" period temperature and high limit humidity control:
 - 1) On a rise in space temperature to above the maximum comfort zone temperature setpoint, initiate stage 1 of cooling via DO point.
 - a) On a continued rise in space temperature to above the maximum comfort zone temperature setpoint, initiate stage 2 of cooling via DO point.
 - 2) On a rise in any space humidity to above the high limit humidity setpoint, initiate stage 1 of cooling via DO point to maintain space humidity at high limit setpoint.
 - a) On a continued rise in any space humidity to above the high limit humidity setpoint, initiate stage 2 of cooling via DO point to maintain space humidity at high limit setpoint.
 - b) Modulate hot gas reheat valve via AO point to maintain space temperature at the maximum comfort zone temperature setpoint.
 - 3) On a fall in space temperature to below the minimum comfort zone temperature setpoint, initiate stage 1 of heating via DO point to maintain space temperature at minimum comfort zone temperature setpoint.
 - a) On a further fall in space temperature to below the minimum comfort zone temperature setpoint, initiate stage 2 of heating via DO point to maintain space temperature at minimum comfort zone temperature setpoint.
 - i. If stage 2 heating is maintained for 15 minutes, but the space temperature continues to fall, energize the stage 3 supplemental

electric resistance heater via DO point to maintain the space temperature at the minimum comfort zone temperature setpoint.

- 4) When the space temperature is within the limits of the minimum and maximum zone temperature setpoint and space humidity is at or below the high limit humidity setpoint, unit fan shall operate and no cooling or heating shall be initiated.
- b. "OFF" period high limit temperature and humidity control:
 - 1) On a rise in space temperature to above the high limit setpoint temperature, energize the unit fan via DO point and initiate stage 1 via DO point of cooling to maintain space temperature at the high limit temperature setpoint **minus 5°F**.
 - a) On a continued rise in space temperature to above the high limit setpoint temperature, initiate stage 2 of cooling via DO point to maintain space temperature at the high limit temperature setpoint **minus 5°F**.
 - 2) On a rise in any space humidity to above the high limit humidity setpoint, energize unit fan via DO point, initiate stage 1 of cooling via DO point to maintain space humidity at high limit humidity setpoint **minus 5% RH**.
 - a) On a continued rise in any space humidity to above the high limit humidity setpoint, initiate stage 2 of cooling via DO point to maintain space humidity at high limit humidity setpoint **minus 5% RH**.
 - b) Modulate the hot gas reheat valve via AO point to maintain space temperature at the high limit temperature setpoint.
 - 3) On a fall in space temperature to below the low limit setpoint temperature, energize the unit fan via DO point and initiate stage 1 of heating to maintain space temperature at the low limit temperature setpoint **plus 5°F**.
 - a. On a further fall in space temperature to below the low limit setpoint temperature, initiate stage 2 of heating via DO point to maintain space temperature at the low limit temperature setpoint **plus 5°F**.
 - i. If stage 2 heating is maintained for 15 minutes, but the space temperature continues to fall, energize the supplemental electric resistance heater (in stages, as applicable) to maintain the space temperature at the low limit temperature setpoint **plus 5°F**.
 - 4) Once space conditions return to within limit conditions, $\pm 5^{\circ}\text{F}$ and/or **minus 5% RH as above**, for 5 minutes, de-energize unit.
- D. 5.30 **Packaged/Split Air-Cooled DX Unit, Outdoor Air Preconditioning System:**
 1. Command unit and associated exhaust fans "ON/OFF," as defined by Sequence 4.00, as defined below or upon operator command.
 - a. Where ventilation air is supplied to air-handling systems, unit shall start/stop via software interlock with air-handling systems served.
 - b. Where ventilation air is supplied directly to occupied spaces, unit shall start/stop in accordance with user-defined "ON/OFF" schedule defined by Sequence 1.14 or upon operator command.
 2. MONITOR HVAC unit fault/failure/alarm as DI point.
 3. MONITOR fan motors(s) status as AI point(s) in accordance with Sequence 1.25.

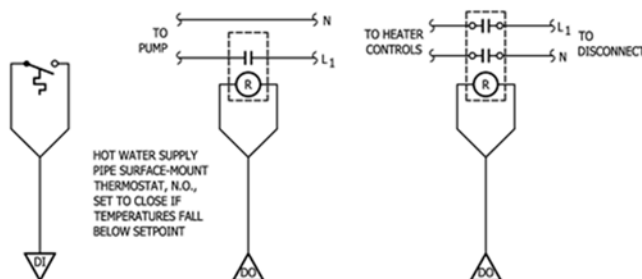
4. Ventilation air temperature and humidity control:
- MONITOR discharge air dry bulb temperature and discharge air dewpoint temperature as AI points.
 - Discharge air dry bulb temperature setpoint controller shall be input via AO point from the DDC system as follows:

Outdoor Air Temperature(°F)	Discharge Air Dry Bulb Temperature (°F)
$\leq 50^{\circ}\text{F}$	72°F
$\geq 85^{\circ}\text{F}$	55°F

- Controller shall maintain discharge air dry bulb and dewpoint temperatures as follows:
 - Discharge air dry bulb temperature shall be maintained at setpoint temperature input from the DDC system.
 - Discharge air dewpoint temperature shall maintained at or below 50°F.
5. Ventilation Airflow Control:
- When DVA unit is "ON":
 - MONITOR supply airflow as AI point, computed on the basis of velocity pressure input and supply duct cross sectional area.
 - MONITOR ventilation supply air duct static pressure as AI input.
 - When ventilation air is distributed into each space through air outlet(s), 2-position air damper(s) shall "OPEN" and close based on user-defined "OCCUPIED/ UNOCCUPIED" schedule in conjunction with space occupancy/vacancy sensor(s) or people-counting technologies sensor(s), as applicable.
 - During "OCCUPIED" periods, when sensor(s) confirms that any space served is occupied, the damper shall be 100% "OPEN".
 - Anytime sensor(s) determine that the space is unoccupied, the damper shall be closed.
 - When unit is "OFF", bypass damper shall be modulated "CLOSED" via AO point.

3.7 SERVICE HOT WATER HEATING

A. 6.10 Service Hot Water Heater:



- "ENABLE" service hot water heater and start/stop recirculation pump(s) in accordance with Sequence 1.21 based upon (1) user-defined "ON/OFF" schedule in accordance with sequence 1.14 or (2) operator command.
- Low hot water temperature alarm:

- a. Set pipe surface mounted thermostat low supply temperature setpoint (default = 100°F)
- b. When heater is commanded "ON", initiate alarm if pipe surface mounted thermostat switch closes, indicating low temperature condition, after 30 minutes.

3.8 LIGHTING

A. 9.10 Exterior Lighting:

1. Each exterior lighting control relay, as indicated on the Drawings, shall be "OPEN"/"CLOSED" via DO point in accordance with user-defined "ON/OFF" schedule in accordance with Sequence 1.14.
 - a. Provide manually adjustable setpoint photocell sensor(s), as indicated on the Drawings, to inhibit exterior lighting during daylight hours.

END OF SECTION

SECTION 26 0000

ELECTRICAL, BASICS

1.1 RELATED DOCUMENTS

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

1.2 GENERAL

- A. Applicable requirements of the Instructions to Bidders and General Conditions of the Contract shall be a part of the Electrical Specifications. The electrical contractor shall examine the general and special conditions before submitting a proposal.
- B. The electrical work shall be performed by a licensed electrical contractor.
- C. The electrical contractor shall assume total responsibility for any portion of the work provided by his subcontractors.

1.3 CODES AND STANDARDS

- A. Building Codes:
 - 1. National Fire Protection Association No. 70, National Electrical Code
 - 2. North Carolina State Building Code, Latest Edition and Revisions (NCSBC)
 - 3. National Electrical Safety Code (NESC)
 - 4. National Bureau of Standards (NBS)
 - 5. Local Codes where applicable
- B. Industry Standards:
 - 1. Underwriter's Laboratories, Inc. Standards and approved listings (UL)
 - 2. Electrical Testing Laboratories Standards (ETL)
 - 3. National Electrical Manufacturers Association Standards (NEMA)
 - 4. Insulated Power Cable Engineers Association Standards (IPCEA)
 - 5. American National Standards Institute (ANSI)
 - 6. American Society for Testing Materials Standards (ASTM)
 - 7. Canadian Standards Association (CSA)

1.4 SCOPE OF WORK

- A. It is the intent and meaning of the drawings and specifications to call for finished work that has been tested and is ready for operation. The electrical contractor shall take this into consideration and include in his proposal allowance for contingencies that will allow him to provide minor pieces of materials and labor not specifically indicated but required for the job to operate properly. This paragraph is intended to insure a complete job will be provided without requests for minor extras.

1.5 ELECTRICAL SERVICE

- A. The electrical contractor shall be totally responsible for coordination with the Utility Company and assistance to the OWNER for rework of the electrical services for the structure. He shall act as coordinator between the Utility Company and the OWNER and shall supply the Utility Company with equipment characteristics, load data, etc. Any installation, connection, underground service or special fees charged by the Utility Company for the new services shall

be paid by the OWNER. Construction and testing power shall be paid for as described in the General Conditions of the project manual. Electrical service to the main school structure shall be 277/480 volts, 3 phase, 4 wire.

- B. Electrical service for mobile unit buildings shall be 120/240 volts, single phase, 3 wire.
- C. The electrical contractor shall coordinate the electrical services, metering and metering equipment with the local utility company for arrangements, locations, connections, etc.
- D. Utility transformer pads shall be installed by the electrical contractor. Coordinate equipment pad requirements with the local utility company.
- E. Current transformer cabinets and self-contained meter cabinets shall be furnished installed by the electrical contractor, unless directed otherwise by the Utility Company. Coordinate metering requirements with the Utility Company before rough-in of service raceways.
- F. The electrical service entrance raceways shall be installed by the electrical contractor and sized as shown on the contract drawings, or as required by the Utility Company. Service entrance conductors will be provided and installed by the Utility Company to the line side of the metering equipment. Service entrance conductors from the metering equipment to the service equipment shall be provided by the electrical contractor. Load side connections shall be made by the electrical contractor.

1.6 RECORD DRAWINGS

- A. A set of drawings covering the electrical contract will be provided to the electrical contractor to mark all changes, modifications, or revisions effected during construction. These field mark-up drawings are to be turned over to the electrical designer.
- B. The electrical contractor shall provide photographs of switchboards and panelboards. Photographs shall clearly show equipment designations, manufacturer nameplates, breaker positions, breaker ratings, and directory descriptions.

1.7 APPROVAL OF MATERIALS

- A. See project manual contract documents for pre-bid substitution requirements.
- B. Construction phase: The CONTRACTOR shall submit his proposal on the specified materials and equipment, or their equivalent, provided the words "or equal" or "or approved equal" follow the named manufacturers. If the above phrases do not appear, the specified manufacturers shall be furnished without substitution. Equivalent shall be interpreted to mean an item of material or equipment, similar to that named and which is suitable for the same use and capable of performing the same functions as that named, the ARCHITECT and/or ENGINEER (A/E) being the judge of equality.
- C. Where no specific material or equipment type is mentioned, any first-class product of a reputable manufacturer may be used provided it conforms to the requirements of the specifications. These materials shall be third party listed or labeled in accordance with the General Statutes of the State (example: UL, ETL, CSA, etc.).

1.8 SHOP DRAWINGS AND SUBMITTAL DATA PROCEDURES

- A. Unless directed otherwise in the Architectural Specifications, Civil Specifications, or General Provisions and/or Conditions of the Contract, the CONTRACTOR shall submit PDF files of shop drawings, certified prints, literature, and cuts to the A/E for all major items of equipment and materials for review and approval. It is preferred that all electrical submittals for the project shall be submitted at one and the same time.

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- B. Product data cut sheets with multiple components, part numbers, etc. shall be clearly marked to identify what is proposed for this project.
- C. The CONTRACTOR shall analyze all shop drawings and submittal data and certify that they meet requirements of Contract Drawings and Specifications, prior to delivery to the A/E. CONTRACTOR Certification shall be in the form of suitable approval stamp placed on each shop drawing submitted for approval.
- D. If the A/E deems submittal data is either incomplete or incorrect, a resubmittal submittal will be required.
- E. At least one set of all “approved” shop drawings, certified prints, etc., shall be maintained at the job site and available to representative of the A/E.
- F. Approval by the A/E of shop drawings for any materials, apparatus, devices, and layouts shall not relieve the CONTRACTOR from the responsibility of furnishing same of proper dimensions, size, quantity, quality and all performance characteristics to efficiently perform the requirements and intent of the contract documents. Such approval shall not relieve the CONTRACTOR from responsibility for errors of any sort on the shop drawings. If the shop drawings deviate from the Contract Documents, the CONTRACTOR shall advise the A/E of the deviations in writing, accompanying the shop drawings, including the reason for the deviations.
- G. Physical sizes of equipment used in the design layout are those of reputable equipment manufacturers. The CONTRACTOR is responsible for providing equipment that will fit the space available. If the CONTRACTOR elects to use equipment that results in conflicts with space clearance or codes, it shall be the responsibility of the CONTRACTOR to correct at his expense. The CONTRACTOR shall assume responsibility for providing code clearances. Where equipment is designated for existing space, the CONTRACTOR shall make necessary field measurements to ascertain space requirements, including those for connections; and shall furnish and install such sizes and shapes of equipment that the final installation shall suit the intent and meaning of the drawings and specifications.
- H. Catalog Data for OWNER:
1. The CONTRACTOR shall provide compilations of catalog data, bound in suitable loose-leaf binders, for each manufactured item of equipment used in the electrical work. These shall be presented to the A/E for transmittal to the OWNER before the final inspection is made. Data shall include printed installation, operation, and maintenance instructions for each item, indexed by product with heavy sheet dividers and tabs. All warranties shall be included with each item. Each manufacturer’s name, address, and telephone number shall be clearly indicated. Generally, shop drawings and submittal data alone are not adequate for catalog data.
- I. Record Documents for OWNER:
1. Conductor and cable megger test results.
 2. Grounding electrode system test results.
 3. Transformer tap settings and output voltages.
 4. Circuit breaker trip settings.
 5. Communications backbone cable:
 - a. Test results.
 - b. Cable schedule.

- c. Cable administration drawings.
- 6. Communications horizontal cable:
 - a. Test results.
 - b. Cable schedule.
 - c. Cable administration drawings.
- 7. Fire alarm system:
 - a. NFPA 72 Fire Alarm System Record of Completion.
 - b. System Status and Programming Report.
 - c. System operational matrix.
 - d. Digital copy of system software on USB flash drive.

1.9 DRAWINGS AND SPECIFICATIONS

- A. The Electrical drawings and specifications are complementary to each other. What may be called for by one shall be as binding as if called for by both. The drawings are diagrammatic and indicate generally the location of outlets, devices, equipment wiring, etc and show the general arrangement of raceways, fixtures, and equipment. Drawings shall be followed as closely as actual building construction and the work of other trades will permit; however, all work shall suit the finished surroundings and/or trim.
- B. It shall be understood that where the words “furnish,” “provide,” and/or “install” are used, it is intended that this CONTRACTOR shall purchase and install completely all material necessary and required for this particular item, system, equipment, etc.
- C. Any omission from either the drawings or the specifications are unintentional, and it shall be the responsibility of the CONTRACTOR to call to the attention of the A/E any pertinent omissions before submitting a proposal. Complete and working systems are required, whether every small item of material is shown and specified or not.
- D. The electrical work shall conform to the requirements shown on all of the drawings. General and Structural drawings shall take precedence over Electrical Drawings. Because of small scale of the electrical drawings, it is not practical to indicate offsets, fittings and accessories that may be required. The CONTRACTOR shall investigate the structural and finish conditions affecting the work and shall arrange his work accordingly, providing such fittings and accessories as may be required to meet such conditions, without additional cost to the OWNER and as directed by the A/E.
- E. Load circuits shall be installed as indicated on the drawings. Circuit number revisions will not be accepted unless approved in writing by the Engineer.

1.10 COORDINATION OF WORK

- A. It is understood and agreed that by submitting a bid, the CONTRACTOR has, by careful examination, satisfied himself as to the nature and location of the work, the conformation of the ground, the character, quality and quantity of the materials to be encountered, the general and local conditions and all other matters which can and may affect the work under this contract. The CONTRACTOR shall be held responsible for visiting the site and thoroughly familiarizing himself with the existing conditions and also any contractual requirements as may be set forth in the other divisions of these specifications. No extras will be considered because of additional work necessitated by obvious job conditions that are not indicated on the drawings.

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- B. The CONTRACTOR shall compare the electrical drawings and specifications with the drawings and specifications for other trades and shall report any discrepancies between them to the A/E and obtain from him written instructions for changes necessary in the electrical work. The electrical work shall be installed in cooperation with other trades installing interrelated work. Before installation, the CONTRACTOR shall make proper provisions to avoid interferences in a manner approved by the A/E. All changes required in the work of the CONTRACTOR caused by his neglect to do so shall be made by him at his expense.
- C. Location of electrical raceways, switches, panels, equipment, fixtures, etc., shall be adjusted to accommodate the work to interferences anticipated and encountered. The CONTRACTOR shall determine the exact route and location of each electrical raceway prior to make up and assembly.
- D. Right-of-Way: Lines which pitch shall have the right-of-way over those which do not pitch. For example, steam, condensate and plumbing drains shall normally have right of way. Lines whose elevations cannot be changed shall have the right of way over lines whose elevations can be changed.
- E. Offsets and changes in direction of electrical raceways shall be made as required to maintain proper headroom and to clear pitched lines whether or not indicated on the drawings. The CONTRACTOR shall furnish and install elbows, pull boxes, etc., as required to affect these offsets, transitions, and changes in directions. Conflicts between electrical raceways, fixtures, etc., and ductwork which cannot be resolved otherwise, will be resolved by the A/E.
- F. The CONTRACTOR shall install all electrical work to permit removal (without damage to other parts) of any equipment requiring periodic replacement or maintenance. The CONTRACTOR shall arrange electrical raceways and equipment to permit ready access to valves, cocks, traps, starters, motors, control components, etc., and to clear the opening of swinging and overhead doors and of access panels.
- G. Work at Existing Facilities
1. Where work may be required to be performed at existing and/or occupied facilities, such work shall be scheduled and arranged to be done at the convenience of the OWNER so as not to interfere with, disrupt, or disturb normal operations at the facilities. The CONTRACTOR shall obtain written approval from the OWNER before proceeding with work at existing facilities and shall work at existing facilities on schedule as agreed upon with the OWNER. This is not to be necessarily construed to mean that the CONTRACTOR is expected to perform work at existing facilities on holidays, weekends, etc., but that the Contractor must schedule work with the OWNER for the OWNER's beneficial and normal usage of the facilities, and that the CONTRACTOR will be required to maintain the schedule as approved by the OWNER.
 2. The CONTRACTOR shall, at all times, provide safety barriers, protective devices, screening, dust barriers, etc., as required to maintain the safety and comfort of the building's personnel and/or occupants in or near his work area.
 3. The CONTRACTOR shall be responsible for cleanup in connection with his work at existing facilities. At the end of each working day, all debris, boxes, waste, etc. shall be removed from the facilities and properly disposed of. Equipment, materials, etc. may be left inside the facilities, but such must be properly stored, stacked, and located as approved by the OWNER.
 4. The CONTRACTOR shall do all cutting, patching, finishing, repairing, painting, etc., necessary for electrical work to be installed at existing facilities. All finishes shall be left to equal finish and condition prior to cutting. No cutting of structural members will be

allowed. All cutting of walls, floors, roofs, etc. shall be repaired and/or replaced to equal finish prior to cutting. The CONTRACTOR shall route conduits and locate equipment as approved by the OWNER and A/E. Routing and locations shall be firmly established and approved before proceeding with any phase of the work.

5. The CONTRACTOR shall be responsible for any and all damage to the existing facilities, grounds, walkways, paving, etc. caused by the work, the CONTRACTOR and/or his personnel, and/or his equipment in the accomplishment of this work. Such damages shall be repaired and/or replaced by the CONTRACTOR at no additional cost to the OWNER, to equal finish prior to damage. The A/E shall be the judge as to equal finishes, etc.
6. Certain power requirements must be met without interruption during certain times on the existing electrical system. It is anticipated that partial power outages will be necessary to accomplish the work covered by these drawings and specifications. The CONTRACTOR shall determine in advance the dates, times and duration of these outages and shall obtain permission from the OWNER to shut down the electric power. Unauthorized power outages will not be tolerated.
7. Existing systems shall remain functional when the building is occupied. This includes power, data/telephone, fire alarm, public address / intercom, security, access control, surveillance, etc.

H. Electrical Work Coordinated with Other Disciplines:

1. Heating, Ventilating and Air Conditioning Equipment:
 - a. The electrical contractor shall provide a source of power for all mechanical equipment. "Source" shall include conductors, raceways, circuit breakers, junction boxes, and/or wiring troughs as required by conditions and codes and/or as shown on the drawings.
 - b. In general, individual disconnecting means for each mechanical equipment unit will be furnished and installed by the Mechanical Contractor. Line side and load side connections shall be made by the electrical contractor. If a rooftop unit is not provided with an integral disconnect switch, the individual disconnecting means for the unit will be furnished and installed by the electrical contractor.
 - c. See Mechanical Specifications for further explanation of CONTRACTOR responsibility.
2. Plumbing Equipment:
 - a. Hot Water Circulating Pump: The electrical contractor shall provide power supply to a junction box adjacent to each hot water circulating pump and shall consult the Plumbing Contractor to determine the exact power supply location before roughing in. Circuitry and equipment between the junction box and the pump shall be made by the electrical contractor. Final connections shall be provided by the contractor providing the equipment.
 - b. Water Heaters: The electrical contractor shall provide a junction box adjacent to the water heater as a source of power. Circuitry and equipment between the junction box and the water heater shall be made by the electrical contractor. Final connections shall be provided by the contractor providing the equipment.
 - c. Electric Water Coolers: As indicated on the drawings, the electrical contractor shall provide either a grounding type 120V, GFCI receptacle for power supply at each electric water cooler, or the branch breaker supplying a grounding type 120V receptacle shall be GFCI type. The electrical contractor shall consult the Plumbing

Contractor to determine the exact outlet location required before roughing in. All outlets and cords shall be concealed within the cabinet.

3. Civil / Site Equipment:

- a. The electrical contractor shall provide a source of power for all civil / site equipment. "Source" shall include feeder and branch circuit breakers, raceways, conductors, receptacles, junction boxes, and/or wiring troughs as required by conditions and codes and/or as shown on the contract drawings. See Civil / Control Specifications for controls, controller, control panel responsibility.
- b. Final power connections to equipment shall be provided by the contractor providing the equipment.

I. Equipment And Materials (General):

1. Materials shall be new and shall bear the manufacturer's name, trade name, and listing label in every case where a standard has been established for the particular material. The equipment to be furnished under this specification shall be essentially the standard product of manufacturers regularly engaged in the production of the required type of equipment and shall be the manufacturer's latest approved design.
2. Delivery and Storage:
 - a. Store products to allow for inspection and measurement of quantity or counting of units.
 - b. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 - 1) Electrical equipment shall be delivered to the site and stored in original containers. Store inside dry, heated spaces, but readily accessible for inspection by the A/E until installed.
 - 2) Rusty and/or corroded materials and equipment will be replaced at the direction of the A/E.
 - c. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 - d. Protect stored products from damage.
3. Equipment and materials of the same general type shall be of the same make throughout the work to provide uniform appearance, operation and maintenance.
4. At the completion of the work; fixtures, equipment, and materials shall be cleaned and polished thoroughly and turned over to the OWNER in a condition satisfactory to the A/E. Damage or defects, developing before acceptance of the work shall be corrected at the CONTRACTOR's expense.
5. Manufacturer's directions shall be followed completely in the delivery, storage, protection, and installation of all equipment and materials. The CONTRACTOR shall promptly notify the A/E, in writing, of any conflicts between any requirements of the Contract Documents and the manufacturer's directions and shall obtain the A/E's written instructions before proceeding with the work. Should the CONTRACTOR perform any work that does not comply with the manufacturer's instructions, recommendations, or requirements; it shall be corrected at the direction of the A/E at no additional cost to the Owner.

J. Sleeves, Inserts, Openings, Etc.:

1. Anchor bolts, sleeves, inserts, supports, etc., that may be required for electrical work shall be furnished, located, and installed by the electrical contractor. Where working under a subcontract for a General Contractor, the electrical contractor shall give sufficient information (marked and located) to the General Contractor in time for proper placement in the construction schedule. Should the electrical contractor delay or fail to provide sufficient information in time, the electrical contractor shall cut and patch construction as necessary and required to install electrical work, with finishes completed to the satisfaction of the Owner, and A/E.

K. Cutting and Patching:

1. The electrical contractor shall do all rough cutting and patching as required for the proper installation of work under this contract. Cutting shall be kept to a minimum, and finishes shall be restored to the satisfaction of the Owner, and A/E.

L. Locations and Measurements:

1. Outlets, equipment, and appliances are shown and located on the drawings as accurately as possible. All measurements shall be verified on the project and coordinated with the drawings of other disciplines. In all cases, the work shall suit the surrounding trim and/or decoration and construction. The locations of outlets for special appliances shall be installed so that when extended, they are flush with the finished wall, floor, or ceiling and permit the proper installation of fixtures, devices, equipment, appliances, etc. Heights of all outlets shown on the drawings are approximate only. Slight relocations of outlets, devices, and equipment shall be made by the electrical contractor as required or as directed by the A/E at no additional cost to the OWNER.

M. Workmanship:

1. Work shall be executed as required by the specifications and the accompanying drawings and shall be done in a workmanlike manner by skilled mechanics, and shall present a neat, trim, and mechanical appearance when completed. All work shall be performed as required by the progress of the job.

N. Final Inspections and Equipment Demonstrations:

1. The CONTRACTOR shall acquire permits for construction & coordinate all required inspections with the office of the local electrical inspector and/or local authority having jurisdiction, if required. The CONTRACTOR shall provide the Owner two (2) copies of Electrical Inspectors' written reports.
2. The CONTRACTOR shall furnish ladders, required tools, and men to open fixtures, boxes, panels, or any other equipment to enable the A/E representatives to see into any parts of the installation he may request.
3. The CONTRACTOR shall furnish meters for observation of readings as directed by the A/E representative. Meters to be furnished include: clamp-on type ammeter, voltmeter, megger, and clamp-on type ground resistance tester.

O. Operating Instructions:

1. At the completion of the entire installation, the CONTRACTOR shall arrange to operate each component of systems and then systems as a whole. When all the requirements of the plans and specifications have been met, the CONTRACTOR shall then arrange to

instruct the OWNER's operating and maintenance personnel in the correct and proper procedures for the operation and maintenance of the systems

END OF SECTION

SECTION 26 0500

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Supporting devices for electrical components.
 - 2. Cutting and patching for electrical construction.
 - 3. Touchup painting.
 - 4. Firestopping
 - 5. Concrete equipment bases.
 - 6. Electrical demolition.

1.3 SUBMITTALS

- A. Product Data:
 - 1. For materials to firestop cable and raceway penetrations of fire-rated floor and wall assemblies.

1.4 Shop Drawings: UL details for firestopping cable and raceway penetrations of fire-rated floor and wall assemblies.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 SUPPORTING DEVICES

- A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.
- B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.
- C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch diameter slotted holes at a maximum of 2 inches o.c., in webs.
 - 1. Channel Thickness: Selected to suit structural loading.
 - 2. Fittings and Accessories: Products of the same manufacturer as channel supports.
- D. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.
- E. Expansion Anchors:
 - 1. Inside: Carbon-steel wedge or sleeve type.

- 2. Outside: Hot-dip galvanized steel wedge or sleeve type.
- F. Toggle Bolts:
 - 1. Inside: All steel wedge or sleeve type.
 - 2. Outside: Hot-dip galvanized steel wedge or sleeve type.
- 2.2 TOUCHUP PAINT
 - A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.
 - B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.
- 2.3 FIRESTOPPING
 - A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items .
- 2.4 CONCRETE BASES
 - A. Concrete: 3000-psi (20.7-MPa), 28-day compressive strength with welded wire fabric reinforcement.

PART 3 - EXECUTION

- 3.1 COORDINATION
 - A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange during progress of construction to facilitate the electrical installations that follow.
 - 1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.
 - B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.
 - C. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces.
- 3.2 ELECTRICAL EQUIPMENT INSTALLATION
 - A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.
 - B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.
 - C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
 - D. Right of Way: Give to raceways and piping systems installed at a required slope.
- 3.3 ELECTRICAL SUPPORTING DEVICE APPLICATION
 - A. Selection of Supports: Comply with manufacturer's written instructions.
 - B. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb (90-kg) design load.
- 3.4 SUPPORT INSTALLATION
 - A. Install support devices to securely and permanently fasten and support electrical components.

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- B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.
 - C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
 - D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.
 - E. Support individual horizontal raceways with separate pipe hangers or clamps.
 - F. Install 1/4-inch- diameter or larger threaded hanger rods, unless otherwise indicated.
 - G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of hangers for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.
 - H. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches from the box.
 - I. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.
 - J. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.
 - K. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:
 - 1. Wood: Fasten with wood screws or screw-type nails.
 - 2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
 - 3. New Concrete: Concrete inserts with machine screws and bolts.
 - 4. Existing Concrete: Expansion bolts.
 - 5. Steel: Spring-tension clamps on steel.
 - 6. Light Steel: Sheet-metal screws.
 - 7. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

3.5 FIRESTOPPING

- A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly.

3.6 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage

recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated.

3.7 DEMOLITION

- A. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.
- B. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.
- C. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches (50 mm) below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.
- D. Remove demolished material from Project site after coordination with the Owner's representative. Equipment and/or materials that the Owner desires to retain shall be moved to a location designated by the Owner's representative.
- E. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.

3.8 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.9 FIELD QUALITY CONTROL

- A. Inspect installed components for damage and faulty work.

3.10 REFINISHING AND TOUCHUP PAINTING

- A. Refinish and touch up paint.
 - 1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
 - 2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
 - 3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.11 CLEANING AND PROTECTION

- A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Final Acceptance.

END OF SECTION

SECTION 26 0519

CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field Quality-Control Test Reports: From Contractor.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 POWER CONDUCTORS AND CABLES

- A. Manufacturers:
 - 1. Cerro Wire LLC.
 - 2. Colonial Wire and Cable.
 - 3. Encore Wire Corporation.
 - 4. General Cable Corporation.
 - 5. Okonite.
 - 6. Prysmian Group.
 - 7. Republic Wire, Inc.
 - 8. Southwire.
 - 9. Or approved equal.
- B. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.
- C. Conductor Material:
 - 1. Copper complying with NEMA WC70 / ICEA S-95-658 solid conductor for No. 10 AWG and smaller, stranded for No. 8 AWG and larger.

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- 2. Power and lighting circuitry: Minimum conductor size shall be #12, and maximum conductor size shall be #500 kcmil.
 - D. Conductor Insulation Types: Type THHN/THWN-2 complying with NEMA WC70 / ICEA S-95-658.
 - E. Metal-Clad Cable, Type MC:
 - 1. Description: A factory assembly of current-carrying insulated copper conductors in an overall metallic sheath.
 - 2. Comply with NEMA WC 70 / ICEA S-95-658 for metal-clad cable, Type MC with ground wire.
 - 3. Power-Limited Fire-Alarm Circuits: Comply with UL 1424
 - 4. Healthcare facilities: MC cable shall be listed for healthcare applications.
- 2.3 CONTROL CONDUCTORS AND CABLE
- A. Discrete control conductors: Copper, stranded, type THHN/THWN-2.
 - 1. Manufacturers:
 - a. Cerro Wire LLC.
 - b. Colonial Wire and Cable.
 - c. Encore Wire Corporation.
 - d. General Cable Corporation.
 - e. Okonite.
 - f. Prysmian Group.
 - g. Republic Wire, Inc.
 - h. Southwire.
 - i. Or approved equal.
- 2.4 CONNECTORS AND SPLICES
- A. Manufacturers:
 - 1. AFC Cable Systems.
 - 2. AMP Incorporated/Tyco International.
 - 3. FCI.
 - 4. Greaves Polaris.
 - 5. Hubbell/Anderson.
 - 6. ILSCO.
 - 7. NSI.
 - 8. O-Z/Gedney; EGS Electrical Group LLC.
 - 9. Penn Union.
 - 10. 3M Company; Electrical Products Division.
 - 11. Or approved equal.
 - B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

1. For conductors #8 & smaller, use wirenut type twist connectors.
2. For conductors #6 & larger, use pre-insulated solderless connectors with two spare port(s) for future cable connection.

PART 3 - EXECUTION

3.1 CONDUCTOR AND INSULATION APPLICATIONS

- A. Service Entrance, Feeders: Type XHHW, single insulated conductors in raceway.
- B. Branch Circuits:
 1. Concealed in Ceilings: Type THHN/THWN-2, single conductors in raceway or metal-clad cable, Type MC.
 2. Concealed in Walls and Partitions: Type THHN/THWN-2, single conductors in raceway or metal-clad cable, Type MC.
 3. Exposed: Type THHN/THWN-2, single conductors in raceway, with the exception of exposed locations in electrical rooms where MC cable may be used where supported properly.
 4. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- C. Discrete Control Circuits: Type THHN/THWN-2, in raceway.
- D. Class 1 Control Circuits: Type THHN/THWN-2, in raceway.

3.2 INSTALLATION

- A. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- B. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables, conductors, or raceway.
- C. Identify and color-code conductors and cables according to Section "Electrical Identification."
- D. Shared neutral conductors shall not be used unless specifically indicated so on homerun circuitry designations on the drawings.

3.3 CONNECTIONS

- A. Connect outlet and component connections to wiring systems and to ground. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

3.4 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:
 1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements.
 2. Inspect for physical damage; test conductors and cable for continuity and shorts.
 3. Megger testing for building wire and cable:

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- a. All current carrying phase conductors and neutrals shall be tested as installed, and before connections are made, for insulation resistance and accidental grounds. This shall be done with a 500 volt megger. Megger testers shall not be electronic type. Megger testers shall be hand crank or power driven crank type. Minimum readings between conductors and between conductor and the grounded metal raceway shall be: 25 mega-ohms for #6 wire and smaller; 50 mega-ohms for #4 wire or larger.
 - b. The CONTRACTOR shall correct malfunctioning conductors and cables, including replacement if necessary, and retest to demonstrate compliance.
 - c. Certify compliance with test parameters.
 - 4. Control / Signal Transmission Media Tests:
 - a. Test cable segments for faulty connectors, splices, terminations, and the integrity of the cable and its component parts.
 - b. Correct malfunctioning conductors and cables at Project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.
 - B. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
 - 4. Provide tabulated megger readings for each panel circuit.
 - C. Witness Tests:
 - 1. The CONTRACTOR shall furnish a megger and show A/E representative and/or Owner that the conductors and panels comply with the above requirements.

END OF SECTION

SECTION 26 0526

GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

1.3 SUBMITTALS

- A. Product Data: For the following:
 - 1. Ground rods.
 - 2. Connection / test / inspection wells.
- B. Field Test Reports: Submit written test reports to include the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with UL 467.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Grounding Conductors, Cables, Connectors, and Rods:
 - a. Chance/Hubbell.
 - b. Copperweld.
 - c. Erico Inc.; Electrical Products Group.
 - d. Framatome Connectors/Burndy Electrical.
 - e. Galvan Industries.
 - f. Harger.
 - g. Heary Brothers Lightning Protection Co.
 - h. Ideal Industries.
 - i. ILSCO.

- j. Kearney/Cooper Power Systems.
 - k. Lyncole XIT Grounding.
 - l. O-Z/Gedney Co.
 - m. Raco, Inc.
 - n. Salisbury: W. H. Salisbury & Co.
 - o. Southern Grounding / South Atlantic LLC.
 - p. Thomas & Betts.
 - q. Thompson Lightning Protection.
 - r. Or approved equal.
2. Connection Test / Inspection Wells:
- a. ALT Fabrication.
 - b. Charles Industries.
 - c. Harger Lightning Protection, Inc.
 - d. Heary Brothers Lightning Protection Co.
 - e. Quazite / Strongewell.
 - f. PVC piping manufacturers.
 - g. Or approved equal.

2.2 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Section "Conductors and Cables."
- B. Grounding Electrode Conductors: Stranded cable.
- C. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.
- D. Bare Copper Conductors: Comply with the following:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Assembly of Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
- E. Grounding Bus:
 - 1. Bare, annealed copper bars of rectangular cross section
 - 2. 1/4" thick, 4" wide, length as required
 - 3. Stand-off insulator mounting brackets.

2.3 CONNECTOR PRODUCTS

- A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.
- C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

2.4 GROUNDING ELECTRODES

- A. Ground Rods: Sectional type; copper-clad steel, 3/4" diameter by 120 inches in length.

- B. Connection / Test / Inspection Wells: Provide handholes as specified below:
 - 1. Cylinder, minimum dimensions of 12" diameter x 19" deep, PVC, with cover.
 - 2. Box, minimum dimensions of 12" x 12" x 12" deep with cover, green PVC or polyethylene.

PART 3 - EXECUTION

3.1 APPLICATION

- A. In raceways, use insulated equipment grounding conductors.
- B. Exothermic-Welded Connections: Use for connections to ground rods, structural steel and for underground connections.
- C. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.
- D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Use insulated spacers; space 1 inch minimum from wall and support 12 inches above finished floor, unless otherwise indicated.
- E. Underground Grounding Conductors: Use tinned- copper conductor. Bury at least 24 inches below grade or bury 12 inches above duct bank when installed as part of the duct bank.

3.2 EQUIPMENT GROUNDING CONDUCTORS

- A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
- B. Install equipment grounding conductors in all feeders and circuits.
- C. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
 - 1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch (6.4-by-50-by-300-mm) grounding bus.
 - 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

3.3 INSTALLATION

- A. Ground Rods: For service entrance, install a minimum of two rods spaced at least twenty feet from each other and located at least the same distance from other grounding electrodes.
 - 1. Drive ground rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
 - 2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds for connections. Make connections without exposing steel or damaging copper coating.
- B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- C. Building Steel: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to building steel. Connect grounding conductors to building steel by exothermic weld.

- D. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Connection shall be made within the first five feet of where the water service line enters the building. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
- E. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.

3.4 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- D. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.
- E. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.5 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:
 - 1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
 - 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - a. Perform tests by the fall-of-potential method according to IEEE 81; or
 - b. Perform tests with a clamp-on ground tester.
 - 3. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and

observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

- a. Equipment Rated 500 kVA and Less: 10 ohms.
 - b. Equipment Rated 500 to 1000 kVA: 5 ohms.
 - c. Equipment Rated More Than 1000 kVA: 3 ohms.
 - d. Substations and Pad-Mounted Switching Equipment: 5 ohms.
 - e. Manhole Grounds: 10 ohms.
4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect and/or Engineer promptly and take corrective action to reduce ground resistance to comply with specified values. Demonstrate compliance by retesting.

END OF SECTION

SECTION 26 0533

RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
 - 1. Section "Basic Electrical Materials and Methods" for supports, anchors, and identification products.
 - 2. Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings.
 - 3. Section "Seismic Controls for Electrical Work" for seismic restraints and bracing of raceways, boxes, enclosures, and cabinets.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.
- C. IMC: Intermediate metal conduit.
- D. LFMC: Liquidtight flexible metal conduit.
- E. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

- A. Product Data: For raceways, fittings, wireways, surface raceways, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer.
 - 1. Design Calculations: Calculate requirements for selecting seismic restraints.
 - 2. Detail assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- C. Manufacturer Seismic Qualification Certification: Submit certification that enclosures, cabinets, accessories, and components will withstand seismic forces defined in Section "Seismic Controls for Electrical Work." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.7 FIELD CONDITIONS

- A. Ground Water: Assume ground-water level is at grade level unless a lower water table is noted on Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 METAL CONDUIT AND TUBING

- A. Manufacturers:
 - 1. Alflex Inc.
 - 2. Allied Tube and Conduit.
 - 3. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 4. Atkore International / Calbrite.
 - 5. Conduit Pipe Products Company.
 - 6. Electri-Flex Co.
 - 7. Gibson Stainless.
 - 8. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
 - 9. Manhattan/CDT/Cole-Flex.
 - 10. Maverick Tube.
 - 11. O-Z Gedney; Unit of General Signal.
 - 12. Patriot Aluminum Products.
 - 13. Republic Conduit.
 - 14. Shaw Stainless and Alloy.
 - 15. Wheatland Tube Co.
 - 16. Or approved equal.
- B. Rigid Aluminum Conduit: Produced to ANSI C80.5; listed to UL 6A.
- C. Rigid Steel Conduit: Produced to ANSI C80.1; listed to UL 6. IMC: Produced to ANSI C80.6; listed to UL 1242.
- D. EMT and Fittings: Produced to ANSI C80.3; listed to UL 797.

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- 1. Fittings: Plated-steel, hexagonal, compression type.
 - E. FMC: Listed to UL 1.
 - F. LFMC: Listed to UL 360.
 - G. Fittings: NEMA FB 1; compatible with conduit and tubing materials.
- 2.3 NONMETALLIC CONDUIT AND TUBING
- A. Manufacturers:
 - 1. American International.
 - 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 3. Arnco.
 - 4. Blue Diamond Industries.
 - 5. Cantex.
 - 6. Certainteed.
 - 7. Condux International.
 - 8. ElecSYS.
 - 9. Electri-Flex.
 - 10. Heritage Plastics / Atkore International.
 - 11. Lamson & Sessions; Carlon Electrical Products.
 - 12. Manhattan/CDT/Cole-Flex.
 - 13. Queen City Plastics.
 - 14. RACO.
 - 15. Southern Pipe, Inc.
 - 16. Spiraldut, Inc./AFC Cable Systems, Inc.
 - 17. Thomas & Betts.
 - 18. Or approved equal.
 - B. RNC: Produced to NEMA TC 2; listed to UL 651.
 - 1. Schedule 40 and Schedule 80 PVC.
 - C. RNC Fittings: Produced to NEMA TC 3; listed to UL 514B; match to conduit or tubing type and material.
- 2.4 METAL WIREWAYS
- A. Listed to UL 870.
 - B. Manufacturers:
 - 1. Austin.
 - 2. B-Line.
 - 3. Hammond/
 - 4. Hoffman.
 - 5. Milbank.
 - 6. Square D.

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- 7. Thomas & Betts.
 - 8. Unity Manufacturing.
 - 9. Or approved equal.
 - C. Material and Construction: Sheet metal sized and shaped as indicated.
 - 1. Indoors: NEMA 1.
 - 2. Outdoors: NEMA 3R .
 - D. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
 - E. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.
 - F. Wireway Covers:
 - 1. Indoors: Hinged type.
 - 2. Outdoors: Flanged-and-gasketed type.
 - G. Finish: Manufacturer's standard enamel finish.
- 2.5 BOXES, ENCLOSURES, AND CABINETS
- A. Manufacturers:
 - 1. Arlington.
 - 2. Austin.
 - 3. B-Line.
 - 4. Cooper Crouse-Hinds.
 - 5. Emerson/General Signal; Appleton Electric Company.
 - 6. Erickson.
 - 7. FSR.
 - 8. Hammond.
 - 9. Hoffman.
 - 10. Hubbell.
 - 11. Milbank.
 - 12. O-Z/Gedney.
 - 13. Peerless.
 - 14. RACO.
 - 15. Robroy Industries.
 - 16. Rose + Bopla.
 - 17. Scott Fetzer Co.; Adalet-PLM Division.
 - 18. Spring City Electrical.
 - 19. Strong.
 - 20. Thomas & Betts.

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- 21. Vynckier.
 - 22. Walker Systems.
 - 23. Woodhead Industries.
 - 24. Or approved equal.
 - B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
 - C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.
 - D. Floor Boxes: Cast metal, fully adjustable, rectangular.
 - E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
 - F. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.
 - G. Metal Hinged-Cover Enclosures:
 - 1. Interior Locations: NEMA 250, Type 1 with continuous hinged cover, concealed hinge, and flush latch. Finished inside and out with manufacturer's standard enamel.
 - 2. Exterior Locations: NEMA 250, Type 3R galvanized steel with continuous hinged cover and 3-point latch.
 - 3. Removable interior panel.
 - 4. Metal barriers to separate wiring of different systems and voltages.
 - 5. Accessory feet where required or freestanding applications.
 - H. Recessed steel TV box:
 - 1. Power and low voltage applications for flat screen TV's.
 - 2. Recessed space to keep plugs, connectors, and cords inside the box.
 - 3. Non-metallic, paintable white trim plate.
 - 4. Design Basis: Arlington #TVBS Series.
 - I. HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING
 - 1. General Requirements for Handholes and Boxes:
 - a. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
 - b. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
 - a. Manufacturers:
 - 1) Quazite.
 - 2) Or preapproved equal.
 - b. Configuration: Designed for flush burial with open closed bottom unless otherwise indicated.
 - c. Cover:
 - 1) Weatherproof, secured by tamper-resistant locking devices.

- 2) Structural load rating consistent with enclosure and handhole location. See drawing details for additional requirements.
- 3) Nonskid finish.
- 4) Cover legend text as detailed.
- d. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors:

1. Exposed: Rigid metal or IMC.
2. Concealed: Rigid metal or IMC.
3. Underground, Single Run: RNC.
4. Underground, Grouped: RNC.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
6. For grounding electrode conductors: RNC Schedule 80.
7. Boxes and Enclosures: NEMA 250, Type 3R.

B. Indoors:

1. Exposed, Higher than 10' AFF: EMT.
2. Exposed, Lower than 10' AFF:
 - a. In Electrical Rooms: EMT.
 - b. Elsewhere: Rigid metal or IMC.
3. Concealed: EMT.
4. Underground branch circuits: RNC. RNC is acceptable when turning up out of the slab inside walls to the first outlet or junction box.
5. Underground feeders: RNC. Where turning up out of the slab, a rigid metal elbow and rigid metal conduit shall be used.
6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except use LFMC in damp or wet locations.
7. Damp or Wet Locations: Rigid metal conduit.
8. For grounding electrode conductors: RNC Schedule 80.
9. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
 - a. Damp or Wet Locations: NEMA 250, Type 4.

C. Minimum Raceway Size: 3/4-inch trade size (DN 21).

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Intermediate Steel Conduit: Use threaded rigid metal conduit fittings, unless otherwise indicated.

- E. Do not install aluminum conduits embedded in or in contact with earth or concrete. For direct burial or concrete encasement or penetrations, coat conduit with asphaltum or bitumastic type coating.
- F. EMT shall not be installed where raceway or fittings would be in direct contact with the earth, underground, in/below concrete, exposed to the elements, exposed to severe physical damage, or exposed to severe corrosive influence.

3.2 INSTALLATION

- A. Keep raceways a minimum of 6 inches away from runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- B. Complete raceway installation before starting conductor installation.
- C. Support raceways as specified in Section "Basic Electrical Materials and Methods."
- D. Install temporary closures to prevent foreign matter from entering raceways.
- E. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.
- F. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.
- G. Conceal raceways within finished walls, ceilings, and floors, unless otherwise indicated.
 - 1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.
- H. Conduits installed on the inside face of exterior building walls shall be spaced off the wall surface a minimum of 1/4" using strut-type channel or "clamp-backs".
- I. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
 - 1. Run parallel or banked raceways together on common supports.
 - 2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
- J. Join raceways with fittings designed and approved for that purpose and make joints tight.
- K. Use insulating bushings to protect conductors.
- L. Expansion joints: Where raceways of any type pass a building or structure expansion joint, a standard expansion joint fitting, compatible with the type of raceway being used, shall be provided and installed. Review architectural and structural drawings for locations of expansion joints.
- M. Raceways Embedded in Slabs: Install in middle 1/3 of slab thickness where practical and leave at least 2 inches (50 mm) of concrete cover.
 - 1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
 - 2. Space raceways laterally to prevent voids in concrete.
 - 3. Run conduit larger than 1-inch trade size (DN 27) parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.

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4. Where turning up into cabinets, equipment, poles, etc.; transition from PVC to rigid steel elbows & raceway stub-ups.
- N. Underground raceways:
1. Where turning up to cabinets, equipment, poles, etc.; transition from horizontal underground PVC to rigid metal for elbows & raceway stub-ups.
 2. Stub-up Connections to Equipment:
 - a. Extend conduits through concrete floor/slab for connection to equipment. Install with threaded coupling for installation of plugs set flush.
 - b. Extend conductors to equipment with rigid metal conduit; FMC or LFMC may be used 6 inches above the floor to equipment subject to vibration or movement.
 - c. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.
 3. Service raceways shall be encased with a minimum of three (3") inches of concrete on all sides.
- O. Terminations:
1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
 2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.
 3. Where using boxes with concentric, eccentric, or over-sized knockouts; provide bonding bushings and jumpers. Size bonding jumpers in accordance with NEC Table 250-122, connecting to the box with ground lugs.
- P. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Label each end of pull wires with location of opposite end.
- Q. Telephone and Signal System Raceways, 2-Inch Trade Size and Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.
- R. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound.
1. Install raceway sealing fittings at the following points:
 - a. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - b. Where otherwise required by NFPA 70.
 2. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces.
- S. Flexible Connections:

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1. Use maximum of 72 inches of flexible conduit for recessed and semi-recessed lighting fixtures.
 2. Use maximum of 24 inches of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for all motors.
 3. Use LFMC in damp or wet locations.
- T. Set floor boxes level and flush with finished floor surface.
- U. Install hinged-cover enclosures and cabinets plumb. Support at each corner.
- 3.3 PROTECTION
- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Final Acceptance.
1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.
- 3.4 CLEANING
- A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.
1. Exposed threads on galvanized conduits and fittings, installed outdoors, shall be coated with galvanizing paint or equivalent protective coating.

END OF SECTION

SECTION 26 0548

SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Restraint channel bracings.
 - 2. Restraint cables.
 - 3. Seismic-restraint accessories.
 - 4. Mechanical anchor bolts.
 - 5. Adhesive anchor bolts.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
- B. Delegated-Design Submittal: For each seismic-restraint device.
 - 1. Include design calculations and details for selecting seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 2. Design Calculations: Calculate static and dynamic loading caused by equipment weight, operation, and seismic and wind forces required to select seismic and wind restraints and for designing vibration isolation bases.
 - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
 - 3. Seismic- and Wind-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.

- c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
 - d. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
 - C. Product Certificates: Signed by manufacturers of seismic restraints certifying that products furnished comply with requirements, including the testing requirements of the 2012 North Carolina Building Code, Section 1708.4.
- 1.4 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For professional engineer.
 - B. Field quality-control reports.
- 1.5 QUALITY ASSURANCE
- A. Comply with seismic restraint requirements in 2012 North Carolina Building Code, Section 1613, unless requirements in this Section are more stringent.
 - B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing seismic engineering services, including the design of seismic restraints, that are similar to those indicated for this Project.
 - C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis. They shall bear anchorage preapproval from OSHPD in addition to preapproval, showing maximum seismic-restraint ratings, by ICC-ES or another agency acceptable to authorities having jurisdiction. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) that support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
 - D. Comply with NFPA 70.
- 1.6 PROJECT CONDITIONS
- A. Seismic Design Category: See the project Code Summary drawing and structural drawings.
 - B. See the project Code Summary drawing and structural drawings for additional building construction criteria.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Wind-Restraint Loading:
 - 1. Basic Wind Speed: Obtain value from Figure 1609, North Carolina Basic Wind Map, in the 2012 North Carolina Building Code.
 - 2. Building Classification Category: See the project Code Summary drawing and structural drawings.
 - 3. Minimum 10 lb/sq. ft. (48.8 kg/sq. m) multiplied by maximum area of equipment component projected on vertical plane normal to wind direction and 45 degrees either side of normal.
- B. Seismic-Restraint Loading:

1. Seismic Design Category: See the project Code Summary drawing and structural drawings.

2.2 RESTRAINT CHANNEL BRACINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Cooper B-Line, Inc.; a Division of Cooper Industries.
 2. Hilti, Inc.
 3. Mason Industries, Inc.
 4. Unistrut; Atkore International.
- B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end, with other matching components, and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.3 RESTRAINT CABLES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Kinetics Noise Control, Inc.
 2. Loos & Co., Inc.
 3. Vibration Mountings & Controls, Inc.
- B. Restraint Cables: ASTM A 603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.4 SEISMIC-RESTRAINT ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Cooper B-Line, Inc.; a Division of Cooper Industries.
 2. Kinetics Noise Control, Inc.
 3. Mason Industries, Inc.
 4. TOLCO; a brand of NIBCO INC.
- B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod.
- C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.
- E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.
- F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.5 MECHANICAL ANCHOR BOLTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Cooper B-Line, Inc.; a Division of Cooper Industries.
 - 2. Hilti, Inc.
 - 3. Kinetics Noise Control, Inc.
 - 4. Mason Industries, Inc.
- B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Note: Expansion-type anchor bolts are not permitted by ASCE/SEI 7 for nonisolated equipment in excess of 10 hp (7.46 kW).

2.6 ADHESIVE ANCHOR BOLTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Hilti, Inc.
 - 2. Kinetics Noise Control, Inc.
 - 3. Mason Industries, Inc.
- B. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 COORDINATION

- A. Coordinate layout and installation of seismic bracing with building structural system and architectural features, and with mechanical, fire-protection, electrical, and other building features in the vicinity.
- B. Coordinate concrete bases with building structural system.

3.3 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where required to prevent buckling of hanger rods caused by seismic forces.

- C. Strength of Support and Seismic-Restraint Assemblies: Select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.4 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork."
- B. Equipment and Hanger Restraints:
 - 1. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
 - 2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- E. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- F. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - 5. Set anchors to manufacturer's recommended torque using a torque wrench.
 - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.5 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.6 FIELD QUALITY CONTROL

- A. The Professional Engineer retained for seismic restraint calculations shall visit the job site as necessary to comply with the Special Inspections requirement of the North Carolina Building Code, Section 1707. This engineer shall provide in writing verification of compliance of the installation with the approved seismic submittal. This verification shall be submitted as a Special Inspections Report and shall bear the Engineer's professional seal. Job site inspections by other than this engineer are not acceptable.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative (if required):
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Schedule test with Owner, through Architect / Engineer, before connecting anchorage device to restrained component (unless post-connection testing has been approved), and with at least seven days' advance notice.
 - 3. Obtain Architect / Engineer's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 - 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect / Engineer.
 - 5. Test to 90 percent of rated proof load of device.
- C. Seismic controls will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.7 ADJUSTING

- A. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION

SECTION 26 0553

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes electrical identification materials and devices intended to comply with NFPA 70, OSHA standards, and authorities having jurisdiction.

1.3 SUBMITTALS

- A. Product Data:
 - 1. For each electrical identification product indicated.
 - 2. For double coated, adhesive tape product indicated.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with NFPA 70 for color-coding.

PART 2 - PRODUCTS

2.1 CABLE LABELS

- A. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches.
- B. Underground-Line Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape.
 - 1. Not less than 6 inches wide by 4 mils thick.
 - 2. Compounded for permanent direct-burial service.
 - 3. Embedded continuous metallic strip or core.
 - 4. Printed legend indicating type of underground line.

2.2 NAMEPLATES AND SIGNS

- A. Engraved Plastic Nameplates and Signs: Engraving stock, plastic laminate, minimum 1/16" thick for signs up to 20 sq. in. and 1/8" thick for larger sizes.
- B. Fasteners for Nameplates and Signs:
 - 1. High performance, double coated tape with adhesive. Design Basis: 3M #06383, or approved equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.

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- C. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before applying.
- E. Caution Labels for Indoor Boxes, Enclosures, Panelboards, and Switchboards for Power and Lighting: Install pressure-sensitive, self-adhesive labels identifying system voltage with black letters on orange background. Install on exterior of door or cover.
- F. Circuit Identification Labels on Boxes: Panel and circuit number.
1. Interior Boxes:
 - a. Exposed: Pressure-sensitive, self-adhesive plastic label on cover.
 - b. Concealed:
 - 1) Pressure-sensitive, self-adhesive plastic label on cover; or
 - 2) Permanent marker on cover, legible by Architect, Engineer, and Owner.
 2. Exterior Boxes:
 - a. Engraved plastic label on cover; and
 - b. Pressure-sensitive, self-adhesive plastic label inside cover.
- G. Location Labels for Lighting Inverters Above the Ceiling: Pressure-sensitive, self-adhesive plastic label on ceiling grid below inverter indicating "INVERTER".
- H. Location Labels for Lighting and Exhaust Fan Power Packs Above the Ceiling: Pressure-sensitive, self-adhesive plastic label on ceiling grid below power pack indicating "POWER PACK".
- I. Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communication lines, install continuous underground-line warning tape located directly above line at 6 to 8 inches below finished grade. Where width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches overall, use a single line marker. Install line marker for underground wiring, both direct-buried cables and cables in raceway.
- J. Color-Coding of Phase, Neutral, and Ground Conductors: Use the following colors for service, feeder, and branch-circuit phase conductors:
- | | Configuration | Phase A | Phase B | Phase C | Neutral | Ground |
|----|---------------------|---------|---------|---------|---------|--------|
| 1. | 120/240-V, 1 Ph, 3W | Black | Red | N/A | White | Green |
| 2. | 120/208-V, 3 Ph, 4W | Black | Red | Blue | White | Green |
| | 277/480-V, 3 Ph, 4W | Brown | Orange | Yellow | Gray | Green |
2. For conductors #6 AWG and smaller, factory apply color the entire length of conductors.
 3. For conductors #4 AWG and larger, field apply colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Use 1-inch- wide tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.
 4. At each panelboard, a color code legend shall be permanently posted corresponding to the conductors and voltage in that panelboard.
- K. Apply identification to conductors as follows:

-
1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.
 2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding to identify circuits' voltage and phase.
 3. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.
- L. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment unless units are delivered with their own self-explanatory identification. Attached engraved labels with high performance double coated adhesive tape. Apply labels for each unit of the following categories of equipment:
1. Switchgear, switchboards, panelboards, electrical cabinets, and enclosures.
 2. Access doors and panels for concealed electrical items.
 3. Disconnect switches and enclosed circuit breakers.
 4. Transformers.
 5. Inverters.
 6. Contactors.
 7. Remote-controlled switches.
 8. Control devices and push-button stations.
 9. Emergency system boxes and enclosures.
 10. Fire alarm control panels, master stations, control panels, local operator consoles, and power supplies.
 11. Security-monitoring master stations and control panels.
 12. Telephone system equipment.
 13. Public address, intercom, and paging system equipment.
 14. TV / audio / video system equipment.
- M. Nameplate colors shall be: White surface with black core.

END OF SECTION

SECTION 26 0923

LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following lighting control devices:
 - 1. Time switches.
 - 2. Outdoor photoelectric switches
 - 3. Switchbox-mounted occupancy and vacancy sensors.
 - 4. Indoor occupancy and vacancy sensors.
 - 5. Multipole contactors.

1.3 DEFINITIONS

- A. PIR: Passive infrared.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
 - 1. Lighting plan showing location, orientation, and coverage area of each sensor.
 - 2. Interconnection diagrams showing field-installed wiring.
- C. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS

- A. Line-Voltage Surge Protection: An integral part of the devices for 120- and 277-V solid-state equipment. For devices without integral line-voltage surge protection, field-mounting surge protection shall comply with IEEE C62.41 and with UL 1449.

2.3 TIME SWITCHES

A. Manufacturers:

1. Area Lighting Research, Inc.
2. Fisher Pierce.
3. Grasslin Controls Corporation.
4. Intermatic, Inc.
5. Paragon Electric Co.
6. TORK.
7. Watt Stopper (The).

B. Digital Time Switches: Electronic, solid-state programmable units with alphanumeric display complying with UL 917.

1. Contact Configuration: DPST.
2. Contact Rating: 30-A inductive or resistive, 240-V ac.
3. Program: Single channel, 8 on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.
4. Circuitry: Allow connection of a photoelectric relay as substitute for on and off function of a program.
5. Astronomical Time: All channels.
6. Battery Backup: For schedules and time clock.

2.4 OUTDOOR PHOTOELECTRIC SWITCHES

A. Manufacturers:

1. Area Lighting Research, Inc.
2. Fisher Pierce.
3. Grasslin Controls Corporation.
4. Intermatic, Inc.
5. Paragon Electric Co.
6. TORK.
7. Touchplate Technologies, Inc.
8. Watt Stopper (The).

B. Description: Solid state, with DPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, microprocessor input, and complying with UL 773A.

1. Light-Level Monitoring Range: 1.5 to 10 fc (16 to 108 lx), with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.
2. Time Delay: 15-second minimum, to prevent false operation.
3. Surge Protection: Metal-oxide varistor type, complying with IEEE C62.41 for Category A1 locations.

4. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the North sky exposure.

2.5 SWITCHBOX-MOUNTED OCCUPANCY AND VACANCY SENSORS

- A. Manufacturers:
 1. Cooper Controls.
 2. Hubbell Lighting Inc.
 3. Leviton Mfg. Company Inc.
 4. Watt Stopper (The).
- B. Description: Dual technology, ultrasonic and PIR type, with integral power-switching contacts rated for 800 W at 120-V ac and 1200 W at 277-V ac, minimum; suitable for electronic ballasts, LED drivers, or 1/6-hp motors.
 1. Configurable occupancy sensing or vacancy sensing operating modes. Operation:
 - a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 - b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 2. Include ground wire.
- C. Single Relay Unit: Device contains one relay for controlling load circuit.
 1. Design Basis: Hubbell # LHMTS1.
 2. One On-Off button for manual control.
- D. Dual Relay Unit: Device contains two relays for controlling independent lighting loads or circuits.
 1. Design Basis: Hubbell #LHMTD2.
 2. Two On-Off buttons for manual control.
- E. Dimmer Unit:
 1. Design Basis: Legrand / WattStopper #DW-311.
 2. Dimming Control Signal: 0-10 VDC.
 3. Suitable for multi-way control from up to four locations.

2.6 INDOOR OCCUPANCY AND VACANCY SENSORS

- A. Manufacturers:
 1. Cooper Controls.
 2. Hubbell Lighting Inc.
 3. Leviton Mfg. Company Inc.
 4. Watt Stopper (The).
- B. General Description: Wall- or ceiling-mounting, as indicated on the drawings; solid-state units with a separate relay unit.

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1. Configurable occupancy sensing or vacancy sensing operating modes. Operation:
 - a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 - b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
 3. Relay Units: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
 - a. Where indicated for 277-V ac lighting systems, provide additional relay units where required for simultaneous control of 120-V ac exhaust fans.
 4. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted though a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
 6. Bypass Switch: Override the on function in case of sensor failure.
 7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (215 to 2150 lx); keeps lighting off when selected lighting level is present.
- C. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on and off functions shall be selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6-inch (150-mm) minimum movement of any portion of a human body that presents a target of at least 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving at least 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch- (2440-mm-) high ceiling.
- D. Design Basis: Hubbell # OMNIDT2000. If room size is significantly smaller than 2000 sq. ft., evaluate the use of a unit with applicably sized reduced range.
- 2.7 MULTIPOLE CONTACTORS
- A. Manufacturers:
1. Allen-Bradley/Rockwell Automation.
 2. Cutler-Hammer; Eaton Corporation.

3. GE Industrial Systems.
4. Siemens.
5. Square D.
- B. Description: Electrically operated and mechanically held, complying with NEMA ICS 2 and UL 508.
 1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
 2. Control-Coil Voltage: Match control power source.

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

- A. Install and aim sensors in locations to achieve at least 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 WIRING INSTALLATION

- A. Wiring Method: Comply with Section "Conductors and Cables."
- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
- E. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 IDENTIFICATION

- A. Identify components and power and control wiring according to Section "Electrical Identification."
- B. Label time switches and contactors with a unique designation.

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
 2. Operational Test: Verify actuation of each sensor and adjust time delays.
- B. Remove and replace lighting control devices where test results indicate that they do not comply with specified requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 6 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
 2. Align ceiling occupancy sensors using manufacturer's aiming instructions.

END OF SECTION

SECTION 26 2200

DRY-TYPE TRANSFORMERS (600 V AND LESS)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
 - 1. Distribution transformers.

1.3 SUBMITTALS

- A. Product Data Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.
- B. Manufacturer Seismic Qualification Certification: Submit certification that transformer assembly and components will withstand seismic forces defined in Section "Seismic Controls for Electrical Work." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Output Settings Reports: Record of tap adjustments specified in Part 3.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with IEEE C 57.12.91, "Standard Test Code for Dry-Type Distribution and Power Transformers".
- C. Comply with IEEE C 57.96, "Guide for Loading Dry-Type Distribution and Power Transformers".
- D. Comply with IEEE C 57.110, "Recommended Practice for Establishing Transformer Capability When Supplying Nonsinusoidal Load Currents".
- E. Energy-Efficient Transformers Rated 15 kVA and Larger: Certified as meeting NEMA TP 1, Class 1 efficiency levels when tested according to NEMA TP 2.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.
- B. Coordinate installation of wall-mounting and structure-hanging supports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Acme Electric Corporation; Power Distribution Products Division.
 - 2. Eaton / Cutler-Hammer.
 - 3. GE Electrical Distribution & Control.
 - 4. Hammond Power Solutions.
 - 5. Siemens Energy & Automation, Inc.
 - 6. Sola/Hevi-Duty Electric.

2.2 MATERIALS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Cores: Grain-oriented, non-aging silicon steel.
- C. Coils: Continuous windings without splices, except for taps.
 - 1. Internal Coil Connections: Brazed or pressure type.
 - 2. Coil Material: Aluminum or copper.

2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NEMA ST 20, and list and label as complying with UL 1561.
- B. Provide transformers that are internally braced to withstand seismic forces specified in Section "Seismic Controls for Electrical Work."
- C. Cores: One leg per phase.
- D. Enclosure:
 - 1. Indoors: Ventilated, NEMA 250, Type 2.
 - 2. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- E. Indoor Transformer Enclosure Finish: Comply with NEMA 250 for "Indoor Corrosion Protection"; Finish Color: Gray.
- F. Efficiency: Meet or exceed DOE 2016 efficiency standards.

TRANSFORMER ENERGY EFFICIENCY LEVELS			
Single-Phase		Three-Phase	
kVA	Efficie	kVA	Efficiency
15	97.7	15	97.89
25	98.0	30	98.23
37.5	98.2	45	98.40
50	98.3	75	98.60
75	98.5	112.5	98.74
100	98.6	150	98.83
167	98.7	225	98.94
250	98.8	300	99.02
333	98.9	500	99.14
---	---	750	99.23
---	---	1000	99.28

- G. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.
- H. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.
- I. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.
- J. Wall Brackets: Manufacturer's standard brackets.

2.4 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.91.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls and floors for suitable mounting conditions where transformers will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

-
1. Brace wall-mounting transformers as specified in Section "Seismic Controls for Electrical Work."
 - B. Install floor-mounting transformers level on concrete bases. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit and 4 inches high. Reinforce concrete bases with welded wire fabric.
 1. Anchor transformers to concrete bases according to manufacturer's written instructions, seismic codes at Project, and requirements in Section "Seismic Controls for Electrical Work."
- 3.3 CONNECTIONS
- A. Ground equipment according to Section "Grounding and Bonding."
 - B. Connect wiring according to Section "Conductors and Cables."
 - C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- 3.4 ADJUSTING
- A. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 5 percent.
 - B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

END OF SECTION

SECTION 26 2413

SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.
- B. Specification 230923, Direct Digital Control System for HVAC.

1.2 SUMMARY

- A. This Section includes service and distribution switchboards rated 600 V and less.

1.3 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.
- B. RMS: Root mean square.

1.4 SUBMITTALS

- A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each switchboard and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Bus configuration, current, and voltage ratings.
 - c. Short-circuit current rating of switchboards and overcurrent protective devices.
 - d. Descriptive documentation of optional barriers specified for electrical insulation and isolation.
 - e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - f. Arc energy reduction method for breakers rated 1200A or higher for compliance with NEC 240.87.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
- C. Manufacturer Seismic Qualification Certification: Submit certification that switchboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 16 Section "Seismic Controls for Electrical Work." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

-
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
 - D. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. If Section "Operation and Maintenance Data" is included in the project manual, in addition to items there, include the following:
 1. Routine maintenance requirements for switchboards and all installed components.
 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 3. Time-current curves, including selectable ranges for each type of overcurrent protective device.
 4. Circuit breaker trip settings.
- 1.5 QUALITY ASSURANCE
- A. Source Limitations: Obtain switchboards through one source from a single manufacturer.
 - B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - C. Comply with NEMA PB 2, "Deadfront Distribution Switchboards."
 - D. Comply with NFPA 70.
 - E. Product Selection for Restricted Space: Drawings indicate specific installation locations required for reconnection to existing feeder conductors. Review locations noted and review current equipment and feeder configurations to understand limitations and requirements for new equipment.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Deliver in sections or lengths that can be moved past obstructions in delivery path.
 - B. Store indoors in clean dry space with uniform temperature to prevent condensation. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.
 - C. Handle switchboards according to NEMA PB 2.1 and NECA 400.
- 1.7 PROJECT CONDITIONS
- A. New switchboards are required to replace existing. New service feeder conductors will be connected to the switchboard main breakers. Existing distribution feeder conductors will be connected to new distribution feeder breakers. The new switchboards shall feature an oversized splice section at the bottom to accommodate splices for extension of existing feeder conductors where necessary. Manufacturer standard switchboard construction will likely not be suitable. See drawing details for more information.
 - B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 1. Notify Architect/Engineer/Owner no fewer than 2 weeks in advance of proposed interruption of electric service.
 2. Indicate method of providing temporary electric service, if required.

3. Do not proceed with interruption of electric service without Owner's written permission.

1.8 COORDINATION

- A. Coordinate layout and installation of switchboards and components with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate size and location of concrete bases.

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Potential Transformer Fuses: Equal to 10 percent of amount installed for each size and type, but no fewer than 2 of each size and type.
 2. Control-Power Fuses: Equal to 10 percent of amount installed for each size and type, but no fewer than 2 of each size and type.
 3. Indicating Lights: Equal to 10 percent of amount installed for each size and type, but no fewer than 1 of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 MANUFACTURED UNITS

- A. Manufacturers:
 1. Eaton Corporation; Cutler-Hammer Products.
 2. General Electric Co.; Electrical Distribution & Protection Div.
 3. Siemens Energy & Automation, Inc.
 4. Square D.
- B. Front-Connected, Front-Accessible Switchboard: Fixed, individually mounted main devices and panel-mounted branches.
- C. Enclosure: Steel, NEMA 250, Type 1.
- D. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
- E. Barriers: Between adjacent switchboard sections.
- F. Insulation and isolation for main and vertical buses of feeder sections.
- G. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
- H. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.
- I. Buses and Connections: Three phase, four wire, unless otherwise indicated.
 1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity with feeder circuit-breaker line connections.
 - a. Use copper for feeder circuit-breaker line connections.

-
2. Ground Bus: 1/4-by-2-inch minimum-size, hard-drawn copper of 98 percent conductivity, equipped with pressure connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
 3. Contact Surfaces of Buses: Silver plated.
 4. Main Phase Buses, Neutral Buses, and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
 5. Neutral Buses: 100 percent of the ampacity of phase buses, unless otherwise indicated, equipped with pressure connectors for outgoing circuit neutral cables. Bus extensions for busway feeder neutral bus are braced.
- J. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.
- K. Fabricate and test switchboards to withstand seismic forces defined in Section "Seismic Controls for Electrical Work."
- 2.3 OVERCURRENT PROTECTIVE DEVICES
- A. Molded-Case Circuit Breaker: NEMA AB 3, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits.
 - b. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 3. Electronic trip-unit circuit breakers shall have RMS sensing, field-replaceable rating plug, and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
- B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
1. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 3. Ground-Fault Protection: Where required or indicated, integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 4. Shunt Trip: Where required or indicated, 120-V trip coil energized from separate circuit.
- C. Enclosed, Insulated-Case Circuit Breaker: Fully rated, encased-power circuit breaker with interrupting capacity rating to meet available fault current.

-
1. Fixed circuit-breaker mounting.
 2. Two-step, stored-energy closing.
 3. Microprocessor-based trip units with interchangeable rating plug, LED trip indicators, and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments with I^2t response.
 - d. Ground-fault pickup level, time delay, and I^2t response.
 4. Shunt Trip: Where required or indicated, 120-V trip coil energized from separate circuit.
- D. For breakers rated 1200A or higher, provide arc energy reduction to comply with NEC 240.87.
- 2.4 INSTRUMENTATION
- A. Instrument Transformers: NEMA EI 21.1, IEEE C57.13, and the following:
1. Potential Transformers: Secondary voltage rating of 120 V and NEMA accuracy class of 0.3 with burdens of W, X, and Y.
 2. Current Transformers: Ratios shall be as indicated with accuracy class and burden suitable for connected relays, meters, and instruments.
 3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kV.
- B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
 - a. Phase Currents, Each Phase: Plus or minus 1 percent.
 - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
 - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
 - d. Megawatts: Plus or minus 2 percent.
 - e. Megavars: Plus or minus 2 percent.
 - f. Power Factor: Plus or minus 2 percent.
 - g. Frequency: Plus or minus 0.5 percent.
 - h. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from 5 to 60 minutes.
 - i. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent. Accumulated values unaffected by power outages up to 72 hours.
 2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.
 3. Output: BACnet MS/TP for monitoring by the building automation system / direct digital control system.

2.5 CONTROL POWER

- A. Control Circuits: 120 V, supplied through secondary disconnecting devices from control-power transformer.
- B. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.
- C. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

PART 3 - EXECUTION

3.1 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

3.2 EXAMINATION

- A. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. Install switchboards and accessories according to NEMA PB 2.1 and NECA 40.
- B. Install and anchor switchboards level on concrete bases, 4-inch nominal thickness, with welded wire fabric reinforcement.
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
 - 2. For switchboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to switchboards.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
- D. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
- E. Install overcurrent protective devices and instrumentation.
 - 1. Set field-adjustable switches and circuit-breaker trip ranges.
 - 2. Prepare documentation of circuit breaker trip settings for Owner record documents.
- F. Comply with mounting and anchoring requirements specified in Section "Seismic Controls for Electrical Work."

3.4 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section "Electrical Identification."

- B. Switchboard Nameplates: Label each switchboard compartment with engraved metal nameplate mounted with corrosion-resistant screws.

3.5 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Perform each electrical test and visual and mechanical inspection stated in manufacturer's installation instructions as appropriate. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.6 CLEANING

- A. On completion of installation, inspect interior and exterior of switchboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION

SECTION 26 2416

PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.
- B. RMS: Root mean square.

1.4 SUBMITTALS

- A. Product Data: For each type of panelboard, overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Trim types and details.
 - c. Bus configuration, current, and voltage ratings.
 - d. Short-circuit current rating of panelboards and overcurrent protective devices.
 - e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- C. Manufacturer Seismic Qualification Certification: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Section "Seismic Controls for Electrical Work." Include the following:
 - 1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Panelboard Schedules: For installation in panelboards.

- E. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. If Section "Operation and Maintenance Data" is included in the project manual, in addition to items there, include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device.
 - 3. Circuit breaker trip settings.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of panelboards and are typically based on Square D products. Products of other manufacturers are acceptable if they can be installed in the space indicated.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

- 1.7 Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
- 1.8 Notify Architect/Engineer/Owner no fewer than two weeks in advance of proposed interruption of electrical service.
- 1.9 Do not proceed with interruption of electrical service without Owner's written permission.

1.10 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

1.11 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Keys: Six spares for each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Panelboards, Overcurrent Protective Devices, and Accessories:
 - a. Eaton Corporation; Cutler-Hammer Products.
 - b. General Electric Co.; Electrical Distribution & Protection Div.

- c. Siemens Energy & Automation, Inc.
- d. Square D.

2.2 MANUFACTURED UNITS

- A. Enclosures: Flush- and surface-mounted cabinets, as scheduled in the drawings. NEMA PB 1, Type 1.
 - 1. Rated for environmental conditions at installed location.
 - a. Outdoor Locations: NEMA 250, Type 3R .
 - b. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
 - c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - 2. Front Hinged Trim: Entire front trim hinged to box with full-length piano hinge, and with standard door within hinged trim cover.
 - 3. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
 - 4. Directory Card: With transparent protective cover, mounted in metal frame, inside panelboard door.
- B. Phase Buses:
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
- C. Ground and Neutral Bars:
 - 1. Equipment Ground Bar: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
 - 2. Neutral Bar: Adequate for feeder and branch-circuit neutral conductors.
- D. Conductor Connectors: Suitable for use with conductor material.
 - 1. Main and Neutral Lugs: Mechanical type.
 - 2. Ground Lugs and Bus Configured Terminators: Mechanical or compression type.
- E. Sub-Feed Lugs (where scheduled): Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device. If sub-feed lugs are not a standard manufacturer option, provide a sub-feed breaker rated the same as the panel feeder.
- F. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.
- G. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices. These locations will be indicated as SPACE on the panel schedules in the drawings.
- H. Fabricate and test panelboards to withstand seismic forces defined in Section "Seismic Controls for Electrical Work."

2.3 PANELBOARD SHORT-CIRCUIT RATING

- A. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.4 DISTRIBUTION PANELBOARDS

- A. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- B. Main Overcurrent Protective Devices: Circuit breaker.

- C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

2.5 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- B. Main Overcurrent Protective Devices: Circuit breaker, where scheduled.
- C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

2.6 OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic trip-unit circuit breakers shall have RMS sensing; field-replaceable rating plug; and with the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
 - 4. GFCI Circuit Breakers: Single- and two-pole configurations
 - a. 5-mA trip sensitivity for personnel protection.
 - b. 30-mA trip sensitivity for equipment protection.
- B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
 - 1. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - 2. Multipole units enclosed in a single housing or factory-assembled to operate as a single unit.
 - 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 - 4. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - 5. Shunt Trip: Where required or indicated, 120-V trip coil energized from separate circuit.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Mount top of trim 74 inches above finished floor, unless otherwise indicated.
- C. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.

- D. Install overcurrent protective devices and controllers. Set field-adjustable circuit-breaker trip ranges.
- E. Panel breaker configurations shall be installed as indicated on the panel schedules or as noted. Breaker position revisions will not be accepted unless approved in writing by the Engineer.
- F. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- G. Install filler plates in unused spaces.
- H. For flush mounted panelboards and unless noted otherwise, stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.
- I. Install overcurrent protective devices and instrumentation.
 - 1. Set field-adjustable switches and circuit-breaker trip ranges.
 - 2. Prepare documentation of circuit breaker trip settings for Owner record documents.
- J. Comply with mounting and anchoring requirements specified in Section "Seismic Controls for Electrical Work."

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section "Electrical Identification".
- B. Create a directory to indicate installed circuit loads.
 - 1. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
 - 2. Include final project room numbers for loads connected to each circuit.
 - 3. *** EXISTING PANELS - NEW DIRECTORIES *** - The contractor shall field investigate existing panel circuitry and prepare new / updated panel directories that reflected connected loads and room numbers.
- C. Panelboard Nameplates: Label each panelboard with laminated-plastic nameplate mounted as specified in Section "Electrical Identification".

3.3 CONNECTIONS

- A. Ground equipment according to Section "Grounding and Bonding."
- B. Connect wiring according to Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
 - 3. Neutral-ground bond testing: After all fixtures, devices and equipment are installed and all connections completed to each panel, the CONTRACTOR shall disconnect the neutral feeder conductor from the neutral bar and take a megger reading between the neutral bar and grounded enclosure. If this reading is less than 25 mega-ohms, the CONTRACTOR shall disconnect the branch circuit neutral wires from the neutral bar. The CONTRACTOR shall then test each one separately to the panel until the low reading ones are found. The CONTRACTOR shall correct troubles, re-connect, and re-test until

at least 25 mega-ohms from the neutral bar to the grounded panel can be achieved with only the neutral feeder disconnected.

- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Perform each electrical test and visual and mechanical inspection stated in manufacturer's installation instructions for molded-case circuit breakers. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.5 CLEANING

- A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION

SECTION 26 2726

WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Single and duplex receptacles and ground-fault circuit interrupter receptacles.
 - 2. Single- and double-pole snap switches and dimmer switches.
 - 3. Device wall plates.
 - 4. Floor service outlets.

1.3 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Wiring Devices:
 - a. Bryant Electric, Inc./Hubbell Subsidiary.
 - b. Eagle Electric Manufacturing Co., Inc.
 - c. Hubbell Incorporated; Wiring Device-Kellems.
 - d. Leviton Mfg. Company Inc.
 - e. Lutron.
 - f. Pass & Seymour/Legrand; Wiring Devices Div.
 - 2. Floor Service Outlets:
 - a. Hubbell Incorporated; Wiring Device-Kellems.
 - b. Pass & Seymour/Legrand; Wiring Devices Div.

- c. Square D/Groupe Schneider NA.
- d. Thomas & Betts Corporation.
- e. Wiremold Company (The).

2.2 RECEPTACLES

- A. Straight-Blade-Type Receptacles: Comply with NEMA WD 1, NEMA WD 6, DSCC W-C-596G, and UL 498.
- B. Straight-Blade and Locking Receptacles:
 - 1. Heavy-Duty grade.
 - 2. Arranged for back and side wiring with brass screws.
 - 3. Grounding type with hex head ground screw terminal.
 - 4. 15-amp and 20-amp, 125-Volt and 250-Volt receptacles in damp or wet locations shall be listed weather-resistant type.
 - 5. Receptacles shall accommodate back and side wiring and shall be grounding type with separate single or double grounding screw terminals.
- C. Tamper-Resistant Convenience Receptacles, 125 V, 15 & 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.
- D. GFCI Receptacles:
 - 1. Straight blade, feed-through type, Heavy-Duty grade, with integral NEMA WD 6, Configuration 5-20R duplex receptacle.
 - 2. Comply with UL 498 and UL 943.
 - 3. Design units for installation in a 2-3/4-inch- (70-mm-) deep outlet box without an adapter.
 - 4. For devices indicated, provide units with integral audible unit that sounds an alarm to indicate that the device is tripped.

2.3 SWITCHES

- A. Single- and Double-Pole Switches: Comply with DSCC W-C-896F and UL 20.
- B. Snap Switches:
 - 1. Heavy-Duty grade, quiet type without the use of mercury switches.
 - 2. Arranged for back and side wiring with brass screws.
 - 3. Grounding type with hex head ground screw terminal.
- C. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible frequency and EMI/RFI filters.
 - 1. Control: Continuously adjustable slider; with single-pole or three-way switching to suit connections.

2.4 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 - 1. Size: All plates shall be oversized / jumbo with matching vertical dimension.
 - 2. Plate-Securing Screws: Metal with head color to match plate finish.
 - 3. Material for Finished Spaces: 0.035-inch- (1-mm-) thick, satin-finished stainless steel.

4. Material for Unfinished Spaces: Galvanized steel.
5. Material for Wet Locations: Cast aluminum, weatherproof, "in-use" type. Receptacle box covers shall be weatherproof whether or not a cord & plug are inserted or not.
6. Toggle Switch Serving as a Disconnect: Wallplate shall be configured with brackets on both sides of the switch to accommodate a padlock to secure the switch in the Off position.

2.5 FLOOR SERVICE FITTINGS

- A. Type: Modular, flush-type, dual-service units suitable for wiring method used.
- B. Compartments: Barrier separates power from voice and data communication cabling.
- C. Service Plate: Rectangular, die-cast aluminum with satin finish.
- D. Power Receptacle: NEMA WD 6, Configuration 5-20R, unless otherwise indicated.
- E. Voice and Data Communication Outlet: Modular, keyed, color-coded, RJ-45 jacks for data cable, unless otherwise indicated.

2.6 FINISHES

- A. Color:
 1. Wiring Devices Connected to Normal Power System: White, unless otherwise indicated or required by NFPA 70.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install devices and assemblies level, plumb, and square with building lines.
- B. Install tamper-resistant receptacles at locations as required by the NEC and/or the local authority having jurisdiction.
- C. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' written instructions.
- D. Arrangement of Devices: Mount flush unless noted otherwise:
 1. Receptacles over counters, backsplashes, etc. shall be mounted with long dimension horizontal.
 2. Otherwise, unless noted differently, mount with long dimension vertical, and with grounding terminal of receptacles on top.
 3. Group adjacent switches under single, multi-gang wall plates.
- E. Remove wall plates and protect devices and assemblies during painting.
- F. Adjust locations of floor service outlets to suit arrangement of partitions and furnishings. Coordinate final placement with Architect and Owner.

3.2 IDENTIFICATION

- A. Comply with Section "Electrical Identification."
 1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped / thermal printing with black-filled lettering on face of plate, and durable wire markers inside outlet boxes.

3.3 CONNECTIONS

- A. Ground equipment according to Section "Grounding and Bonding."

- B. Connect wiring according to Section "Conductors and Cables."
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.
 - 2. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.
- B. Remove malfunctioning units, replace with new units, and retest as specified above.

END OF SECTION

SECTION 26 4313

SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes UL 1449 Type 2 surge protective devices for low-voltage power.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.
- B. Product Certificates: Signed by manufacturers of surge protective devices, certifying that products furnished comply with the following testing and labeling requirements:
 - 1. UL 1283 certification.
 - 2. UL 1449 listing and classification.
- C. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Failed test results and corrective action taken to achieve requirements.
- D. Maintenance Data: For surge protection devices to include in maintenance manuals.
- E. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain suppression devices and accessories through one source from a single manufacturer.
- B. Product Options: Drawings indicate size and dimensional requirements.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. IEEE Compliance: Comply with:
 - 1. IEEE C62.41.1, "Guide on the Surge Environment in Low-Voltage (1000V and less) AC Power Circuits".
 - 2. IEEE C62.41.2, "Recommended Practice on Characterization of Surges in Low-Voltage (1000V and less) AC Power Circuits".
 - 3. IEEE C62.45, "Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000V and less) AC Power Circuits".
 - 4. IEEE C62.72, "Guide for the Application of Surge Protective Devices for Low-Voltage (1000V and less) AC Power Circuits".
 - 5. IEEE C62.45, "Standard Test Specifications for Surge Protective Devices for Low-Voltage (1000V and less) AC Power Circuits".

- E. NEC Compliance: Comply with NEC 285, "Surge Protective Devices".
- F. UL Compliance: Comply with:
 - 1. UL 96A, "Installation Requirements for Lightning Protection Systems": Where UL Master Label Certification is required for a lightning protection system.
 - 2. UL 1283, "Electromagnetic Interference Filters".
 - 3. UL 1449, "Transient Voltage Surge Suppressors": latest edition.

1.5 PROJECT CONDITIONS

- A. Placing into Service: Do not energize or connect service entrance equipment and panelboards to their sources until the surge protective devices are installed and connected.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Architect/Engineer/Owner not less than two weeks in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Owner's written permission.

1.6 COORDINATION

- A. Verify voltage rating of system to be protected by surge protective device.
- B. Coordinate location of field-mounted surge suppressors to allow adequate clearances for maintenance.

1.7 WARRANTY

- A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of surge suppressors that fail in materials or workmanship within five years from date of Final Acceptance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Current Technology, Inc.
 - 2. ASCO.
 - 3. Thor Systems, Inc.

2.2 SERVICE ENTRANCE SUPPRESSORS

- A. Manufacturer Series:
 - 1. Current Technology #TG3 Series.
 - 2. ASCO #460 Series.
 - 3. Thor Systems #TSri Series.
- B. Include the following features and accessories:

-
1. LED indicator lights for power and protection status.
 2. Surge Rating: 100kA per mode / 200KA per phase
 3. ANSI / UL 1449 VPR:
 - a. 120/208V: 800V maximum (L-N, L-G, N-G), 1200V maximum (L-L).
 - b. 277/480V: 1200V maximum (L-N, L-G, N-G), 2000V maximum (L-L).
 4. Enclosures: NEMA 1.
 5. Surge-event operations counter.
 - C. Connection Means: Permanently wired.
 - D. Protection modes:
 1. Line to Neutral.
 2. Line to Ground.
 3. Neutral to Ground.

2.3 PANELBOARD SUPPRESSORS

- A. Manufacturer Series:
 1. Current Technology #CGP Series.
 2. ASCO #440 Series.
 3. Thor Systems #TSni Series.
- B. Include the following features and accessories:
 1. LED indicator lights for power and protection status.
 2. Surge Rating: 50kA per mode .
 3. ANSI / UL 1449 VPR:
 - a. 120/208V: 800V maximum (L-N, L-G, N-G), 1200V maximum (L-L).
 - b. 277/480V: 1200V maximum (L-N, L-G, N-G), 2000V maximum (L-L).
 4. Enclosures: NEMA 1.
 5. Surge-event operations counter.
- C. Connection Means: Permanently wired.
- D. Protection modes:
 1. Line to Neutral.
 2. Line to Ground.
 3. Neutral to Ground.

2.4 ENCLOSURES

- A. NEMA 250, with type matching the enclosure of panel or device being protected.

PART 3 - EXECUTION

3.1 INSTALLATION OF SURGE PROTECTIVE DEVICES

- A. Install devices at service entrance on load side, with ground lead bonded to service entrance ground. Use conductors between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length.

-
1. Provide multipole, 60-A circuit breaker as a dedicated disconnect for the suppressor, unless otherwise indicated
 - B. Install devices for panelboards with conductors between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
 1. Provide multipole, 30-A circuit breaker as a dedicated disconnect for the suppressor, unless otherwise indicated.

3.2 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:
 1. After installing surge protective devices, but before electrical circuitry has been energized, test for compliance with requirements.
 2. Complete startup checks according to manufacturer's written instructions.
- B. Repair or replace malfunctioning units. Retest after repairs or replacements are made.

END OF SECTION

SECTION 26 5119

LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes LED luminaires, materials, finishes, supports.
- B. Related Requirements:
 - 1. Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting contactors.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaires.
 - 4. Include emergency lighting units, including batteries and chargers.
 - 5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.

1.5 INFORMATIONAL SUBMITTALS

- A. Sample warranty.
- B. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Drivers: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. LED Light Modules: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
 - 4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Provide luminaires from a single manufacturer for each luminaire type.
- C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period:
 - 1. Materials: Ten years from date of Substantial Completion.
 - 2. Labor: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires and lamps shall withstand the effects of earthquake motions and be labeled vibration and shock resistant.
 - 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 LUMINAIRE REQUIREMENTS

- A. Standards:
 - 1. Design Lights Consortium (DLC) qualified products list or ENERGY STAR certified.
 - 2. UL 1598, Standard for Luminaires.
 - 3. Recessed luminaires shall comply with NEMA LE 4.
 - 4. UL Listing: Listed for damp or wet location as applicable.

- B. CRI minimum of 80 CCT at 4000 K.
- C. Rated lamp life of 50,000 hours minimum to L70.
- D. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- E. Internal driver.

2.3 EMERGENCY LIGHTING UNITS

- A. General: Self-contained units complying with UL 924.
 - 1. LED lamp heads.
 - 2. Battery: Sealed, maintenance-free, nickel-cadmium or nickel metal hydride type with minimum 10-year nominal life and special warranty. Battery sized to provide emergency illumination for not less than 90 minutes.
 - 3. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - 4. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - 5. Protective Guard: Where indicated, or where located in gyms or multi-purpose rooms provide clear polycarbonate guard to protect lamp heads or fixtures.
 - 6. Integral Time-Delay Relay: Holds unit on for fixed interval when power is restored after an outage; time delay permits high-intensity-discharge lamps to restrike and develop adequate output.

2.4 EXIT SIGNS

- A. General: Comply with UL 924; for sign colors and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
 - 1. Lamps for AC Operation: Light-emitting diodes, 70,000 hours minimum of rated lamp life.
- C. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
 - 1. Battery: Sealed, maintenance-free, nickel-cadmium or nickel metal hydride type with special warranty. Battery sized to provide emergency illumination for not less than 90 minutes.
 - 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - 3. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - 4. Protective Guard: Where indicated, or where located in gyms or multi-purpose rooms provide clear polycarbonate guard to protect lamp heads or fixtures.

2.5 MATERIALS

- A. Metal Parts:

-
1. Free of burrs and sharp corners and edges.
 2. Sheet metal components shall be steel unless otherwise indicated.
 3. Form and support to prevent warping and sagging.
- B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- C. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place. Label shall include the following lamp characteristics:
1. "USE ONLY" and include specific lamp type.
 2. Lamp diameter, shape, size, wattage, and coating.
 3. CCT and CRI for all luminaires.
- 2.6 METAL FINISHES
- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.
- 2.7 LUMINAIRE SUPPORT
- A. Comply with requirements in Section "Basic Materials and Methods" for channel and angle iron supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as luminaire.
- D. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gauge.
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gauge.
- F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- G. Aircraft Cable Support: Use cable, anchorages, and intermediate supports recommended by fixture manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

-
- C. Install lamps in each luminaire.
 - D. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Provide support for luminaire without causing deflection of ceiling or wall.
 - 4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.
 - E. Flush-Mounted Luminaire Support:
 - 1. Secured to outlet box.
 - 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
 - 3. Trim ring flush with finished surface.
 - F. Wall-Mounted Luminaire Support:
 - 1. Attached to structural members in walls or a minimum 20 gauge backing plate attached to structure.
 - G. Suspended Luminaire Support:
 - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
 - 3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing for suspension for each unit length of luminaire chassis, including one at each end.
 - 4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
 - H. Ceiling-Grid-Mounted Luminaires:
 - 1. Fixture is to be supported at two (2) opposite ends to the steel frame of the building using the same type of wire as used to support the lay-in ceiling track.
 - 2. Support Clips:
 - a. Fasten fixtures to ceiling grid main runner members with manufacturer clips.
 - 3. Fixtures of Sizes Less Than Ceiling Grid Pattern:
 - a. Install as indicated on reflected ceiling plans or center in acoustical panel.
 - b. Support fixtures independently with at least two 3/4-inch (metal channels spanning and secured to ceiling tees.
 - c. Fixture is to be supported at two (2) opposite ends to the steel frame of the building using the same type of wire as used to support the lay-in ceiling track.
- 3.3 FIELD QUALITY CONTROL
- A. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories; and after electrical circuitry has been energized, test units to confirm proper operation.

2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify normal transfer to battery power source and retransfer to normal. Perform a test on each unit after it is permanently installed and charged for a minimum of 24 hours. Battery shall be tested for 90 minutes. The battery test shall demonstrate compliance with the requirements of NEC 700.12(F). Repair and/or replace any units that fail the test, then retest.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Corroded Fixtures: During warranty period, replace fixtures that show any signs of corrosion.

END OF SECTION

SECTION 27 0000

COMMUNICATIONS

1.1 RELATED DOCUMENTS

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

1.2 DOCUMENT INFORMATION

- A. The specifications provided in the Appendix that follows are provided **FOR REFERENCE** as New Hanover County School System Standard Specifications. These specifications are provided in their entirety as received from New Hanover County School System. Inclusion here is not intended to represent that these specification sections are the work of Cheatham and Associates, P.A. Contact the Engineer for clarification of conflicts that may arise by inclusion of these specifications.

1.3 CONTENTS

- A. New Hanover County School System Standard Specifications:
 - 1. Division 27 – Communications, 27 00 00 Communications.

END OF SECTION



DIVISION 27 – COMMUNICATIONS

27 00 00 COMMUNICATIONS

27 01 00 OPERATION AND MAINTENANCE OF COMMUNICATION SYSTEMS

ARCHITECTURAL ISSUES RELATED TO TECHNOLOGY

TELECOMMUNICATION ROOMS

- ☐ The typical telecommunications infrastructure for a building is designed based upon telecommunications rooms located throughout the facility. These rooms house wiring cross-connect panels as well as network electronics needed for voice, data, security camera systems, and intercom systems.
- ☐ Each building has one Equipment Room (ER), and possibly one or more Telecommunication Rooms (TR) located elsewhere in the building.
- ☐ The minimum requirements ER for square footage in new construction are as follows:
 - o Elementary School 200 Square Feet
 - o Middle School 300 Square Feet
 - o High School 400 Square Feet
- ☐ The minimum TR square footage requirements for new construction is 10' wide x 8' deep and minimum 10' wide x 8' deep for renovation projects.
- ☐ Doors are to be designed so they do not open into the TR space.
- ☐ The designer should include a floor plan for the ER within the project drawings. This floor plan should show type and locations (dimensioned) of equipment racks, overhead ladder racks, and all wireways and conduits that enter the room.
- ☐ The ER serves as the connection point between the entrance and riser cabling systems.
- ☐ The ER serves as the connection point between the riser and horizontal cabling systems. In most cases the ER also serves as one of the TRs (an originating point of horizontal cabling serving its own geographic zone)
- ☐ Each TR serves as the hub for a particular geographic zone of the building (i.e. floor or wing).
- ☐ In addition, controller-type equipment for auxiliary building systems which require either dial tone or network connections may be located in the ER/TRs with permission from the owner. These include fire alarm dialers, security system controllers, building automation system controllers, and other similar devices.
- ☐ Determination if other communications related equipment may be installed in the ER/TR will be done on a case by case basis. Occupants who desire to house other equipment in these rooms should contact the NHCS Facilities, Maintenance and Technology Departments for approval and coordination.
- ☐ Room location selection. When possible, the ER should be located on the first floor in the middle of a building with TRs stacked on each floor directly above it. In some larger buildings, multiple stacks of TRs will be required. One key limiting factor in determining acceptable locations for ER/TR is that current data communications technologies require that the length of the horizontal data cable link does not exceed 295 ft. (90m). A good rule of thumb to use in determining acceptable locations is the "250 ft. rule". The pathway run from the outlet box farthest from a ER/TR back to where the wireway penetrates the wall of that



ER/TR should not exceed 250 ft. It is imperative that this calculation include allowances for the vertical conduit run from the wireway to the outlet box and for the vertical and horizontal deviations in the wireway routing which are common in construction projects. Since the selection of ER/TR locations will probably be done prior to specifying the exact routing of the pathway system, the designer is encouraged to use conservative estimating in determining maximum length of runs.

- ☐ Typically, ER/TR are located near the center of the building adjacent to other core service spaces.
- ☐ Unacceptable locations. ER/TR should not be located in areas subject to water infiltration, steam infiltration, excessive humidity from nearby operations, excessive heat, or direct sunlight (rooms should not have windows). They should also not be located too close to sources of significant EMI or hazardous substances.
- ☐ Room administration. The owner has final authority over access to, and the use of, all ER/TR.
- ☐ Security. All ER/TR will be keyed to the owner's discretion. A limited number of keys will be provided to parties who require access on an ongoing basis.
- ☐ Accessibility. The designer should locate the ER/TR such that they can be easily accessed by technicians without having to pass through lockable space. Typically, each will be located with a door exiting to a corridor or common area which can be reached by personnel possessing keys to the main building entrance door only. It is acceptable to locate these rooms with the door directly accessing the exterior of a building. However, extra effort must be made to ensure these doors are sealed properly from water, dirt, dust, and heat potentially present outside buildings.
- ☐ Locating the doors of the ER/TR so that they are to be entered from mechanical, electrical, or other similar space is unacceptable. Doors of ER/TR should not be blocked by furniture or equipment, vending machines, trash or recycling bins, or other movable equipment restricting quick access by technicians.
- ☐ General construction. ER/TR can be constructed with materials similar to those used for basic office space construction, and can be matched to nearby spaces. In retrofit projects, these rooms should be constructed to match surrounding areas as closely as possible.
- ☐ Walls. The walls of each room should be installed to the deck above. Typically, walls will be constructed using 3 5/8" steel studs (25 GA at walls, 20 GA around door) at 16" O.C. with one layer of 5/8" thick type X (ASTM C-36) gypboard each side. 4" rubber cove base should be installed on all walls inside the room.
- ☐ Ceilings. The minimum height for ceilings in the ER/TR should be 9' – 0". However, when allowable by fire code, no ceiling should be installed in the rooms, and the walls should be run to the deck above. Where existing utilities prevent walls from being run to deck or where a ceiling is required to maintain a particular fire rating, the ceiling should be installed as high as possible.
- ☐ Fire rating. In general, the walls of a ER/TR do not need to be fire rated assemblies. However, if any wall of the room is required to be a rated wall (i.e. the wall between the ER/TR and the corridor, or the wall between the ER/TR and a stairwell), that wall should be installed to comply with the rating required. The fire rating of the ceiling and floor of a ER/TR is no different than that required for similar occupied space.
- ☐ Interior doors. Doors should swing out, not into the ER/TR. Doors and frames should match



surrounding doors as closely as possible.

- ☐ **Seals.** It is important that moisture and dust be kept out of ER/TR. The electronics in these rooms are equipped with fans which pull in air to cool internal components. Excess moisture or dust will damage this equipment over time. The bottom of interior doors should be equipped with door shoes, solid door sweeps, brush door sweeps, or thresholds equipped with vinyl inserts as applicable to prevent water and dust from entering room underneath door.
- ☐ **Flooding.** Typically, the ER is located in an area on the lowest floor of a building. However, this can create significant problems if this area is subject to flooding. When possible, the designer may consider locating the ER on a higher level (first floor as opposed to basement). In extreme cases, the designer may elect to have a floor drain installed just outside the ER with the ER floor sloped properly to allow drainage.
- ☐ **Another potential source of flooding in the ER occurs when the first telecommunications manhole outside the building is at a higher elevation than the ER.** Storm water collects in the manhole and gravity forces it through the entrance duct bank. While installation of water tight sealant inside the conduits usually prevents flooding, the ER finished floor should be located higher than the top of the manhole, when feasible.
- ☐ **Interior/finishes.** The interior of each ER/TR should be completely painted with two coats of latex paint. Floors should be finished with 12" x 12" commercial grade vinyl composition tiles.
- ☐ **¾" thick plywood is to be installed, on the wall behind the equipment racks, from 24" to 96" AFF.** Plywood is to be either fire retardant plywood with label side out or standard plywood painted with fire retardant white paint. If fire retardant plywood is used, the contractor shall have the designer approve the completed installation prior to the plywood being painted with the latex paint described above. If fire retardant paint is used, the contractor shall paint all sides of the plywood. The contractor shall also provide a product submittal for the paint to the designer for approval.
- ☐ **If needed, voice riser cables.** Route riser cables from entry point into ER/TR to nearest ladder rack. Fasten cables to overhead ladder racks to reach equipment racks where cables are to be terminated. Install an additional 10ft. cable slack loop in the cable run, and fasten to overhead ladder racks. Route cables neatly, parallel to each other, and secure with Velcro-type cable wraps to the ladder rack.
- ☐ **Install cables down from ladder racks inside 12" vertical U-channels in equipment racks to reach locations where cables are to be terminated.** Attach cables to channels with rack loop straps. Allow for 6" drop slack loop after termination.
- ☐ **Fiber optic riser cables.** Route fiber optic cables from entry point into ER/TR to nearest ladder rack. Fasten cables to overhead ladder racks to reach equipment racks where cables are to be terminated. Install an additional 10ft. (minimum) cable slack loop in the runs and fasten to overhead ladder racks, securing with Velcro cable ties to the ladder rack.
- ☐ **Install inner-duct down from ladder racks inside vertical U-channels in equipment racks to reach housings where cables are to be terminated.** Attach inner-ducts to channels with rack loop straps. Stop inner-duct run just above the uppermost closet connector housing in the equipment rack, and extend fiber cable into the housing for termination. Use velcro-type cable wraps as required to neatly secure fiber optic cables once they exit inner-duct.



27 01 10 Operation and Maintenance of Structured Cabling and Enclosures

- ☐ The designer should include a floor plan for the ER/TRs within the project drawings. This floor plan should show type and locations (dimensioned) of equipment racks, overhead ladder racks, and all wireways and conduits that enter the room.
- ☐ The placement of equipment racks in each ER/TR should be specified such as to allow maximum possible access to equipment by technicians. Where possible, do not place racks in front of wall mounted interface equipment. In general, racks should be positioned in a line abreast with a 12" space left between racks, and parallel to the longest wall of the ER. When possible, a minimum of 36" should be left between the cable management channel on each end of the line of racks and the wall. If this is not possible, the channel on one end of the line of racks should be positioned directly adjacent to one wall of the room with maximum space (36" min.) remaining at the opposite end of the line of racks. The minimum clearance from the rear of an equipment rack to the wall should be 36". A minimum of 36" should be maintained between the front of the equipment rack and any extended equipment mounted on the facing wall.
- ☐ The number and type of equipment racks installed in a specific ER/TR will be based on the number of outlets projected to be wired back to that ER/TR and the electronics required to support those outlets. This number of outlets is determined by the design of the placement of actual outlets required for a particular area of a building. A minimum of an additional 20% projected growth capacity should be added to the above outlet quantity calculation.
- ☐ All Division 27 and 28 cabinets will be specified to be the same general products and each contractor will coordinate their cabinets to match those provided by the Structured Cabling contractor.

Structural Cabling

- ☐ Provide, ready for operation, a complete and operational communication network infrastructure system that is a manufacturer certified Category 6 system. The system shall include, but not be limited to, copper and fiber optic cabling, cable protectors, racks, modules, patch panels, faceplates, connectors, hardware, accessories, connections, grounding, and all other material, labor and operations required for a complete operating system in this building.
- ☐ Provide, ready for operation, a complete and operational **wireless access point** communication network infrastructure system that is a manufacturer certified **Category 6a** system. The system shall include, but not be limited to, copper and fiber optic cabling, cable protectors, racks, modules, patch panels, faceplates, connectors, hardware, accessories, connections, grounding, and all other material, labor and operations required for a complete operating system in this building.
- ☐ Patch Cables ER & TR: **Provide Category 6 green patch cords for all patch panel jacks, evenly divided between 3, 5 and 7 foot cords, plus 15% spare of each length.** Cables shall be of the same manufacture as that of the patch panels. Patch cables are to be installed by communications contactor (coordinate with NHCS).



- ☐ Patch Cables ER & TR: **Provide Category 6a yellow patch cords for the wireless access point communication network for all patch panel jacks, evenly divided between 3, 5 and 7 foot cords, plus 15% spare of each length.** Cables shall be of the same manufacture as that of the patch panels. Patch cables are to be installed by communications contactor (coordinate with NHCS).
- ☐ Contractor and authorized subcontractors will use certified technicians for all cable terminations. Use of temporary or uncertified technicians shall not be permitted. Copies of certifications from the manufacturer are required with shop drawing submittal.
- ☐ Cabling vendors must permanently employ at least one RCDD (Registered Communications Distribution Designer). Use of a temporary employee or subcontracted employee for the sole purpose of meeting this requirement shall not be permitted. A copy of the certification is required with the shop drawing submittal.
- ☐ Acceptable manufacturers are Hubbell , CommScope, and Panduit.

Riser Cabling

- ☐ Riser cables. The riser (backbone) cabling from the ER to each TR in the building consists of multi-pair UTP cables for distribution of voice (telephone) lines, single-mode fiber optic cables for data network distribution, and a ground wire.
- ☐ A 12 strand single-mode fiber optic cable shall be installed in each TR.
- ☐ If needed, Voice riser sizing. The owner of a new or completely renovated building should estimate the maximum number of telephone lines which are projected to be cross-connected at each TC including a margin for routine growth.
- ☐ Physical topology. The voice riser cables, if needed, and fiber optic riser cables will be installed in a star topology originating at the ER.
- ☐ Fire rating/pathway. The riser cabling system will consist of appropriately jacketed cables installed in a pathway system interlinking the ER and TRs.

Horizontal Cabling

- ☐ Station cables. The horizontal (station) cabling from the ER/TR to the outlet (faceplate) in each work area in the building consists of a bundle of 3 or 4 cables installed via the pathway system. This guideline describes the installation and termination of this cabling.

Outlets

- ☐ Outlets. The typical outlet to be installed for almost all workspace locations will be a modular faceplate using front loaded adapters and inserts. These outlets are suited for offices, classrooms, computer labs, and auxiliary spaces. They will be equipped with the appropriate number of Category 6 cables.
- ☐ Wall VoIP telephone outlets. Finally, some locations will require only a telephone connection. These typically are utility locations, but also include locations where courtesy public telephones are needed. The outlets to be installed in these locations are equipped with one Category 6 cable.



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- ☐ Access Point Outlets. The typical outlet to be installed for almost all locations will be a one port surface mount box (biscuit jack) . They will be equipped with the appropriate number of Category 6a cables.
- ☐ Outlet selection. The designer of a new or completely renovated building system should determine from the occupants of the workspaces the type of connections they will require. As needed, the designer should coordinate with the owner to determine the best type of outlet to meet the needs of specific occupant spaces.
- ☐ Blanks. Provide blanks for all unused portions of the faceplate.
- ☐ Outlet Patch Cables: **Provide one green Category 6 patch cord for all telecommunications inserts/jacks throughout the facility, evenly divided into 7, 10 and 15 foot cords, plus 15% spare of each length.** Cables shall be of the same manufacture as that of the patch panels. All patch cords supplied shall be from an approved manufacturer. Outlet patch cables will be installed by NHCS.
- ☐ Acces Point Outlet Patch Cables: **Provide one yellow Category 6a patch cord for all access point jacks of appropriate length to ensure proper connectivity to the acces point.** Cables shall be of the same manufacture as that of the patch panels. All patch cords supplied shall be from an approved manufacturer. Access Point Outlet patch cables will be installed by contractor.



27 05 00 Common Work Results for Communications

NOTE: Specific sections herein relate to portions of the overall project scope of work as performed by the **DIVISION 26 – ELECTRICAL** designer and contractor but are utilized by the **DIVISION 27 – COMMUNICATIONS** designer and contractors. Where designated, it is the responsibility of the Electrical Designer to adhere to the design requirements herein and enforce those conditions with the Electrical Contractor. The Sections which apply to this requirement will be designated with the phrase (DIV 26 Scope of Work) in parentheses.

27 05 01 NHCS References and Closeout Requirements

- ☐ Design consultants should refer to the “Agreement for design Consultant Services” between NHCS and the Design Consultant, Exhibit D – Scope of Services, for specific engineering design submittal requirements
- ☐ **NOTE:** Reference Design Guidelines Division 01 for information pertaining to closeout requirements, O&M Manuals, demonstration and training.
- ☐ The Contractor shall submit to the Owner three copies of an operating manual for the systems that have been installed. Each manual will contain the following information:
 - o Warranty and service call information, including any forms needed for notification.
 - o Project Record Drawings. One manual will contain an electronic copy on CD-ROM (AutoCad format).
 - o Where applicable, manufacturer operation manuals.
 - o Where applicable, single line diagrams showing levels throughout system and impedances.
 - o Copies of Training materials.
 - o Copies of Training videos
 - o Verification and Acceptance Test Reports. Each set of hard copy test results will contain an electronic copy of the test data on CD-ROM. Include any special vendor software necessary to view the test results.
- ☐ Where applicable provide three sets of maintenance data.
- ☐ Provide three sets of Project Record drawings (Project drawing submittals) which have been updated from the submittal process to document the actual project conditions upon Final Closeout.

27 05 10 Abbreviations and Acronyms for Division 27

- ☐ AES – Audio Engineering Society
- ☐ BICSI – Building Industry Consulting Service International
- ☐ ITSIM – Information Transport Systems Installation Manual
- ☐ NAB – National Association of Broadcasters
- ☐ NEC – National Electrical Code
- ☐ NFPA – National Fire Protection Association
- ☐ TDDM – Telecommunications Distribution Methods Manual

27 05 11 Reference Standards for Division 27



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- ☐ All Division 27 10 00 – Structured Cabling work will conform to the requirements of the BICSI, 2014 TDDM 13th Edition including TIA-568-B and TIA-569 standards and all addenda.
- ☐ All Divisions 27 40 00 – Audio-Video Communications, 27 50 00 Distributed Communications and Monitoring Systems, work will conform to the following reference standards:
 - o AES – Handbook for Sound Engineers
 - o Sound System Engineering – Davis – Howard Sams 1987
 - o The New Audio Cyclopedia
 - o NAB Engineers Handbook
 - o Manufacturer's recommendations and best practices

Contractor Quality Control

- ☐ Contractor shall perform this work in accordance with acknowledged industry and professional standards and practices, and the procedures specified herein. Furnish and install all materials, devices, components, and equipment for complete, operational systems.
- ☐ Contractor shall maintain a competent supervisor and supporting technical personnel, acceptable to the Owner or Owner's Agent, during the entire installation. Change of the supervisor during the project will not be acceptable without prior written approval from the Owner or Owner's Agent.
- ☐ Contractor shall coordinate all efforts with those of related trades. In the event of any conflicts, delayed or improper preparatory work by others, notify the Owner or Owner's Agent; the Owner or Owner's Agent's decision will be binding. Verify all field conditions.

27 05 26 Grounding and Bonding for Communications Systems (DIV 26 Scope of Work)

GROUNDING.

- ☐ In order to protect personnel and equipment from hazardous voltages and reduce electromagnetic interference (EMI), a proper bonding and grounding system is required for the telecommunications infrastructure in NHCS buildings. The designer should specify this system within the project design for new or completely renovated buildings. This system should comply with appropriate codes, industry standards, and these guidelines.
- ☐ Grounding conductors should be installed neatly, with as few bends as possible, and routed such as to minimize the length of the conductor runs.
- ☐ The grounding conductors may be wall mounted or fastened to ladder racks with plastic cable ties. While they may be routed adjacent to telecommunications cables, they should not be attached to them in any way.
- ☐ An acceptable bond between the grounding conductor and painted metal surfaces is required. In these cases, a small area of the paint should be removed by blade or wire brush prior to the attachment of the ground lug. In TRs, this typically applies to the surface of metal wire ways and to the surface of equipment racks.

THE TELECOMMUNICATIONS GROUNDING SYSTEM WITHIN A BUILDING WILL CONSIST OF THE FOLLOWING COMPONENTS:



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- ☐ Design and install telecommunications grounding and bonding system per ANSI/TIA/EIA-607 as defined in TDDM 13th Edition.
- ☐ Bonding conductor (BC) for telecommunications. This conductor links the telecommunications grounding system to the main electrical power grounding system for the building. It originates in the ER.
- ☐ Telecommunications main grounding bus bar (TMGB). This bar is located in the ER and serves as the hub for the telecommunications grounding system in the entire building. Bond the TMGB to the BC, TBB, and local building steel.
- ☐ Telecommunications grounding bus bar (TGB). This bar is located in each TR and serves as the hub for the telecommunications grounding system for that room. It shall be a copper bus bar, insulated from its supports, 1/4" thick minimum, and 2" high minimum. Bond every TMG to the TBB and local building steel.
- ☐ Telecommunications bonding backbone (TBB). This conductor links the TGB in each TR back to the TMGB.

THE GROUNDING SYSTEM WITHIN EACH TR SHOULD BE INSTALLED AS FOLLOWS

- ☐ TGB. One telecommunications grounding busbar should be installed onto the plywood on the wall of each TR. It should be installed at 24" AFF. The bar should be electrically insulated from its mounting bracket.
- ☐ TBB. One insulated, stranded, #6 copper wire should be installed from the TGB in the TR to the TMGB in the ER. This conductor should be routed inside the riser conduit system along side the telecommunications riser cables. It should be fastened to the TGB.
- ☐ Multiple TRs. Stacked TRs may be connected by TBBs in series. A TBB would be installed from the ER to the first TR, a second TBB from the first TR to the second TR, and continued in a daisy chain fashion to the end of the TR stack.
- ☐ Equipment racks. A #6 grounding conductor should be installed between one equipment rack and the TGB using the appropriate grounding lug. The remaining equipment racks should be connected together in series to the first rack to provide a continuous connection to all racks.
- ☐ Ladder racks. A #6 grounding conductor should be installed between one section of overhead ladder rack to the TGB or to one of the equipment racks.
- ☐ Pathway components. A #6 grounding conductor should be installed from each distinct wireway or conduit (over 1" in diameter) which exits the ER and houses either horizontal or riser cabling back to the TGB, ladder rack, or equipment rack. As needed, these components may be connected in series to provide a continuous connection to all components. Grounding lugs should be used to connect the conductor to wireways. Grounding bushings should be installed on conduit ends to connect these conduits to the conductor.

27 05 28 Pathways for Communications Systems (DIV 26 Scope of Work)

ER/TR ELECTRICAL REQUIREMENTS

- ☐ Lighting requirements. Fluorescent lighting fixtures should be installed in each ER/TR to provide a minimum of 50 foot-candles measured 3 ft. AFF. Typically, one pendant mounted fluorescent light fixture should be installed between the front of the row of equipment racks and the wall, and one between the rear of the row of equipment racks and the wall. For



rooms with more than three equipment racks, additional fixtures will be needed.

- ☐ The designer should denote the exact location of fixtures on the drawings to ensure that they do not interfere with or are interfered by the cable ladder racks. Fixtures should not be installed directly above these ladder racks, but instead in spaces between the ladder racks to provide maximum lighting coverage for the room. Since the ladder racks usually are installed directly adjacent walls, the lighting fixtures are usually located 12" from the walls. Finally, the fixtures should be located between 8'-6" and 10'-0" AFF. In some locations, an additional wall mounted fixture may be necessary. These should be installed so that the top of the fixture is below 6'-6" AFF since cable ladder racks are installed at 7'-0" AFF.
- ☐ The typical pendant mounted fixtures are four lamp, 2' X 4' fixtures with acrylic prismatic lens, equipped with electronic ballast and T-8 bulbs. The typical wall mounted fixtures are two-tube fixtures with acrylic prismatic lens, equipped with electronic ballast and T-8 bulbs. All of the fixtures in a room should be controlled from a single pole switch located just inside the door of the room.
- ☐ Power requirements. One duplex receptacle each should be located at 8' intervals on each wall of the ER/TR except the wall containing the door. The receptacles should be NEMA specification grade, 20A, 125V, 3 wire grounding, Leviton, Inc. mfg. part number 5362-I, or equal with steel cover plate.
- ☐ Additionally, each ER/TR should be provisioned with 20A branch circuits located in junction boxes above the ceiling level of each rooms. Quantity of circuits will be determined by the Technology Consultant and the Electrical consultant. The Electrical contractor will be responsible to connect those circuits to cabinets provided by the Division 27 and 28 contractors.
- ☐ ER outlets consist of: (2)6L-20p , (1)L14-30p, at least 2 double duplex 20 amp standard outlets, all attached to rack(s). Coordinate with owner on placement locations.
- ☐ TR outlets consist of: (4)6L-20p, at least 1 double duplex 20 amp standard outlet, all attached to rack(s). Coordinate with owner on placement locations.
- ☐ Emergency power. ER/TR are not required to be connected to a generator based emergency power system.

ER ELECTRICAL COMMUNICATION PATHWAYS

- ☐ ER/TR penetrations. Wireways shall transition to EMT sleeves of appropriate size when entering ER/TR. Penetration into ER/TR horizontally will be at 7'-6" AFF minimum. The ideal penetration height for wireways is 8'-6" AFF. Each sleeve should be stubbed into the room approximately 4" and turned down with a single 45 degree bend. This provides a smooth path to protect cabling and allows smooth flow of cables onto ladder racks (installed at 7'-0" AFF). If installation of this elbow is not practical, Sleeves serving floors below should be stubbed into the ER 12" AFF. Sleeves serving floors above should penetrate the ceiling of the ER and terminate vertically at 8'-6" AFF.

INTERIOR COMMUNICATION PATHWAYS

- ☐ Horizontal pathway system. A pathway system will be installed in buildings to route and protect all horizontal telecommunications cabling from the ER/TR to the outlets in all work space locations.
- ☐ Riser pathway system. A pathway system will also be installed in buildings to route and



protect all riser telecommunications cabling linking the ER with all TRs in the building. This system will be installed between ER/TR whether they are vertically stacked or not.

- ❑ Both systems. Although a variety of materials may be used based on site conditions encountered, typically the horizontal pathway system will consist of a network of wire ways and conduits installed in the ceiling areas of the building.
- ❑ Aesthetics. Generally, all visible elements of the pathway system should be painted to match surrounding surfaces. Elements installed in locations not visible by building occupants do not require painting. Typically, these include wire ways and conduits installed above acoustic tile ceilings or in mechanical rooms. Ideally, all elements of the pathway system except for the actual outlet boxes in work spaces will be completely hidden from view. However, in many retrofit projects, this is not possible. In these cases, the designer should carefully determine routing, components used, and supporting methods to minimize the negative aesthetics impact that the installation of the pathway system will have on a building.
- ❑ In some instances, false columns, soffits, and archways have been constructed to conceal wireways and conduits in especially sensitive areas of buildings. These structures should be installed in a manner consistent with the visual architecture of the building, while still allowing access for installation of cabling.
- ❑ Fire safety considerations. The installation of the pathway system shall comply with all applicable fire safety and electrical codes. In general, the N.C. Dept. of Insurance determines the compliance of these systems with codes, and they reserve the right to inspect and approve/disapprove their installation. All wireway and conduit penetrations of rated walls and floors shall be firestopped per applicable UL assembly.
- ❑ Horizontal pathway sizing. The designer should determine the capacity required for each separate section of the horizontal pathway system, and specify these on the drawings. All horizontal cabling is run in a star topology (homerun) from each outlet back to the nearest TR. Therefore, the required capacity of the system increases as it gets closer to the TR. The capacity requirements are smallest at the farthest instances from the TR. **The area should be increased an additional 25% for anticipated growth.**
- ❑ Support mechanisms. A variety of structures may be used to provide mechanical support for the pathway system components. Usually, these are trapeze structures supported from the deck above or wall mounted “L” brackets. The design of the support mechanisms should be based on the structural and architectural composition of the surrounding building structures. In certain locations, aesthetics concerns and limited available space may impact the support systems selected.
- ❑ Cable Tray Wireways:
 - Trapeze (Ladder Tray only). These structures consist of 1 ½” steel channel installed below and fastened to the wireway and supported with two 3/8” threaded rods run vertically from the channel to the deck or support beams above. One threaded rod is run on each side of the wireway.
 - When all-thread is used as a support for wireways, smooth rigid tubing will be installed to a minimum of twelve inches above the tray.
 - Cable trays will have minimum 1” W x 4” D support stringers with twelve inch spacing.
 - Wireways shall be supported at intervals not exceeding 5’. Wireways will be supported within 18” of 90 degree turns.



- ☐ Wireways that are not cable trays
 - o Wall brackets. These are “L” brackets fastened to the bottom of the wireway and to an adjacent wall.

Design Parameters

- ☐ Topologies. The horizontal pathway system will consist of a series of wireways radiating from each ER/TR. Larger wireways will be installed from the ER/TR to provide access to all general areas of its geographic zone. Smaller, lateral wireways will branch off as necessary from the larger wireways to extend the pathway system to all occupied areas of the building.
- ☐ The riser pathway system will usually consist of a series of ladder racks in the ER connected to 4” conduits sleeves to cable trays extending to all of the TRs. The design of the system is based on the geographic location of the ER and TRs. Ideally, all of the TRs will be stacked vertically directly above the ER. In this scenario, conduits will be installed through the ceiling of the ER, and stubbed up through the floor of the first TR. Additional conduits would be installed through the ceiling of the first TR, and stubbed up through the floor of the second TR. This pattern would be repeated until the last TR was reached. However, in most buildings it is not feasible to have such a single stack layout. In these cases, the designer should specify routes to interlink the TR to all TRs in the most efficient manner possible, requiring the least amount of cable tray to be installed. In situations where riser conduits can be used between TRs on different floors, the conduits should not be installed through intermediate TRs. All conduits should be stubbed into and terminated in each TR. The cables that are destined for TRs farther along the stack will merely be routed through the intermediate TR using ladder rack or cable management rings.
- ☐ All conduit used as wireway is to have pull strings installed for future use.
- ☐ Conduit requirements. All conduit should be installed neatly, maintaining the appropriate bend radius for the size of conduit used. The length of flexible conduit installed in the ceiling area should be minimized. Flex conduit should be transitioned to EMT immediately after it exits the hollow wall with the flex conduit supported at its exit from wall. Conduits should be installed with appropriate offsets (box kicks) where they are connected to outlet boxes and junction boxes to keep surface mounted conduits flush against walls and decks.
- ☐ A maximum of 180 degrees between pull points should be maintained in all conduit runs. This does not include the box kicks described above. No LB-type (or similar) condulets shall be used.
- ☐ No conduit or wireway shall lie directly on top of an acoustic tile ceiling grid or be supported by the grid or the grid supports.
- ☐ No conduit or wireway shall be supported by the same system used to support any other conduits, piping, ceiling structures, ductwork, or other building system or equipment. No non-telecommunications system components should ever be supported by the telecommunications pathway support system.
- ☐ For horizontal pathway system conduits, use junction boxes to create pull points. These should be placed in straight sections of conduits where possible, but may be used to replace conduit bends where bends are impractical. When junction boxes are used in lieu of bends, the conduits should be connected to the junction box with maximum separation to allow the maximum cable radius within the box as possible.
- ☐ Maximum horizontal pathway length. Modern data communications technologies require



that the maximum length of the horizontal cable channel is limited to 295 ft. (90m). Since this channel includes patch cords at the outlet and in the TR/ER and also the cable slack loop installed in the TR/ER, the actual length of the horizontal pathway is somewhat shorter. A good rule of thumb to use in designing these pathways is the “250 ft. rule”. The pathway run from the outlet box farthest from an TR/ER back to where the wireway penetrates the wall of that ER should not exceed 250 ft. It is imperative that this calculation includes allowances for the vertical conduit run from the wireway to the outlet box and for the vertical and horizontal deviations in the wireway routing which are common in construction projects.

- ❑ Routing. Typically, wireways are routed in corridors or other publicly accessible areas of the building. Normally, they are routed in the ceiling areas, above acoustic tile ceilings when available. Routing of wireways through occupied spaces is discouraged. This is to prevent disruption caused when an additional outlet is installed after occupancy. In certain cases, however, there is no choice but to route wireways through occupied spaces. As much as possible, this should be limited to lateral wireways farthest from the TR where the disruptive impact is less due to fewer occupants being further “down the line”. Individual 1” conduit runs to outlets may be run wherever feasible. For aesthetics purposes, surface mounted conduits should be routed in less visible spaces (closets, storage rooms, etc.) when possible.
- ❑ The wireways should be installed to maximize accessibility for future cable and conduit installations. A minimum of 24” accessible work space should be maintained to the sides of the cable tray.
- ❑ All telecommunications junction boxes should remain accessible. Likewise, wireways and conduits should be installed so as not to block access to other building system components. Some of the access requirements are addressed by codes (electrical junction box covers, breaker panels, exit signs, fire alarm horns and strobes, etc.). Access requirements for other components, while not specifically addressed by codes, should be determined by “common sense” evaluation of system function and ergonomics. These components include water valves, light fixtures, drain clean-outs, HVAC damper controls, and other similar items.
- ❑ EMI sources. Wireways and conduits should be located away from sources of electromagnetic interference (EMI). While the bonded and grounded wireway and conduit system will eliminate considerable EMI effects, it is still prudent to route these components away from potential sources. Potential sources include electrical transformers, large motors, lighting ballasts, etc.
- ❑ Access. In areas of buildings where acoustic tile ceilings are present, the wireway system is typically installed between the top of the grid and the deck above. In these applications, the bottom of the support structure (trapeze) should be installed at least 3” above the grid, independent from ceiling grid. In areas without acoustic tile ceilings, the wireway system should be installed exposed with the bottom of the support structure at least 8’-6” AFF. Wireways should not be installed above inaccessible (hard) ceilings.



- ☐ Perimeter wireway systems. In certain locations (usually labs with large numbers of outlets) non metallic perimeter wireway systems may be used. The system will be Wiremold V5000 series or equal wireway system. This can be mounted horizontally at any height needed (above 12" AFF) with faceplates installed directly onto the front of the wireway (using a device plate). The wireway can also be installed vertically to create power pole units described above, again with faceplates installed directly onto the front of the wireway (with device brackets). The system can be painted as needed to match surroundings.
- ☐ Outlet location. Typically, all outlets are installed at 18" AFF. For aesthetics purposes in new construction, the bottom of the outlet box should be installed even with the bottom of electrical receptacle boxes. Outlet boxes may be mounted higher if necessary to be located above furniture, counter tops, or equipment.
- ☐ **Wireless access points shall be installed by the cabling contractor.**
- ☐ Outlet boxes should not be located too close to wet areas such as sinks where water could splash onto faceplates or where patch cords could come into contact with water. Boxes also should not be located too close to sources of excessive heat, dust, chemicals, or EMI.
- ☐ Outlet boxes should also be located so that they will be accessible to technicians for patch cord installation or for faceplate re-termination even after furniture and equipment is installed. A balance should be maintained between "hiding" outlets for aesthetics purposes and keeping the faceplates accessible. Boxes should not be installed behind heavy equipment or modular furniture panels.
- ☐ Ergonomics and egress factors should be considered when planning outlet locations. Outlets should be located so as not to require telephone or data patch cords to be installed across doorways, aisles, or other "people" traffic areas.
- ☐ Outlet box type. The outlet box type is determined by the type of wall construction present where the outlet is to be installed.
- ☐ Flush mounted outlet boxes should be installed in all walls of drywall and standard stud (2 1/2" -3 5/8" deep) construction. In some retrofit projects, the presence of cross members (purlins) in the walls may complicate or even prohibit the installation of flush mounted outlet boxes. The top and bottom flanges (ears) of old work boxes should be adjusted so that the box itself does not protrude at all beyond the surface of the drywall. In general, flush mounted outlet boxes should be installed exactly straight (perpendicular to walls and floor) and flush with the surface of the drywall (after plaster ring installation). No gaps between the edge of the faceplate and the drywall should be present after final installation. Conduit to be installed so as to come into the top of the box, into one of the back knockouts.
- ☐ Surface mounted outlets should be installed onto all other wall types (masonry, plaster, prefabricated wall panels, etc.). In cases where a surface mounted outlet is required use Wiremold 2300 or equivalent raceway. The raceway and box may or may not be painted to match the surrounding wall surface. For cleanest appearance, a bead of latex caulk may be applied between the wall and each side of the raceway. In these cases, the raceway and box should be painted.
- ☐ Outlet quantities. Since the cost of the telecommunications infrastructure of a building is directly proportional to the number of outlets installed, careful planning of outlet quantities and locations is essential. While each project is unique, the following guidelines may assist in determining outlet quantities:
 - o Offices. Typically, a single occupancy office is equipped with two



telecommunications jacks. Due to the ergonomic and egress issues addressed above, some offices may require a second faceplate containing the necessary jacks. Normally, the primary outlet is located near the corner of the room farthest from the door. While outlet locations may be specified to coincide with the furniture layout of a room, it should be noted that the occupant and the furniture layout of an office is likely to change several times over the life of the telecommunications infrastructure. Usually, it makes better sense to locate the outlet to fit the space, not necessarily the current occupant's furniture layout.

- Classrooms – A typical classroom will be equipped with Category 6 jacks. Coordinate with owner for specific jack counts.
- Conference rooms. Usually, four Category 6 jacks are installed in each conference room, two at each end of the room. This is to allow maximum flexibility in the arrangement of the room for particular presentations.
- CTE labs. These are rooms where desktop computers are permanently located in the room (as opposed to classrooms where students bring in laptop computers for one class session at a time). Design of outlets for these student computer labs requires careful coordination with the furniture and computer equipment layouts of the room. Typically, one faceplate is installed in the room at the “instructor” station. The remaining lab computers are served by faceplates where all jacks are used for computer connections. The room should be provisioned so that each computer is served by its own jack. Usually, the necessary jacks are installed on a wall to serve each contiguous group of desks. Jacks should be located so that patch cords will not be required to be installed across doorways or aisles between desks. For groups of desks which cannot be located adjacent a wall, a power pole with jacks attached should be installed to each group. Using a section of Wiremold V5000 mounted vertically from floor to ceiling with faceplates mounted onto the cover is the desired methodology.
- Other instructional spaces. Locating jacks in these rooms requires a case-by-case design with input from the personnel who will be inhabiting each particular space. In general, a jack should be installed in each office-type work space where a telephone and/or computer is likely to be located. In addition, jacks should be installed where equipment or monitoring devices are to be installed which need access to the data network.
- Auxiliary spaces. An additional jack is required for many building spaces not addressed above. These include: the main mechanical room in each building (for connection of energy monitor controller equipment), copy machine areas, and main janitorial rooms which serve as office space for custodial staff, etc.
- Cafeterias will typically require data at the serving line, office, and the location designated for an external ringer.
- **Mobile classrooms/structures shall use a cable rated for wet locations.**

Support Structures

- The structures installed to support the pathway systems must be adequate to support the weight of the pathway components, the weight of the cables, and the force exerted on the pathway system during cable pulling operations. The support system must be adequately anchored into the surrounding building structure. A variety of support structure components



may be used as dictated by site specific conditions. However, all components shall be supported per NEC codes or per these guidelines, whichever is stricter

Anchoring

- ❑ Suitable anchoring methods must be utilized to fasten pathway support components to the building's structure. These must be matched to the various structural and architectural elements found in NHCS buildings. Careful research may be required by the designer to determine the existing conditions of buildings. Since these buildings were constructed over a multiple year timeframe, existing structures vary widely in type of construction and in quality (due to deterioration). Following are some general guidelines regarding anchor installation:
 - Masonry walls, decks, and beams. Masonry structures provide perhaps the ideal system for anchor installation. This system involves installing appropriate metal anchors into solid concrete decks or beams or into masonry walls. These anchors may be installed by drilling or by use of powder actuated tools.
 - Steel beams and trusses. Threaded rods installed vertically up to beam clamps that are fastened to overhead steel structural elements are an acceptable anchoring practice.
 - Stud walls. Normally, wireways and riser conduits are not supported from drywall/plaster and stud construction walls. However, if no overhead support is possible, "L" brackets may be fastened securely to the wall studs. Brackets should not be fastened to the wall surface material only.
 - Hard ceilings. Ceilings that are not suspended acoustic tile (drywall, tongue and groove tile, spline type, etc.) shall not be used to support wireways or riser conduits. Threaded rods may pass through ceilings of this type to reach structural elements above. If these ceilings form part of a fire rated barrier, they must be completely restored to maintain the originally designed rating.
 - Outlet conduits. 1" conduits run between wireways and outlet boxes may be fastened to a variety of surfaces using one-hole straps and anchors. The anchors must be suitable for the material to which they are fastened. These straps may be fastened to concrete decks and beams, masonry walls, or surfaces of gypboard/plaster ceilings and walls. They also may be fastened to steel beams and trusses using beam clamps and threaded rod. They may not be attached to ceiling tiles or grids of any type, including acoustic tile, tongue and groove, spline type, etc...
 - Toggle bolts. In general, toggle bolts should not be used for support of any pathway component larger than a 1" conduit.

Firestopping

- ❑ All locations where wireways or conduits penetrate rated walls or floors shall be fire stopped per the applicable UL assembly. The designer shall be responsible for inclusion of the proper assemblies in the design drawings.
- ❑ At locations where wireways penetrate rated walls or floors, conduit sleeves (18" long) should be used through the penetration. Proper fire stopping should be installed around the penetrated sections. Also, the conduit shall be fastened securely to the wall or floor to prevent future invalidation of the fire stopping by vibration or movement of the section with respect to the wall or floor. Comply with UL assemblies designated for fire stopping around EMT conduits.



Installation Checklist

- ☐ The standard checklist below has been developed to govern the installation of the various pathway system components commonly installed. Some of the items are described above in greater detail. These items should be included in the designer's inspection prior to the final acceptance of the system. This list is to be used as a guide only. It is not intended as a substitute for the drawings, specifications, applicable codes, or good work practices.
- ☐ Surface outlets.
 - Is the outlet box level?
 - Is the outlet box painted to match wall (if required)?
 - Are proper conduit offsets (box kick) installed?
 - Are all junction box covers screwed shut?
 - Is a pull string installed with minimum 12" at each end?
 - Are penetrations of rated walls firestopped properly?
 - Is the firestopping installed on both sides of the wall?
 - Does it meet the appropriate UL assembly requirements?
 - Is the annular space around the conduit within UL limits?
 - Are visible penetrations of all walls patched and painted properly?
 - Are plastic bushings installed on telecommunication conduits?
- ☐ Flush outlets.
 - Is the outlet level?
 - Is the outlet flush with the wall surface?
 - Are the box ears or plaster ring adjusted to recess box into wall?
 - Are the center (device screw hole) tabs cut into drywall?
 - Is the outlet secure, with jiffy clips tight?
 - Is the locknut secure?
 - Are all junction box covers screwed shut?
 - Is a pull string installed with minimum 12" at each end?
 - Is the flex penetration hole patched?
 - Is the flex securely strapped as it exits the hollow wall?
 - Is the flex to EMT connection installed properly?
 - Is the conduit strapped or supported every 5'?
 - Are junction boxes located between every 180 degrees of conduit bends?
 - Are penetrations of rated walls firestopped properly?
 - Is the fire stopping installed on both sides of the wall?
 - Does it meet the appropriate UL assembly requirements?
 - Is the annular space around the conduit within UL limits?
 - Are visible penetrations of all walls patched and painted properly?
 - Are plastic bushings installed on telecommunication conduits?
- ☐ Wireway.
 - Are all cuts deburred?
 - At rated wall and floor penetrations, have necessary conduits been installed to support the wireway penetration?
 - Are penetrations of rated walls and floors firestopped properly?
 - Is the firestopping installed on both sides of the wall/floor?



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- Does it meet the appropriate UL assembly requirements?
 - Is the annular space surrounding the wireway sleeve within UL limits?
 - Are wireway penetrations into TRs turned down with a single 45 degree elbow?
- ☐ Riser conduits.
 - Are wireway section pull points installed between every 180 degrees of conduit bends?
 - Are penetrations of rated walls firestopped properly?
 - Is the firestopping installed on both sides of the wall?
 - Does it meet the appropriate UL assembly requirements?
 - Is the annular space around the conduit within UL limits?
 - Are visible penetrations of all walls patched and painted properly?
 - Are grounding bushings installed on all conduit ends in ER/TRs?
 - Are plastic bushings installed on conduits larger than 1”?
 - Are pull strings installed with minimum 12” at each end?
 - Are vertical runs secured properly to walls?
- ☐ Trapeze and All-Thread supports.
 - Are threaded rods properly secured to anchors?
 - Is smooth rigid tubing installed to a minimum of twelve inches above the tray?
 - Are anchors properly installed and secured to the building structure?
 - Are the trapeze channels level (horizontal)?
 - Are threaded rods cut flush and deburred?
 - Are supports installed every 5’?
 - Are wireways connected to securely?
 - Are nuts and washers installed both above and below the bracket?
- ☐ Wall bracket supports.
 - Are “L” brackets properly secured to walls?
 - Are wireways securely connected to brackets?
 - Is proper (3” min.) clearance maintained between wireways and wall?
 - Are visible brackets painted to match surrounding area?

AREAS OF BUILDINGS THAT SHOULD TYPICALLY NOT BE USED FOR WIREWAY OR CONDUIT ROUTING. THESE INCLUDE:

- ☐ Stairwells.
- ☐ Elevator shafts and equipment rooms.
- ☐ Outdoor areas (including covered breezeways) where moisture may be present.
Even areas protected from rain, but subject to dew or other condensation sources should not be used for these pathway systems components.
- ☐ Wet areas inside buildings such as shower facilities, equipment wash down areas, steam rooms, etc.
- ☐ Hazardous locations. Since the wireways need to remain accessible for technicians to install cabling on an ongoing basis, routing through areas exposing personnel to dangerous heights, high voltage equipment, hazardous chemicals, etc. should be avoided. Likewise, areas housing equipment or activities that are particularly susceptible to damage by technicians installing new cabling should also be avoided.



- ☐ Locations with excessive heat. The cabling to be installed in these pathway systems is not designed to withstand excessive heat. Wireways and conduits should be routed to avoid heat sources hot enough to cause sheath deformation over time in the cables. These include steam lines, boilers, etc.

(DIV 27 Scope of Work)

CABLE MANAGEMENT

- ☐ Building Locations - Comb straight and form in a neat and orderly manner all conductors in cable support systems, providing circuit and conductor identification. Tie wraps are only to be used for cable management, not support. Arrange as required using tie wraps of appropriate size and type, (plenum rated as required).
- ☐ Equipment Cabinets or Racks - Comb straight and form in a neat and orderly manner all conductors located within equipment cabinets in the head end room or remote locations, and wiring harnesses in the head end room. Tie as required using Velcro cable ties of appropriate type and size.
- ☐ Service Loops - Provide 10 foot service loops at each termination so that plates, panels, and equipment can be dismounted for service and inspection.
- ☐ Supports - All cable installations which are not supported by a cable tray or conduit system methodology as noted for J-Hooks installation.
- ☐ The installation of all education technology cabling, regardless of type and separation requirements, from the head end room to various zones throughout the facility will use common pathway routes.
- ☐ Inaccessible ceiling areas, such as lock-in ceiling tiles, drywall or plaster, will not be used as distribution pathways. Should inaccessible ceiling areas be the only available pathway, the designer will notify the owner immediately for direction.
- ☐ Accessible ceiling areas must have adequate and suitable space available for the distribution layout (minimum of three inches clear vertical space between ceiling tiles and distribution wiring and pathway).
- ☐ The design shall provide a suitable means and method for supporting cables and wires from the head end room (and/or telecommunications closet) to the area being served. The cable will not be laid directly on the ceiling tiles or rail.
- ☐ Cable support will be provided through the use of open-top cable supports located on 48-60 inch centers.
- ☐ Cables from each zone to TR/ER will be grouped and tied.
- ☐ Wiring Harnesses - All wires and cables used in assembling custom panels and equipment racks shall be formed into harnesses, tied with Velcro tie wraps and supported in accordance with accepted engineering practice.
- ☐ Harnessed cables shall be combed straight. Each cable that breaks out from a harness for termination shall be provided with an ample service loop.
- ☐ Harnessed cables shall be formed in either a vertical or horizontal relationship to equipment, controls, components, or terminations.
- ☐ Do not pull wire or cable through any box fitting or enclosure where change of raceway alignment or direction occurs; do not bend conductors to less than recommended radius. Employ temporary guides, sheaves, rollers, and other necessary items to protect cables from excess tension, abrasion, or damaging bending during installation. Care shall be taken not to



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bend, crush or kink cables.

- ☐ All cable shall be installed in a complete, neat, and orderly fashion. Cables shall not be twisted or have any damage to the cable jacket.
- ☐ Cables will be installed parallel or at 90 degree angles to the building walls. Diagonal, beeline, or non-supported cable routing is unacceptable

Terminal Blocks

- ☐ All terminal block connections shall be readily accessible. Not more than one wire connected to one terminal. Spare terminal blocks, equivalent to 10% of those in actual use shall be provided.
- ☐ **Terminal blocks shall be 66-Type and be installed on fire rated plywood backboard located in ER.**
- ☐ Splicing - Splicing of cables is not permitted between terminations.
- ☐ Wall and Floor Penetrations - All penetrations through floors and walls will be sleeved. All sleeves will have permanently installed bushings.
- ☐ **Sleeves will be sized to accept 50% growth.**
- ☐ All sleeves will installed per manufacturer's instructions and will protrude 3 inches on each side of the penetration.
- ☐ Sleeves through floors will be supported with conduit riser clamp.
- ☐ Existing sleeves can be used with the following exceptions:
 - o Use of any sleeve containing emergency signaling cable is prohibited
 - o Using any sleeve, when doing so would exceed 40% fill ratio, is prohibited.

27 05 43 Underground Ducts and Raceways for Communications Systems (DIV 26 Scope of Work)

EXTERIOR COMMUNICATION PATHWAYS

Overview

- ☐ Inter-building communications pathways are classified as either of two basic types:
 - o Building entrance pathways are duct banks which connect an individual building to the above campus backbone pathway system. These guidelines mainly describe design parameters for building entrance duct banks. Design and planning for a campus backbone duct bank system does not really pertain to the types of campuses found in New Hanover County. However, the detailed requirements for entrance duct banks described here typically apply to backbone duct banks as well, just on a larger scale.
 - o Campus backbone pathways comprise a network of underground duct banks and manholes interconnecting Equipment Room (ER) facilities to all areas of the campus.

Pathway Composition

- ☐ The underground pathway system consists of a series of manholes and hand holes connected by concrete encased duct banks. These duct banks include 3" and 4" diameter PVC conduits (for copper cables) and 1 1/2" diameter PVC conduits (for fiber optic cables) installed in the same duct bank trench. In remote areas un-encased ducts, direct buried, or aerial pathway systems may be used with approval from the owner.



- ☐ New buildings. The design and construction of the building entrance pathway system for a new building should be included in the building project scope. If applicable, contact the owner to determine the location of backbone manholes near a project site.
- ☐ Single function. The inter-building communications duct banks and manholes are to be used solely for the telecommunications cables described above. They are not to be shared with electrical cabling, any auxiliary low voltage systems, or any other utility. They shall not be used by other communication service providers. The duct bank trench may be constructed as a joint telecommunications/electrical trench as long as there is a minimum of 4" of concrete separating each telecommunications duct cell from any electrical duct cell. Also, cells from each utility should split at manhole locations so that they are routed to a separate manhole for electrical or for telecommunications connections.

Duct Bank Design

- ☐ Sizing. The entrance duct bank for a campus building shall consist of two 4" and four 1 ½" conduits from the nearest telecommunications manhole to the building ER. For single buildings not connected to a campus duct bank, one 4" and two 1 ½" conduits to the utility service point will suffice.
- ☐ Construction methodology. Typically, all duct banks will consist of PVC conduits encased in concrete. On occasion, when site considerations dictate, other underground installation methods may be employed. These include boring of metal casings under rail lines or roadways, directional boring, and other similar non-trenching methods. These should only be used when trenching is not feasible.
- ☐ Water infiltration. Entrance duct banks should be designed so that water, which may collect in the conduits, will drain away from where the conduits enter the building. Whenever possible, the top of the manhole nearest to the building should be lower than the finished floor of the ER. In addition, the manhole wall should be sealed around the conduit penetrations to prevent excess water infiltration. Finally, the manhole should be placed so as to provide slight positive drainage away from manhole cover after final restoration to grade is completed.
- ☐ Duct bank bends. A manhole or hand hole should be installed in duct bank runs for every 180 degrees of conduit bends. The minimum bend radius which is acceptable at any point in the duct bank run (horizontally or vertically) is 3"– 6" for 4" conduits and 9" for 1 ½" conduits. Duct banks should be designed to allow for installation of very long sweep bends accomplished by heating and bending straight conduit sections. When factory elbow fittings are required, the bend radii for such fittings should not be less than those specified above. These fittings shall be electrical or utility elbows. Use of plumbing fittings is not allowed.
- ☐ Manhole placement. Manholes or hand holes should be installed at least every 300' in straight duct bank sections and every 150' in duct bank sections with at least 90 degrees of total conduit bends.
- ☐ Building penetration. For new buildings, the entrance duct bank should be installed under the building slab and turned up vertically through the floor of the ER. Horizontal penetration into a below grade building area is also acceptable. For duct banks installed into existing buildings, the designer should determine the best method of building penetration based on: the structural aspects of the building slab and footings, exterior of building aesthetics concerns, and existing utility conflicts. When possible, it is preferred to have the duct bank



penetrate underneath the building and turned up inside the building to reach the ER. If this is not possible, the ductbank can be turned up on the outside wall of the building to a large junction box. Conduits would then be installed through the back of the junction box through the exterior wall of the building and on to the ER. LB type (or similar) condulets should not be used in lieu of the above junction box.

- ☐ Routing to the ER. Entrance ductbanks which require less than 50' of entrance cable (measured from the point where the ductbank enters the building to the point of cable termination) may be constructed with EMT conduits run inside the building. For runs longer than 50', rigid or intermediate metal conduit and fittings shall be used. The section of conduits installed in the building slab are not to be considered in the length calculations.
- ☐ In either case, conduit turns inside the building should be accomplished by conduits bends, not by installation of pull points at the bend. Pull points should be installed in the entrance conduit runs for every 180 degrees of conduit bends (including bends both inside and outside the building). These pull points should be installed only in straight conduit sections. For EMT conduit runs, these pull points should be constructed by installing junction boxes or straight sections of wireway along the run. For rigid metal conduit runs, they should be constructed by installing "Type C" condulets along the run. LB type (or similar) condulets should not be used.
- ☐ Tree protection. Ductbanks should be routed so as to remain outside of the drip line of existing trees.

Manholes and Handholes

- ☐ Contractor scope. The contractor will provide all materials, labor, and equipment necessary to install new manholes and handholes. All manholes and handholes are to be installed according to manufacturer specifications.
- ☐ Interior hardware. Two cable racks are to be installed securely on the inside of each wall of the manhole or handhole. They are to be evenly spaced horizontally unless prevented by the location of the conduit penetrations. Two cable hooks are to be installed on each cable rack.
- ☐ A manhole ladder is to be installed inside each manhole. It is to be securely fastened with bolts and anchors to the neck (or top) and the bottom of the manhole.



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- ☐ Each manhole and handhole is to be equipped with a minimum of four floor mounted pulling irons.

Grounding

- ☐ A grounding rod is to be installed in the bottom of each manhole or handhole, either through a designated ground rod hole or through the sump opening. Each cable rack is to be properly bonded and grounded to the grounding rod in series using a #6 copper ground wire or bonding ribbon using bolted connectors
- ☐ Covers. Heavy duty manhole covers are to be installed for all manholes and hand holes, regardless of the type of pedestrian or vehicular traffic expected in the area. Covers are to be installed flush with the surface of asphalt streets, and with the surface of asphalt, concrete, or brick paver walkways. For non-paved surfaces, the covers are to be installed to ensure that positive water drainage away from the cover occurs. The contractor is to provide all items necessary, whether pre-cast or masonry, to extend the rim and cover above the manhole or hand hole to accomplish the above. All entrance extensions should be sealed to prevent water infiltration. Duct bank conduits shall not be installed into these entrance extensions (necks).

Duct Bank Construction

- ☐ Pre-trenching. Prior to any excavation activity, the contractor shall arrange for an approved utility locator service to locate and mark all public utilities on the project site. The contractor shall also coordinate with the Maintenance Department to locate and mark utilities on the project site.
- ☐ Asphalt and concrete surfaces are to be sawcut along the duct bank route and at manhole and hand hole locations. Removed materials are to be disposed of legally, off site, by the contractor at no expense to the owner.
- ☐ Trenching. The contractor shall follow all OSHA trenching and excavation safety standards. Unsuitable materials are to be disposed of legally, off site, by the contractor at no expense to the owner. These shall be promptly removed from the project site, without significant on-site stockpiling. In all areas where new duct bank crosses existing utilities of all types, hand excavation will be employed by the contractor.
- ☐ The contractor shall notify the owner immediately if any existing utilities are damaged. Any existing utilities damaged shall be repaired by the contractor (or the owning public utility paid by the contractor) at no additional expense to the owner. Repairs shall be made expeditiously to minimize inconvenience to the owner and with methods and materials of the same or better quality than the existing.
- ☐ Conduit installation. All conduit installed shall be Schedule 40 PVC unless otherwise noted. The 1 ½" conduits will typically consist of prefabricated units of four conduits connected by plastic spacers and arranged in a square pattern (tetra-duct). If necessary, individual 1 ½" conduits may be installed instead.
- ☐ Plastic spacers are to be installed every 5' to maintain minimum separations, vertically and horizontally, between adjacent conduits, and between the conduits and the sides, top, and bottom of the duct bank. The minimum required spacing between conduits is 2 ½" (with the exception of the internal spacing of the conduits within the tetra-duct described above). The minimum required spacing between any conduit and any edge (side, top, or bottom) of the duct bank is 4". The exact configuration (cross-section layout) of the duct cells should be



specified by the designer. However, the contractor may modify this configuration if required by field conditions as long as the spacing and minimum backfill cover requirements are maintained.

- ☐ Contractors must adhere to OSHA confined space entry standards when working within existing manholes.
- ☐ Sections of #4 rebar shall be installed between the bottom of the conduits and the bottom edge of the duct bank. A minimum of 1 ½" of concrete should be maintained between the rebar and the bottom edge of the duct bank. Rebar should be installed longitudinally at 12" O.C. with cross members of #4 rebar installed every 60" O.C.
- ☐ Concrete pouring. The contractor shall have the installed conduits inspected and approved by the owner and/or designer prior to pouring of concrete. 3,000 PSI concrete will be used to encase all duct banks. The concrete should be allowed to set for 24 hours, minimum, prior to backfill.
- ☐ Warning tape. A continuous run of magnetically detectable underground marking tape shall be run directly above the duct bank at 12" below finished grade.
- ☐ Backfill. A minimum of 24" of cover is required above the top of the concrete in each duct bank run. This is measured to the top of final grade, and includes asphalt, concrete sidewalk, brick paver, seeded topsoil, and corresponding sub-grade base layers. In roadway and walkway areas, at contractor discretion, controlled low strength material (CLSM), "flowable fill," may be used to backfill the trench. The contractor shall have the installed concrete encasement inspected and approved by the owner or designer prior to installation of backfill material.
- ☐ Compaction of earth backfill shall be at least 98 – 100% maximum density, using the Modified Proctor Method at all locations. Compaction testing is to be performed by a geo-technical testing firm approved by the owner.
- ☐ Final construction items. Following duct bank installation, all construction debris should be removed from manholes. Also, a mandrel should be pulled through each duct cell in the presence of the owner or designer, and each duct cell cleaned of debris. Finally, a mule tape (high strength, conduit measuring tape of non-deteriorating material, with footage markings) should be installed in each duct cell and secured to cable racks in each manhole or hand hole.

Site Restoration - Asphalt Pavement

- ☐ Scope. All asphalt pavement surfaces cut or damaged by the construction of the duct bank should be restored to pre-project conditions as much as possible. Methods used shall comply with the latest version of the NCDOT – Standard Specifications for Roads and Structures.
- ☐ Sub-grade preparation. The finished sub-grade should provide a uniform bearing surface. The sub-grade should remain in satisfactory condition and properly drained until surface courses are placed. Methods used shall be in accordance with the NCDOT Specifications Section 500.
- ☐ Aggregate base course. The aggregate base course (stone) shall comply with the applicable paragraphs of the NCDOT Specifications Section 520. The compacted base shall be a minimum of 6" thick.
- ☐ Bituminous concrete surface course. The spreading, compaction, and finishing of the surface course shall comply with the NCDOT Specifications Sections 610 and 645. The asphalt installed shall be type I-2 at a minimum compacted depth of 2".



- ☐ Tack coat. Application rates, methods of application, and curing shall be in accordance with NCDOT Specifications Section 605. Vertical surfaces shall be coated with AC-20 tack coat prior to paving operations to ensure proper bonding.
- ☐ Pavement markings. All pavement markings disturbed by the ductbank construction shall be replaced to match existing. All work will conform with the NCDOT Specifications Section 920.

Site Restoration – Concrete Sidewalks, Curbs, and Gutters

- ☐ Curb and gutters. Curb and gutter disturbed by the duct bank construction shall be constructed or repaired to match original conditions. Present alignment and grade should be maintained to promote drainage to existing curb inlets. The curb and gutters shall be constructed in accordance with the NCDOT Specifications Section 846.
- ☐ Concrete sidewalks. Concrete sidewalks disturbed by the duct bank construction shall be constructed or repaired to match original conditions. The sidewalks shall be constructed in accordance with the NCDOT Specifications Section 848. In addition, sidewalks should have contraction joints spaced equal to width of the walk. A ½” expansion joint should be placed at all intersections and at locations where the walk abuts structures and other walks. Finally, walks should receive a light broom finish

Site Restoration – Grass Areas

- ☐ Acceptance. The final authority for the acceptance of the restoration work and the practices used for grass areas is the NHCS Maintenance Department. The contractor shall ensure a uniform stand of specified turf no less than 30 days after germination. Upon final acceptance, Maintenance will assume responsibility for maintenance of the work. Intermediate inspection and acceptance of the work by Maintenance is required at the following milestones:
 - o 1) after installation of the subsoil and topsoil, and
 - o 2) at the removal of the Certified Seed Tag from the seed being placed – witnessed by Maintenance personnel.
- ☐ At the discretion of Maintenance, the contractor may be required to submit a list of proposed materials, together with such samples as may be requested.
- ☐ Subsoil. All areas should be subsoiled to a depth of 6”. Subsoils should be used which are closely related to existing soils in the area, and should be compacted to 85% density. Subsoils should not be worked under frozen, muddy, or saturated conditions. Immediately prior to the dumping and spreading of the topsoil, at least the top 2” of the subsoil should be loosened or scarified to permit bonding of the topsoil to the subsoil.
- ☐ Topsoil materials. The contractor should furnish soil which is fertile, friable, natural loam surface soil. Existing topsoil removed during excavation may be used upon approval from Maintenance. New topsoil shall not have more than 20% subsoil, and shall not contain slag, cinders, stones, lumps of soil, sticks, roots, trash, or other extraneous materials larger than 1” in diameter or length. It shall also be free of plants or plant parts of : kudzu, quackgrass, Johnson grass, nut sedge, poison ivy, or other noxious weeds.
- ☐ Topsoil installation. Topsoil should be uniformly distributed to a depth of 4” after firming. The topsoil should be graded to match the surrounding drainage scheme. Upon completion of grading, the area should be cleared of all grade stakes, surface trash, or other objects which would hinder the maintenance of the seeded areas.



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- ☐ Seeding materials. Since the exact composition of seed materials is site and season dependent, the type used will be determined by Maintenance on a case by case basis.
- ☐ All seed shall be 95% pure with 85% germination. Seed shall be fresh, clean, new crop seed complying with the tolerance for purity and germination established by the Official Seed Analysis of North America. Wet or moldy seed shall not be used. Seed mulch shall be clean wheat straw.
- ☐ Seeding. Seed should be lightly disked or raked into top 1" of topsoil. Clean wheat straw should be applied as mulch at a rate of 45 lbs./1,000 sq. ft. Emulsified asphalt tack should be installed in sufficient quantities to hold straw in place.
- ☐ Warranty. Any seeding requiring correction shall be reseeded by the contractor up to one year following the completion of the project at no expense to the owner.
- ☐ Site restoration – site equipment.
 - o Fencing. All fencing damaged or removed as part of duct bank construction shall be restored to original conditions.
 - o Misc. equipment. Other on site equipment damaged or relocated during the duct bank construction shall be restored to original conditions, including supports.

Site Protection

- ☐ Cleanliness. Contractors will be required to maintain a clean work site at all times during, and upon completion of, construction. Sites shall remain clear of excess debris, surplus materials, and tools and equipment not in active use. Contractors will be responsible for cleaning campus streets and walks of any debris, dirt, or mud resulting from construction and contractor's vehicle traffic.
- ☐ Catch basins should be protected or covered to eliminate dirt, mud, asphalt, and tack from entering them. Any materials which do enter catch basins shall be cleaned out by the contractor at no expense to the owner.
- ☐ Vehicle traffic. Contractors shall be responsible to coordinate all closings of parking lots and streets with the owner. Contractors will be required to make arrangements for closings at least two full working days prior to closure. Contractors shall maintain continuous, safe vehicular traffic flow through and adjacent to the project site. This includes, but is not limited to, use of flagmen, signage, barricades, cones, and lighting. Contractors will be responsible to provide all such equipment and will not be allowed to use district equipment for such purposes.
- ☐ Areas where sawcut asphalt has been removed may not be left open for vehicle traffic unless backfilled with stone or flowable fill. Warning signs will be required to alert traffic of uneven surface.
- ☐ Pedestrian traffic and safety. Contractors shall be responsible for ensuring that all sites are properly equipped with warning and barricade equipment at all times. Detours for pedestrian walkways are to be properly planned with considerations given to handicapped access. They are to be approved by the owner, and clearly marked and barricaded. No handmade signs will be allowed.
- ☐ Tree protection. Contractors will not stockpile debris or surplus materials, or park vehicles or equipment under trees. Care should be taken to ensure tree limbs are not damaged by vehicles or equipment. No excavation of any kind should be performed under the drip line of trees. No trees or shrubs may be removed without prior owner approval.



27 05 53 Identification for Communications Systems

- ☐ **Manufacturers Identification** - Each major component of equipment shall have the manufacturer's name, address, model number, and rating on a plate securely affixed in a conspicuous place. NEMA code ratings, UL label, or other data which is diestamped into the surface of the equipment shall be stamped in a location easily visible.
- ☐ **Custom Panel Identification and Nomenclature** - Switches, connectors, jacks, receptacles, outlets, cables and cable terminations shall be logically and permanently marked in a manner approved by the Owner. Custom panel nomenclature shall be engraved, etched, or screened. Marking for these items are purposely detailed in the drawings to ensure consistency and clarity. Verify any changes in working type size, and/or placement with the owner prior to marking. Mount on the custom rack panels as described above a designation of each source machine, which correlates to the system architecture. Submit a sample layout for Architect approval.
- ☐ **Terminal Blocks and Rack Mounted Equipment Identification** - All terminal blocks, rack mounted equipment, and active slots of card frame systems shall be clearly and logically labeled in a manner acceptable to the owner as to their function, circuit, or system as appropriate. Labeling on manufactured equipment shall be engraved plastic laminate with white lettering on black background or dark background. Handwritten identification is not permitted. The contractor may substitute metallized polyester permanent identification labels with black printing on silver, white, or another light color background for the phenolic labels above.
- ☐ **Cable Identification** - All cable terminations shall be clearly and permanently labeled with appropriate cable number. Labeling of termination system shall be provided on white labels with black typed lettering. Handwritten labels shall not be permitted. Provide a sample of labeling material and example of the numbering scheme planned for use at the facility with project submittals. The contractor will endeavor to utilize the environmental room number the facility administrators plan to use for new construction projects. If environmental room numbers are not available, the contractor will utilize the most recent set of architectural floor plan room numbers for the cable numbers. Once the contractor has utilized a set of room numbers, those numbers and floor plans showing those numbers must be used for all documentation purposes from that point forward for the project unless changes are approved in writing by the Owner's Agent.
- ☐ For jacks installed above the ceiling grid for use with wireless access points, door access controls, etc., a permanent label with appropriate cable number shall be placed on the ceiling tile grid in as close proximity as possible to the terminated jack. The label shall be yellow with black typed lettering. Handwritten labels shall not be permitted.
- ☐ Wall plates shall have the ER/TR # and Room # identified across the top of the plate.
- ☐ The intent of this labeling scheme is to assist in troubleshooting cable problems. Therefore the cables are labeled in a manner that will direct the technician to the opposite end of the cable to allow for testing and troubleshooting.
- ☐ All fiber backbone cables will be labeled with a unique identifier at each end and at junction / pull boxes. Fiber backbone cables will be labeled 12" from each end of the cable with a destination tag that identifies each cable's remote destination and the unique identifier to be determined and approved by owner.



- ☐ All telecommunication outlet (TO) cables are to be labeled within 12” of each end of the cable using the above described identifier. TO numbers in each room are determined by numerical sequence starting from the main doorway of each room and continuing in a clockwise manner around the room. Each faceplate containing data ports will be labeled starting in the upper left hand corner of each 1 gang section and assigned in a left to right and top to bottom direction.
- ☐ Patch Panel- ports are to be labeled using the unique identifier to be determined by the owner.
 - o Telecommunication Outlets (TO) that are serviced by a patch panel will be labeled using the unique identifier to be determined by the owner.
- ☐ All test report documentation will contain a complete circuit id based on the applicable labeling scheme.

27 06 00 Schedules for Communications

NOTE: It is the intent of the revised specifications to have “schedules” of technology ports and components similar to “door schedules” for architectural sections. See Attached Example “Room Matrix Definitions” and “Room Matrix”

27 08 00 Commissioning of Communications

27 08 01 Preliminary Closeout Review (Verification Report)

- ☐ Upon substantial completion of the specific system, test entire system including primary functions as defined in Division 27 or 28. Document, on a contractor generated form, the compliance of each circuit, the individual performing the test will initialize, and date the results of each location.
- ☐ Submit a written report detailing the results of initial adjustments and verification tests including all relevant drawings, charts, and photographs. This report will be completed and submitted to the Owner or Owner’s Agent for review at least five (5) days prior to acceptance testing.

27 08 02 Final Closeout Review – Commissioning/Acceptance Testing

- ☐ The Acceptance Testing and provision of testing equipment will be the responsibility of and performed by the Contractor in the presence of the Owner, Architect, or the Owner's representative. Coordinate this period so that free access, work lighting, electrical is available on the site. See the commissioning requirements in Divisions 27 or 28.
- ☐ Should the contractor schedule an Acceptance Test and the system or components are not ready for or fail Acceptance Testing, the contractor will pay for all subsequent trips and man-hours required for the consultant to properly document specification conformance by the contractor. The Owner will have the right to reduce pay requests or final application of payment to the contractor in an amount equal to the travel costs and man-hours expended by the Consultant and charged to the contractor. The Owner would then pay the Consultant from the funds withheld from the contractor.
- ☐ Upon witness of the Acceptance Testing and the determination, in the owner’s opinion, that a



contractor has falsified the verification test reports, the owner has the right to hire an Independent Testing Agency to provide outside verification of the results. Falsification of the test results is defined as cables shown as testing correctly in the verification report failing during the acceptance testing. (The contractor has the right to hire directly an Independent Testing Agency approved by the owner.) Furthermore, the owner will have the right to reduce pay requests or final application of payment to the contractor in an amount equal to the travel costs and man-hours expended by the Independent Testing Agency. The owner would pay the Independent Testing Agency from the funds withheld from the contractor

27 08 10 Commissioning of Structure Cabling Systems

- ☐ Review of Overview of Testing, Division 01 45 23.01
- ☐ Upon substantial completion of the data network, test every data port for the functional requirements as listed in previously. Document, on a contractor generated form, the compliance of every port. The testing individual will initialize the results of each location. Submit a electronic copy of the reports detailing the results of initial adjustments and verification tests including all relevant drawings, charts, and photographs.
- ☐ Copper Cable Tests - Test and document results for each four (4) pair UTP data cable for the following conditions. (These tests are minimum requirements for Cat 3 Cable). A wire map test of the cable may be used to demonstrate conformance of the cable to the following parameters where applicable.
 - a. Proper polarity;
 - b. No reversals;
 - c. No transpositions;
 - d. Continuity;
 - e. No shorts
 - f. No AC voltage;
 - g. No DC voltage
 - h. No opens;
 - i. Proper numbering at each termination
- ☐ Each permanent link or channel in the network must be field tested in accordance with the TIA-568-B.2-1 series industry standard testing requirements. The installed permanent links and channels must have passed all applicable TIA performance requirements. Minimum testing for copper systems includes Wire Map, Length, Attenuation, Near End Crosstalk, Far End Crosstalk, Return Loss, PS NEXT, ELFEXT, PS ELFEXT.
All wiring shall be certified to meet or exceed the specifications as set forth in ANSI/TIA-568C for Category 6a requirements for permanent link.

Field Testing shall include the following parameters for each pair of each cable installed:

- a. Store number and name.
- b. Test equipment manufacturer and model number.
- c. Cable I.D. The test sheets will be in numerical order by cable ID.
- d. Date of test.
- e. Wire map (pin to pin connectivity and polarity check) i.e. near 12345678, far 12345678.
- f. Length (in feet).
- g. Insertion Loss.



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- h. Near End Crosstalk (NEXT).
- i. Power Sum Near End Crosstalk (PSNEXT).
- j. Equal-Level Far End Crosstalk (ELFEXT).
- k. Power Sum Equal-Level Far End Crosstalk (PSELFEXT).
- l. Return Loss.
- m. Delay Skew.
- n. Attenuation to Crosstalk ratio (ACR).
- o. DC Resistance per 100M/328 feet.
- p. Impedance. Permanent

Link Testing shall be completed on all horizontal (station) cables as a minimum requirement.

Provide electronic copies of tests for every cable as part of the Verification Test Report.

- ☐ Fiber Testing
- ☐ Factory Testing. All fiber optic cable shall be factory tested on a reel basis with performance data for each cable supplied to the contractor and to the owner. Tests shall be conducted utilizing an OTDR (Optical Time Domain Reflectometer) at 1310nm and 1550nm with the attenuation in dB/km recorded for each fiber. Post Rough-In Test. Upon completion of the installation of all fiber optic cable and prior to termination, each fiber optic strand shall be tested for light continuity to insure no damage occurred during installation. (The contractor may wish to perform a light continuity test on each fiber optic strand of the cable upon receipt of reel from manufacturer to insure no damage occurred during shipping).
- ☐ Termination Testing - After completion of the installation provide the following tests. An Optical Test Set consisting of an Optical Source (transmitter) and Optical Meter (receiver) will be used to determine end-to-end attenuation and fiber length. This testing is in Accordance with EIA/TIA-526-14 Method B: Optical Power Loss Measurement of Installed Single-mode Fiber Optic Plant. Each fiber should be measured in one direction at both 1310 and 1550 wavelengths. Record each measurement and provide copies to the owner.
- ☐ **An electronic copy of ALL test results related to the above work performed shall be delivered to the Technology department upon substantial completion of the project.**

END OF SECTION

SECTION 27 1100

COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Telecommunications mounting elements.
2. Backboards.
3. Telecommunications equipment racks and cabinets.
4. Telecommunications service entrance pathways.
5. Grounding.

B. Related Sections:

1. Section "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
2. Section "Communications Horizontal Cabling" for voice and data cabling associated with system panels and devices.

C. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.

D. BICSI: Building Industry Consulting Service International.

E. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel not exceeding 6 inches (152 mm) in width.

F. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).

G. LAN: Local area network.

H. RCDD: Registered Communications Distribution Designer.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Floor-mounted cabinets and cable pathways shall withstand the effects of earthquake motions determined according to ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
 3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.
 - C. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.
- 1.5 QUALITY ASSURANCE
- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of RCDD.
 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
 - B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - C. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
 - D. Grounding: Comply with ANSI-J-STD-607-A.
- 1.6 PROJECT CONDITIONS
- A. Environmental Limitations: Do not deliver or install equipment frames and cable trays until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and work above ceilings is complete.
- 1.7 COORDINATION
- A. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
 1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
 2. Record agreements reached in meetings and distribute them to other participants.
 3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
 4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.
 - B. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-A.
- B. Cable Support: NRTL labeled. Cable support brackets shall be designed to prevent degradation of cable performance and pinch points that could damage cable. Cable tie slots fasten cable ties to brackets.
 - 1. Comply with NFPA 70 and UL 2043 for fire-resistant and low-smoke-producing characteristics.
 - 2. Support brackets with cable tie slots for fastening cable ties to brackets.
 - 3. Lacing bars, spools, J-hooks, and D-rings.
 - 4. Straps and other devices.
- C. Cable Trays / Ladder Racks:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cable Management Solutions, Inc.
 - b. Cablofil Inc.
 - c. Cooper B-Line, Inc.
 - d. Cope - Tyco/Allied Tube & Conduit.
 - e. GS Metals Corp.
 - 2. Cable Tray Materials: Metal, suitable for indoors and protected against corrosion by electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than 0.000472 inch (0.012 mm) thick or hot-dip galvanizing, complying with ASTM A 123/A 123M, Grade 0.55, not less than 0.002165 inch (0.055 mm) thick.
 - a. Basket Cable Trays: Dimensions as indicated on the drawings, and 4" deep. Wire mesh spacing shall not exceed 2 by 4 inches (50 by 100 mm).
 - b. Ladder Cable Trays: Nominal dimensions as indicated on the drawings, and a rung spacing of 9 inches (305 mm).
- D. Conduit and Boxes: Comply with requirements in Section "Raceway and Boxes for Electrical Systems".
 - 1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm).

2.3 EQUIPMENT FRAMES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. ADC.
 - 2. Aim Electronics; a brand of Emerson Electric Co.
 - 3. AMP; a Tyco International Ltd. company.

4. Cooper B-Line, Inc.
5. Hubbell Premise Wiring.
6. KRONE Incorporated.
7. Leviton Voice & Data Division.
8. Middle Atlantic Products, Inc.
9. Nordex/CDT; a subsidiary of Cable Design Technologies.
10. Ortronics, Inc.
11. Panduit Corp.
12. Simon Co. (The).

B. General Frame Requirements:

1. Distribution Frames: Freestanding, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
2. Module Dimension: Width compatible with EIA 310 standard, 19-inch (480-mm) panel mounting.
3. Finish: Manufacturer's standard, baked-polyester powder coat.

C. Modular Freestanding Cabinets:

1. Removable and lockable side panels.
2. Hinged and lockable front and rear doors.
3. Adjustable feet for leveling.
4. Screened ventilation openings in the roof and rear door.
5. Cable access provisions in the roof and base.
6. Grounding bus bar.
7. Power strip.
8. Baked-polyester powder coat finish.
9. All cabinets keyed alike.

D. Cable Management for Equipment Frames:

1. Metal, with integral wire retaining fingers.
2. Baked-polyester powder coat finish.
3. Vertical cable management panels shall have front and rear channels, with covers.
4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

2.4 POWER STRIPS

A. Power Strips: Comply with UL 1363.

1. Rack mounting.
2. Six, 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles.
3. LED indicator lights for power and protection status.
4. LED indicator lights for reverse polarity and open outlet ground.

5. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
6. Cord connected with 15-foot (4.5-m) line cord.
7. Rocker-type on-off switch, illuminated when in on position.
8. Peak Single-Impulse Surge Current Rating: 26 kA per phase.
9. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all 3 modes shall be not more than 330 V.

2.5 GROUNDING

- A. Comply with requirements in Section "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.
- B. Telecommunications Main Bus Bar:
 1. Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
 2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide (6 mm thick by 100 mm wide) with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart.
 3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.
- C. Comply with ANSI-J-STD-607-A.

2.6 LABELING

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

- A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.
- B. Install underground pathways complying with recommendations in TIA/EIA-569-A, "Entrance Facilities" Article.
- C. Install underground entrance pathway complying with Section "Raceway and Boxes."

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.
- C. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.
- D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.3 FIRESTOPPING

- A. Comply with requirements in Section "Penetration Firestopping." Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.4 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.
 - 1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

3.5 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A.
- B. Comply with requirements in Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- C. See Section "Communications Horizontal Cabling" for additional identification requirements. See Evaluations for discussion of TIA/EIA standard as it applies to this Section.
- D. Labels shall be preprinted or computer-printed type.

END OF SECTION

SECTION 27 1300

COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Pathways.
 - 2. UTP cable.
 - 3. Single Mode, optical fiber cabling.
 - 4. Cable connecting hardware, patch panels, and cross-connects.
 - 5. Cabling identification products.

1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- C. EMI: Electromagnetic interference.
- D. IDC: Insulation displacement connector.
- E. LAN: Local area network.
- F. RCDD: Registered Communications Distribution Designer.
- G. UTP: Unshielded twisted pair.

1.4 BACKBONE CABLING DESCRIPTION

- A. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.
- B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.5 PERFORMANCE REQUIREMENTS

- A. General Performance: Backbone cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.6 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.
- C. Source quality-control reports.

- D. Field quality-control reports.
- E. Maintenance Data: For splices and connectors to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field testing program development by an RCDD.
 - 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
- D. Grounding: Comply with ANSI-J-STD-607-A.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 - 1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical fiber flashlight or optical loss test set.
 - 2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.
 - 3. Test each pair of UTP cable for open and short circuits.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.10 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

1.11 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Patch-Panel Units: One of each type.
 - 2. Connecting Blocks: One of each type.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-A.
- B. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
 - 1. Support brackets with cable tie slots for fastening cable ties to brackets.

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2. Lacing bars, spools, J-hooks, and D-rings.
 3. Straps and other devices.
 - C. Cable Trays:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cable Management Solutions, Inc.
 - b. Cablofil Inc.
 - c. Cooper B-Line, Inc.
 - d. Cope - Tyco/Allied Tube & Conduit.
 - e. GS Metals Corp.
 2. Cable Tray Material: Metal, suitable for indoors, and protected against corrosion by electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than 0.000472 inches (0.012 mm) thick or hot-dip galvanizing, complying with ASTM A 123/A 123M, Grade 0.55, not less than 0.002165 inches (0.055 mm) thick.
 - a. Basket Cable Trays: Dimensions as indicated on the drawings, and 4" deep. Wire mesh spacing shall not exceed 2 by 4 inches (50 by 100 mm).
 - b. Ladder Cable Trays: Nominal dimensions as indicated on the drawings, and a rung spacing of 9 inches (305 mm).
 - D. Conduit and Boxes: Comply with requirements in Section "Raceway and Boxes for Electrical Systems."
 1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.
- 2.2 BACKBOARDS
- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm).
- 2.3 UTP CABLE
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Belden CDT Inc.; Electronics Division.
 2. Berk-Tek; a Nexans company.
 3. CommScope, Inc.
 4. Draka USA.
 5. Genesis Cable Products; Honeywell International, Inc.
 6. KRONE Incorporated.
 7. Mohawk; a division of Belden CDT.
 8. Molex Premise Networks; a division of Molex, Inc.
 9. Nordex/CDT; a subsidiary of Cable Design Technologies.
 10. Superior Essex Inc.
 11. SYSTIMAX Solutions; a CommScope Inc. brand.

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- 12. 3M.
 - 13. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
 - B. Description: 100-ohm, 25-pair UTP, with a gray thermoplastic jacket.
 - 1. Comply with ICEA S-90-661 for mechanical properties.
 - 2. Comply with TIA/EIA-568-B.1 for performance specifications.
 - 3. Comply with TIA/EIA-568-B.2, Category 6.
 - 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
 - a. Communications, Riser Rated: Type CMR, complying with UL 1666.
- 2.4 UTP CABLE HARDWARE
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Technology Systems Industries, Inc.
 - 2. Dynacom Corporation.
 - 3. Hubbell Premise Wiring.
 - 4. KRONE Incorporated.
 - 5. Leviton Voice & Data Division.
 - 6. Molex Premise Networks; a division of Molex, Inc.
 - 7. Nordex/CDT; a subsidiary of Cable Design Technologies.
 - 8. Panduit Corp.
 - 9. Siemon Co. (The).
 - 10. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
 - B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
 - C. Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.
 - D. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
 - 1. Number of Jacks per Field: One for each four-pair UTP cable, plus spares and blank positions adequate to suit specified expansion criteria.
 - E. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.
 - F. Patch Cords: Factory-made, 4-pair cables in 48-inch (1200-mm) lengths; terminated with 8-position modular plug at each end.
 - 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6a performance. Patch cords shall have latch guards to protect against snagging.

2.5 OPTICAL FIBER CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Berk-Tek; a Nexans company.
 2. CommScope, Inc.
 3. Corning Cable Systems.
 4. General Cable Technologies Corporation.
 5. Mohawk; a division of Belden CDT.
 6. Nordex/CDT; a subsidiary of Cable Design Technologies.
 7. Optical Connectivity Solutions Division; Emerson Network Power.
 8. Superior Essex Inc.
 9. SYSTIMAX Solutions; a CommScope Inc. brand.
 10. 3M.
 11. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
- B. Description: Single mode, 12-fiber, nonconductive, tight buffer, optical fiber cable.
1. Indoor Cable: Comply with ICEA S-83-596 for mechanical properties.
 2. Outside Plant Cable: Comply with ICEA S-87-640 for mechanical properties.
 3. Comply with TIA/EIA-568-B.3 for performance specifications.
 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - a. Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.
 5. Maximum Attenuation: 0.4 dB/km at 1310 nm; 0.4 dB/km at 1383 nm.
- C. Jacket:
1. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
 2. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

2.6 OPTICAL FIBER CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ADC.
 2. American Technology Systems Industries, Inc.
 3. Berk-Tek; a Nexans company.
 4. Corning Cable Systems.
 5. Dynacom Corporation.
 6. Hubbell Premise Wiring.
 7. Molex Premise Networks; a division of Molex, Inc.
 8. Nordex/CDT; a subsidiary of Cable Design Technologies.
 9. Optical Connectivity Solutions Division; Emerson Network Power.

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- 10. Siemon Co. (The).
 - B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
 - 1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.
 - C. Patch Cords: Factory-made, dual-fiber cables in 36-inch (900-mm) lengths.
 - D. Cable Connecting Hardware:
 - 1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
 - 2. Quick-connect, simplex and duplex, Type LC.
- 2.7 GROUNDING
- A. Comply with requirements in Section "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.
 - B. Comply with ANSI-J-STD-607-A.
- 2.8 IDENTIFICATION PRODUCTS
- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- 2.9 SOURCE QUALITY CONTROL
- A. Factory test cables on reels according to TIA/EIA-568-B.1.
 - B. Factory test UTP cables according to TIA/EIA-568-B.2.
 - C. Factory test single mode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.
 - 1. All fiber optic cable shall be factory tested on a reel basis with performance data for each cable supplied to the contractor and to the owner. Tests shall be conducted utilizing an OTDR (Optical Time Domain Reflectometer) at 1310 nm and 1550nm with the attenuation in dB/km recorded for each fiber.
 - D. Cable will be considered defective if it does not pass tests and inspections.
 - E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

- A. Coordinate relocation of demarcation point with communications service provider. Reference existing and new locations in the drawings.
- B. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays.
 - 1. Comply with requirements for raceways and boxes specified in Section "Raceway and Boxes."

- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A.
- B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Section "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.
- C. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- D. Comply with requirements in Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- E. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- F. Pathway Installation in Communications Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
 - 2. Install cable trays to route cables if conduits cannot be located in these positions.
 - 3. Secure conduits to backboard when entering room from overhead.
 - 4. Extend conduits 6 inches (152 mm) above finished floor.
 - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- G. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical and bottom at 6" AFF. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.4 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 - 1. Comply with TIA/EIA-568-B.1.
 - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 - 3. Install 110-style IDC termination hardware unless otherwise indicated.
 - 4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 - 5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

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7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
 8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 10. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
 11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. UTP Cable Installation:
1. Comply with TIA/EIA-568-B.2.
 2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.
- D. Optical Fiber Cable Installation:
1. Comply with TIA/EIA-568-B.3.
 2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.
- E. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
- F. Group connecting hardware for cables into separate logical fields.
- G. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
 2. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
 3. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
 4. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.5 FIRESTOPPING

- A. Comply with requirements in Section "Penetration Firestopping." Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.7 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A.
- B. Comply with requirements in Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- C. See Section "Communications Horizontal Cabling" for additional identification requirements. See Evaluations for discussion about TIA/EIA standard as it applies to this Section.
- D. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.
- F. Cable and Wire Identification:
 - 1. Label each cable within 12 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
 - 4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.

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5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
 6. All cables shall be labeled with a unique identifier at each end and at junction / pull boxes. Backbone cables shall be labeled with a destination tag that identifies each cable's remote destination and the unique identifier to be determined and approved by Owner.
- G. Patch panel ports are to be labeled using a unique identifier to be determined by the Owner. Manufacturers Identification - Each major component of equipment shall have the manufacturer's name, address, model number, and rating on a plate securely affixed in a conspicuous place. NEMA code ratings, UL label, or other data which is die-stamped into the surface of the equipment shall be stamped in a location easily visible.
- H. Custom Panel Identification and Nomenclature - Switches, connectors, jacks, receptacles, outlets, cables and cable terminations shall be logically and permanently marked in a manner approved by the Owner. Custom panel nomenclature shall be engraved, etched, or screened. Verify any changes in working type size, and/or placement with the Owner prior to marking. Mount on the custom rack panels as described above a designation of each source machine, which correlates to the system architecture. Submit a sample layout for Architect approval.
- I. Terminal Blocks and Rack Mounted Equipment Identification - All terminal blocks, rack mounted equipment, and active slots of card frame systems shall be clearly and logically labeled in a manner acceptable to the Owner as to their function, circuit, or system as appropriate. Labeling on manufactured equipment shall be engraved plastic laminate with white lettering on black background or dark background. Handwritten identification is not permitted. The contractor may substitute metallized polyester permanent identification labels with black printing on silver, white, or another light color background for the phenolic labels above.
- J. Cable Identification - All cable terminations shall be clearly and permanently labeled with appropriate cable number. Labeling of termination system shall be provided on white labels with black typed lettering. Handwritten labels are not be permitted. The contractor will endeavor to utilize the environmental room number from the facility administrators plan to use for new construction projects. If environmental room numbers are not available, the contractor will utilize the most recent set of architectural floor plan room numbers for the cable numbers. Once the contractor has utilized a set of room numbers, those numbers and floor plans showing those numbers must be used for all documentation purposes from that point forward for the project unless changes are approved in writing by the Owner.
- K. Unless specified otherwise, labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA 606-A. Labels shall use flexible vinyl or polyester that flexes as cables are bent.
- 3.8 FIELD QUALITY CONTROL
- A. Perform tests and inspections.
- B. Tests and Inspections:
1. Visually inspect UTP and optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.

2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

Test UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

- a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
3. Optical Fiber Cable Tests:
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - b. Upon completion of the installation of all fiber optic cable and prior to termination, each fiber optic strand shall be tested for light continuity to insure no damage occurred during installation. (The contractor may wish to perform a light continuity test on each fiber optic strand of the cable upon receipt of reel from manufacturer to insure no damage occurred during shipping.)
 - c. After completion of the installation provide the following tests:
 - 1) An Optical Test Set consisting of an Optical Source (transmitter) and Optical Meter (receiver) will be used to determine end-to-end attenuation and fiber length. This testing is in Accordance with EIA/TIA-526-14 Method B: Optical Power Loss Measurement of Installed Single-mode Fiber Optic Plant. Each fiber should be measured in one direction at both 1310 and 1550 wavelengths. Record each measurement and provide copies to the Owner.
4. Acceptance Testing and provision of testing equipment will be the responsibility of and performed by the Contractor in the presence of the Owner, Architect, or the Owner's representative. Coordinate this period so that free access, work lighting, electrical is available on the site.
 - a. Should the contractor schedule an Acceptance Test and the system or components are not ready for or fail Acceptance Testing, the contractor will pay for all subsequent trips and man-hours required for the consultant to properly document specification conformance by the contractor. The Owner will have the right to reduce pay requests or final application of payment to the contractor in an amount equal to the travel costs and man-hours expended by the Consultant and charged to the contractor. The Owner would then pay the Consultant from the funds withheld from the contractor.
 - b. Upon witness of the Acceptance Testing and the determination, in the owner's opinion, that a contractor has falsified the verification test reports, the owner has the right to hire an Independent Testing Agency to provide outside verification of the results. Falsification of the test results is defined as cables shown as testing correctly in the verification report failing during the acceptance testing. (The

contractor has the right to hire directly an Independent Testing Agency approved by the owner.) Furthermore, the owner will have the right to reduce pay requests or final application of payment to the contractor in an amount equal to the travel costs and man-hours expended by the Independent Testing Agency. The owner would pay the Independent Testing Agency from the funds withheld from the contractor.

- C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- D. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION

SECTION 27 1500

COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pathways.
2. UTP cabling.
3. Optical fiber cable.
4. Cable connecting hardware, patch panels, and cross-connects.
5. Telecommunications outlet/connectors.
6. Cabling system identification products.
7. Cable management system.

B. Related Sections:

1. Section "Division 27 – Communications" for New Hanover County Schools Design Guidelines.
2. Section "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

- A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- B. BICSI: Building Industry Consulting Service International.
- C. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel.
- D. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- E. EMI: Electromagnetic interference.
- F. IDC: Insulation displacement connector.
- G. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- H. LAN: Local area network.
- I. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
- J. RCDD: Registered Communications Distribution Designer.
- K. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of longitudinal side rails and a bottom without ventilation openings.

- L. Trough or Ventilated Cable Tray: A fabricated structure consisting of longitudinal side rails and a bottom having openings for the passage of air.

- M. UTP: Unshielded twisted pair.

1.4 HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.

1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector. Where allowed, transition points or consolidation points will be indicated on the drawings.
3. Bridged taps and splices shall not be installed in the horizontal cabling.

- B. A work area is approximately 100 sq. ft. (9.3 sq. m), and includes the components that extend from the telecommunications outlet/connectors to the station equipment.

- C. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) in the horizontal cross-connect.

1.5 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.6 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 1. Cabling administration drawings and printouts.
 2. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
- C. Qualification Data:
 1. For installing contractor.
 2. For Installer and installation supervisor.
- D. Field quality-control reports.
- E. Maintenance Data: For splices and connectors to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field testing program development by an RCDD.
 2. Installation Supervision:

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- a. Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
 - b. Holds a North Carolina Electrical Contractors License in one of the following categories: Unlimited, Limited, Intermediante or SP-Low Voltage.
 - B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - C. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
 - D. Grounding: Comply with ANSI-J-STD-607-A.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Test cables upon receipt at Project site.
 - 1. Test each pair of UTP cable for open and short circuits.
- 1.9 PROJECT CONDITIONS
- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- 1.10 COORDINATION
- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.
 - B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.
- 1.11 EXTRA MATERIALS
- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Patch-Panel Units: One of each type.
 - 2. Connecting Blocks: One of each type.

PART 2 - PRODUCTS

- 2.1 PATHWAYS
- A. General Requirements: Comply with TIA/EIA-569-A.
 - B. Cable Support: NRTL labeled for support of Category 6 and 6A cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
 - 1. Support brackets with cable tie slots for fastening cable ties to brackets.
 - 2. Lacing bars, spools, J-hooks, and D-rings.
 - 3. Straps and other devices.
 - C. Conduit and Boxes: Comply with requirements in Section "Raceway and Boxes for Electrical Systems."
 - 1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.
- 2.2 BACKBOARDS
- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm).

2.3 UTP CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hubbell.
 - 2. Molex.
 - 3. Panduit.
- B. Description: 100-ohm, 4-pair UTP, covered with a thermoplastic jacket.
 - 1. Comply with ICEA S-90-661 for mechanical properties.
 - 2. Comply with TIA/EIA-568-B.1 for performance specifications.
 - 3. Comply with TIA/EIA-569-B.2, Category 6a for wireless access points cabling.
 - 4. Comply with TIA/EIA-568-B.2, Category 6 for all other cabling.
 - 5. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
 - a. Communications, General Purpose: Type CM or CMG.
 - b. Communications, Under Ground: Type OSP, Gel Fill, Location "Wet" listed.

2.4 UTP CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hubbell.
 - 2. Molex.
 - 3. Panduit.
- B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- C. Connecting Blocks: 110-style IDC. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.
- D. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
 - 1. Number of Jacks per Field: One for each four-pair conductor group of cables, plus spares and blank positions adequate to suit specified expansion criteria.
- E. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.
- F. Patch Cords: Factory-made, four-pair cables in 48-inch (1200-mm) lengths; terminated with eight-position modular plug at each end.
 - 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure required performance.
 - 2. Patch cords shall have latch guards to protect against snagging.
 - 3. Ratings:
 - a. Category 6a for wireless access point cords.

- b. Category 6 for all other points.

2.5 TELECOMMUNICATIONS OUTLET/CONNECTORS

- A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.
- B. Workstation Outlets:
 - 1. Two-port-connector assemblies mounted in single faceplate.
 - 2. Four-port-connector assemblies mounted in multigang faceplate.
 - 3. See drawings for other outlet quantities for number of ports. Mount assemblies in multigang faceplate.
 - 4. Metal Faceplate: Stainless steel, complying with requirements in Section "Wiring Devices."
 - 5. Flush mounting snap-in jacks.
 - 6. Provide blanks for unused portions of faceplates.
 - 7. Legend: Machine printed, in the field, using adhesive-tape label.

2.6 GROUNDING

- A. Comply with requirements in Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
- B. Comply with ANSI-J-STD-607-A.

2.7 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Section "Identification for Electrical Systems."

2.8 SOURCE QUALITY CONTROL

- A. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.
- B. Factory test UTP cables according to TIA/EIA-568-B.2.
- C. Cable will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 WIRING METHODS

- A. Wiring Method: Install cables in raceways and suitable specified cable supports except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and attics, where unenclosed wiring method may be used. Conceal raceway except in unfinished spaces.
 - 1. Comply with requirements for raceways and boxes specified in Section "Raceway and Boxes."
 - 2. Where not in conduit or cable tray, cable support shall be provided through the use of open-top cable supports located on 48-60 inch centers. Cables shall be installed parallel or at 90 degree angles to the building walls. Diagonal, beeline, or non-supported cable routing is not acceptable.
- B. Wiring within Enclosures:

1. Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
2. All wires and cables used in assembling custom panels and equipment racks shall be formed into harnesses, tied with Velcro tie wraps and supported in accordance with accepted engineering practice. Harnesses cables shall be combed straight. Each cable that breaks out from a harness for termination shall be provided with an ample service loop. Harnesses cables shall be formed in either a vertical or horizontal relationship to equipment, controls, components, or terminations.

3.2 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.
- B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Section "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.
- C. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- D. Comply with requirements in Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- E. Install manufactured conduit sweeps and long-radius elbows whenever possible.

3.3 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 1. Comply with TIA/EIA-568-B.1.
 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 3. Install 110-style IDC termination hardware unless otherwise indicated.
 4. Consolidation points may be installed only where indicated on the drawings and may be used only for making a direct connection to telecommunications outlet/connectors:
 - a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
 - b. Locate consolidation points for UTP at least 49 feet (15 m) from communications equipment room.
 5. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 6. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 7. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 8. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.

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9. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 10. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 11. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
 12. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. UTP Cable Installation:
1. Comply with TIA/EIA-568-B.2.
 2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.
 3. Provide 10-foot service loops at each termination so that plates, panels, and equipment can be dismounted for service and inspection.
- D. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.
 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- E. Group connecting hardware for cables into separate logical fields.
- F. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA/EIA-569-A for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
 2. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
 3. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
 4. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).
- 3.4 FIRESTOPPING
- A. Comply with requirements in Section "Penetration Firestopping."

- B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.
- E. Where attached to painted metal surfaces, a small area of the paint should be removed by blade or wire brush prior to the attachment of the ground lug. This typically applies to the surface of metal wire ways and to the surface of equipment racks.

3.6 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section "Identification for Electrical Systems."
- B. Comply with requirements in Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- C. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.
- E. Cable and Wire Identification:
 - 1. Label each cable within 12 inches (100 mm) of each termination, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 30 feet (9 m).
 - 4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.

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- b. Label each unit and field within distribution racks and frames.
 - 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
 - 6. Patch panel ports are to be labeled using a unique identifier to be determined by the Owner.
 - F. Manufacturers Identification - Each major component of equipment shall have the manufacturer's name, address, model number, and rating on a plate securely affixed in a conspicuous place. NEMA code ratings, UL label, or other data which is die-stamped into the surface of the equipment shall be stamped in a location easily visible.
 - G. Custom Panel Identification and Nomenclature - Switches, connectors, jacks, receptacles, outlets, cables and cable terminations shall be logically and permanently marked in a manner approved by the Owner. Custom panel nomenclature shall be engraved, etched, or screened. Verify any changes in working type size, and/or placement with the Owner prior to marking. Mount on the custom rack panels as described above a designation of each source machine, which correlates to the system architecture. Submit a sample layout for Architect approval.
 - H. Terminal Blocks and Rack Mounted Equipment Identification - All terminal blocks, rack mounted equipment, and active slots of card frame systems shall be clearly and logically labeled in a manner acceptable to the Owner as to their function, circuit, or system as appropriate. Labeling on manufactured equipment shall be engraved plastic laminate with white lettering on black background or dark background. Handwritten identification is not permitted. The contractor may substitute metallized polyester permanent identification labels with black printing on silver, white, or another light color background for the phenolic labels above.
 - I. Cable Identification - All cable terminations shall be clearly and permanently labeled with appropriate cable number. Labeling of termination system shall be provided on white labels with black typed lettering. Handwritten labels are not permitted. The contractor will endeavor to utilize the environmental room number from the facility administrators plan to use for new construction projects. If environmental room numbers are not available, the contractor will utilize the most recent set of architectural floor plan room numbers for the cable numbers. Once the contractor has utilized a set of room numbers, those numbers and floor plans showing those numbers must be used for all documentation purposes from that point forward for the project unless changes are approved in writing by the Owner.
 - J. Wall plates shall have the Equipment Room # (or Telecom Room #) and Outlet Room # identified across the top of the plate.
 - 1. All telecommunication outlet cables are to be labeled within 12" of each end of the cable using the above described identifier. Telecommunication outlet numbers in each room are determined by numerical sequence starting from the main doorway of each room and continuing in a clockwise manner around the room. Each faceplate containing data ports will be labeled starting in the upper left hand corner of each 1 gang section and assigned in a left to right and top to bottom direction.
 - K. Unless specified otherwise, labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A. Labels shall use flexible vinyl or polyester that flexes as cables are bent.
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3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. New Hanover County Schools has developed a standard checklist for installation. Applicable items from that checklist are duplicated below.

☐ Surface outlets.

- ☐ Is the outlet box level?
- ☐ Is the outlet box painted to match wall (if required)?
- ☐ Are proper conduit offsets (box kick) installed?
- ☐ Are all junction box covers screwed shut?
- ☐ Is a pull string installed with minimum 12" at each end?
- ☐ Are penetrations of rated walls firestopped properly?
- ☐ Is the firestopping installed on both sides of the wall?
- ☐ Does it meet the appropriate UL assembly requirements?
- ☐ Is the annular space around the conduit within UL limits?
- ☐ Are visible penetrations of all walls patched and painted properly?
- ☐ Are plastic bushings installed on telecommunication conduits?

☐ Flush outlets.

- ☐ Is the outlet level?
- ☐ Is the outlet flush with the wall surface?
- ☐ Are the box ears or plaster ring adjusted to recess box into wall?
- ☐ Is the center (device screw hole) tabs cut into drywall?
- ☐ Is the outlet secure?
- ☐ Is the locknut secure?
- ☐ Are all junction box covers screwed shut?
- ☐ Is a pull string installed with minimum 12" at each end?
- ☐ Is the conduit strapped or supported every 5'?
- ☐ Are junction boxes located between every 180 degrees of conduit bends?
- ☐ Are penetrations of rated walls firestopped properly?
- ☐ Is the fire stopping installed on both sides of the wall?
- ☐ Does it meet the appropriate UL assembly requirements?
- ☐ Is the annular space around the conduit within UL limits?
- ☐ Are visible penetrations of all walls patched and painted properly?
- ☐ Are plastic bushings installed on telecommunication conduits?

☐ Riser conduits.

- ☐ Are wireway section pull points installed between every 180 degrees of conduit bends?
- ☐ Are penetrations of rated walls firestopped properly?

- ☐ Is the firestopping installed on both sides of the wall?
- ☐ Does it meet the appropriate UL assembly requirements?
- ☐ Is the annular space around the conduit within UL limits?
- ☐ Are visible penetrations of all walls patched and painted properly?
- ☐ Are grounding bushings installed on all conduit ends in ER/TRs?
- ☐ Are plastic bushings installed on conduits larger than 1"?
- ☐ Are pull strings installed with minimum 12" at each end?
- ☐ Are vertical runs secured properly to walls?
- ☐ Trapeze and All-Thread supports.
 - ☐ Are threaded rods properly secured to anchors?
 - ☐ Is smooth rigid tubing installed to a minimum of twelve inches above the tray?
 - ☐ Are anchors properly installed and secured to the building structure?
 - ☐ Are the trapeze channels level (horizontal)?
 - ☐ Are threaded rods cut flush and deburred?
 - ☐ Are supports installed every 5'?
 - ☐ Are wireways connected to securely?

Are nuts and washers installed both above and below the bracket?

C. Tests and Inspections:

1. Visually inspect UTP cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
2. Visually confirm marking of outlets, cover plates, outlet/connectors, and patch panels.
3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
4. UTP Performance Tests:
 - a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:
 - 1) Wire map. Demonstrate conformance of the cable to the following parameters where applicable:
 - a) Proper polarity.
 - b) No reversals.
 - c) No transpositions.
 - d) Continuity.
 - e) No shorts.
 - f) No AC voltage.
 - g) No DC voltage.
 - h) No opens.

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- i) Proper numbering at each termination.
 - 2) Length (physical vs. electrical, and length requirements).
 - 3) Insertion loss.
 - 4) Near-end crosstalk (NEXT) loss.
 - 5) Power sum near-end crosstalk (PSNEXT) loss.
 - 6) Equal-level far-end crosstalk (ELFEXT).
 - 7) Power sum equal-level far-end crosstalk (PSELFEXT).
 - 8) Return loss.
 - 9) Propagation delay.
 - 10) Delay skew.
 - 11) Attenuation to Crosstalk ratio (ACR).
 - 12) DC Resistance per 100M/328 feet.
 - 13) Impedance
 5. All wiring shall be certified to meet or exceed the specifications as set forth in ANSI/TIA-568C for Category 6 and 6a requirements for permanent link. Field Testing shall include the following parameters for each pair of each cable installed:
 - a. Store number and name.
 - b. Test equipment manufacturer and model number.
 - c. Cable I.D. Test sheets shall be in numerical order by cable ID.
 - d. Date of test.
 6. Preliminary Closeout Review Verification: Upon substantial completion of the specific system, test entire system including primary functions as defined in Division 27 or 28. Test every data port and cable for the functional requirements required. Document, on a contractor generated form, the compliance of each circuit. The individual performing the test will initialize, and date the results of each location. Submit an electronic copy of the report detailing the results of initial adjustments and verification tests including all relevant drawings, charts, and photographs. This report shall be completed and submitted to the Owner and Owner's Agent for review a minimum of five (5) working days prior to acceptance testing.
 7. Acceptance Testing and provision of testing equipment will be the responsibility of and performed by the Contractor in the presence of the Owner, Architect, or the Owner's representative. Coordinate this period so that free access, work lighting, electrical is available on the site.
 - a. Should the contractor schedule an Acceptance Test and the system or components are not ready for or fail Acceptance Testing, the contractor will pay for all subsequent trips and man-hours required for the consultant to properly document specification conformance by the contractor. The Owner will have the right to reduce pay requests or final application of payment to the contractor in an amount equal to the travel costs and man-hours expended by the Consultant and charged to the contractor. The Owner would then pay the Consultant from the funds withheld from the contractor.

- b. Upon witness of the Acceptance Testing and the determination, in the owner's opinion, that a contractor has falsified the verification test reports, the owner has the right to hire an Independent Testing Agency to provide outside verification of the results. Falsification of the test results is defined as cables shown as testing correctly in the verification report failing during the acceptance testing. (The contractor has the right to hire directly an Independent Testing Agency approved by the owner.) Furthermore, the owner will have the right to reduce pay requests or final application of payment to the contractor in an amount equal to the travel costs and man-hours expended by the Independent Testing Agency. The owner would pay the Independent Testing Agency from the funds withheld from the contractor.
- D. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports. Test report documentation shall contain a complete circuit id based on the applicable labeling scheme.

END OF SECTION

SECTION 27 5116

INTERCOM / PUBLIC ADDRESS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.
- B. New Hanover County Schools Standard Specification Section 275123.50, Educational Intercommunications and Program Systems.

1.2 SUMMARY

- A. Section includes equipment, accessories, and materials to provide a complete and operational system for paging, building wide announcements, bell schedule tones, and life safety warnings

1.3 DEFINITIONS

- A. Channels: Separate parallel signal paths, from sources to loudspeakers or loudspeaker zones, with separate amplification and switching that permit selection between paths for speaker alternative program signals.
- B. VU: Volume unit.
- C. Zone: Separate group of loudspeakers and associated supply wiring that may be arranged for selective switching between different channels.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. The specific item proposed and its area of application shall be marked on the catalog cut sheets.
- B. Shop Drawings: Power, signal, and control wiring.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Console layouts.
 - 4. Control panels.
 - 5. Rack arrangements.
 - 6. Calculations: For sizing backup battery.
 - 7. Wiring Diagrams: For power, signal, and control wiring.
 - a. Identify terminals to facilitate installation, operation, and maintenance.
 - b. Single-line diagram showing interconnection of components.
 - c. Cabling diagram showing cable routing.
 - d. Clearly differentiate between portions of wiring that are manufacturer installed and portions that are field installed.
- C. Delegated-Design Submittal: For supports and seismic restraints for control consoles, equipment cabinets and racks, and components indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of supports and seismic restraints for control consoles, equipment cabinets and racks, and components.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installing Contractor showing factory authorized certification as an authorized distributor.
- B. Qualification Data: For Installer showing factory authorized training.
- C. Seismic Qualification Certificates: For control consoles, equipment cabinets and racks, accessories, and components, from manufacturer.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation. Include qualification data for testing agency.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For public address systems to include in emergency, operation, and maintenance manuals.
 1. In addition to items specified in "Closeout Procedures" and "Operation and Maintenance Data," include the following:
 - a. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
 - b. Operating instructions laminated and mounted adjacent to operating console location.
 - c. Training plan.

1.7 QUALITY ASSURANCE

- A. The system shall be supplied by a manufacturer's authorized contractor who is qualified in the proper installation, operation, and service of the system.
- B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

1.8 WARRANTY

- A. The contractor shall warrant the equipment to be new and free from defects in material and workmanship, and will, within one year from date of installation, repair or replace any equipment found to be defective. This warranty shall not apply to any equipment that has been subject to misuse, abuse, negligence, accident, or unauthorized modification.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Preferred Alternate: Bogen.

- B. Where equipment is specified herein or on drawings, by manufacturers' names or numbers, this shall denote the Design Basis for the preferred alternate bid and the minimum requirements as to quality, type, capacity, function, and performance.
 - 1. Where a specific model may have been discontinued, the manufacturer's intended replacement shall be substituted. Such substitutions shall be identified in the submittals.
- C. Source Limitations: Obtain public address system from single source from single manufacturer.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NFPA 70.

2.2 FUNCTIONAL DESCRIPTION OF SYSTEM

- A. System Functions:
 - 1. Selectively connect any zone to any available signal channel.
 - 2. Selectively control sound from microphone outlets and other inputs.
 - 3. "All-call" feature shall connect the all-call sound signal simultaneously to all zones regardless of zone or channel switch settings.
 - 4. Telephone paging adapter shall allow paging by dialing an extension from any local telephone instrument and speaking into the telephone.
 - 5. Produce a program-signal tone that is amplified and sounded over all speakers, overriding signals currently being distributed.
 - 6. Reproduce high-quality sound that is free of noise and distortion at all loudspeakers at all times during equipment operation including standby mode with inputs off; output free of nonuniform coverage of amplified sound.

2.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports and seismic restraints for control consoles, equipment cabinets and racks, and components, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Seismic Performance: Supports and seismic restraints for control consoles, equipment cabinets and racks, and components shall withstand the effects of earthquake motions determined according to the North Carolina State Building Code.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified."

2.4 SYSTEM DESCRIPTION

- A. Compatibility of Components: Coordinate component features to form an integrated system. Match components and interconnections for optimum performance of specified functions.
- B. Equipment: Comply with UL 813. Equipment shall be modular, using solid-state components, and fully rated for continuous duty unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz.
- C. Equipment Mounting: Where rack, cabinet, or console mounting is indicated, equipment shall be designed to mount in a 19-inch (483-mm) housing complying with EIA/ECA-310-E.
- D. Weather-Resistant Equipment: Listed and labeled by a qualified testing agency for duty outdoors or in damp locations.

2.5 POWER AMPLIFIERS

- A. Mounting: Rack.
- B. Corridor speaker zones and outside horn zones: 125 Watt.

2.6 EQUIPMENT CABINET

- A. Comply with EIA/ECA-310-E.
- B. House amplifiers and auxiliary equipment at each location.
- C. Cabinet Housing:
 - 1. Constructed of 0.0478-inch steel, minimum, with front- and rear-locking doors and standard EIA/ECA-310-E-compliant, 19-inch racks.
 - 2. Sized to house all equipment required, plus spare capacity.
 - 3. Ventilated rear and sides and solid top. Use louvers in panels to ensure adequate ventilation.
- D. Power Provisions:
 - 1. Rack mounted surge protection outlet strips.
 - 2. Rack mounted UPS for standby power during power failures. Size for 30 minutes operation for continuous load, 1500 VA minimum.
- E. Ventilation: A low-noise fan for forced-air cabinet ventilation. Fan shall be equipped with a filtered input vent and shall be plug connected to operate from 105- to 130-V ac, 60 Hz.

2.7 LOUDSPEAKERS

- A. Classroom, Corridor, and Administrative Loudspeakers:
 - 1. Flush-Ceiling-Mounted Units: In steel back boxes, acoustically dampened. Metal ceiling grille with white baked enamel.
 - 2. In all administrative areas there shall be an external volume control that is accessible from below ceiling grid for ceiling mounted speaker. Adjustment shall be made with a knob-type control. Mounting height shall match that of the light switches. Label: "PA Volume."
 - 3. Design Basis: Bogen Model CSD2X2VR.
- B. Horn-Type Loudspeakers:
 - 1. Mounting: Integral bracket.
 - 2. Units in Damp, Wet, or Outdoor Locations: Listed and labeled for environment in which they are located.
 - 3. Design Basis: Bogen Model SPT-15A.
 - 4. Exterior horn circuits will require lightning protection at head-end equipment.

2.8 OUTLETS

- A. Volume Attenuator Station: Wall-plate-mounted autotransformer type with paging priority feature.
 - 1. Wattage Rating: 10 W unless otherwise indicated.
 - 2. Attenuation per Step: 3 dB, with positive off position.
 - 3. Insertion Loss: 0.4 dB maximum.

4. Attenuation Bypass Relay: SPDT. Connected to operate and bypass attenuation when all-call, paging, program signal, or prerecorded message features are used. Relay returns to normal position at end of priority transmission.

5. Label: "PA Volume."

2.9 SURGE SUPPRESSION

- A. Provide surge suppression protectors for any intercom cables that enter from outside the building and on all exterior horn circuits.
- B. Provide protectors for any intercom cables that enter the equipment rooms from outside the building. Examples of this would be outside horns and mobile classrooms.
- C. Design Basis: ITW LINX #UP25-39.

2.10 CONDUCTORS AND CABLES

- A. Jacketed, twisted pair and twisted multipair, untinned solid copper.
 1. Insulation for Wire in Conduit: Thermoplastic, not less than 1/32 inch thick.
 2. Cables shall be permanently identified at each wire end utilizing a self-laminated wire or cable marker comprised of a white label with black lettering and clear laminate area, in a manner approved by the Owner. Each cable identification shall be a unique number located approximately 1-1/2" from cable connection at both ends of cable. Numbers shall be approximately 1/4" in height. These unique numbers shall appear on the As-Built Drawings provided by the installer and these drawings shall be mounted in each equipment room used to support any part of the entire system.
 3. Design Basis:
 - a. Corridors & Exterior Horns: Belden 5300FE, #18 AWG.
 - b. Classrooms, Admin, & Locations other than Corridors: Belden 5500FE, #22 AWG.

2.11 PATHWAYS

- A. Conduit, Cable Tray, and Boxes: Comply with Sections "Raceways and Boxes" and "Wire Mesh Cable Trays".
 1. Outlet boxes shall be not less than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

PART 3 - EXECUTION

3.1 WIRING METHODS

- A. Wiring Method: Install cables in pathways and cable trays except within consoles, cabinets, desks, and counters, and except in accessible ceiling spaces where unenclosed wiring method may be used. Conceal pathway and cables except in unfinished spaces.
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.2 INSTALLATION OF CABLES

- A. Comply with NECA 1.

B. General Cable Installation Requirements:

1. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.
2. Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables may not be spliced.
3. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
4. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
5. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
6. Service Loops:
 - a. Provide 10-foot service loops at each equipment termination so that plates, panels, and equipment can be dismounted for service and inspection.
 - b. Provide 3-foot service loops at each loudspeaker.
7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used.

C. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend speaker cable not in a wireway or pathway a minimum of 24 inches above ceiling by cable supports not more than 60 inches apart. Cables shall be installed parallel or at 90 degree angles to the building walls. Diagonal, beeline, or non-supported cable routing is unacceptable.
3. Cable may be run through structural members but shall not be in contact with pipes, ducts, or other potentially damaging items.
4. Utilize wall sleeves, dedicated to low voltage cabling, for penetrations through walls.

- D. Separation of Wires: Separate speaker-microphone, line-level, speaker-level, and power wiring runs. Install in separate pathways or, where exposed or in same enclosure, separate conductors at least 12 inches apart for speaker microphones and adjacent parallel power and telephone wiring. Separate other communication equipment conductors as recommended by equipment manufacturer.

3.3 INSTALLATION

- A. The contractor shall furnish all equipment, accessories, and material required for the installation of a comprehensive communication system in strict compliance with these specifications and applicable contract drawings. Any material and/or equipment necessary for the proper operation of the system, which is not specified or described herein, shall be deemed part of this specification.
- B. Coordinate layout and installation of system components 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.

-
- C. Match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.
 - D. Identification of Conductors and Cables: Color-code conductors and apply wire and cable marking tape to designate wires and cables so they identify media in coordination with system wiring diagrams.
 - E. Equipment Cabinets and Racks:
 - 1. Group items of same function together, either vertically or side by side, and arrange controls symmetrically. Mount monitor panel above the amplifiers.
 - 2. Arrange all inputs, outputs, interconnections, and test points so they are accessible at rear of rack for maintenance and testing, with each item removable from rack without disturbing other items or connections.
 - 3. Blank Panels: Cover empty space in equipment racks so entire front of rack is occupied by panels.
 - 4. Install cables, combed straight and formed in a neat and orderly manner. Tie as required using Velcro cable ties of appropriate type and size.
 - F. Volume Limiter/Compressor: Equip each zone with a volume limiter/compressor. Install in central equipment cabinet. Arrange to provide a constant input to power amplifiers.
 - G. Wall-Mounted Outlets: Flush mounted.
 - H. Connect wiring according to Section 271500 "Communications Horizontal Cabling" and Section 280513 "Conductors and Cables for Electronic Safety and Security."
- 3.4 GROUNDING
- A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments. Cable shielding shall be connected to common ground at point of lowest audio level and shall be free from ground at any other point. Cable shields shall be terminated in same manner as conductors.
- 3.5 FIELD QUALITY CONTROL
- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 - B. Tests and Inspections:
 - 1. Schedule tests with at least seven days' advance notice of test performance.
 - 2. After installing public address system and after electrical circuitry has been energized, test for compliance with requirements.
 - 3. Operational Test: Perform tests that include originating program and page messages at microphone outlets, preamplifier program inputs, and other inputs. Verify proper routing and volume levels and that system is free of noise and distortion.
 - 4. Signal-to-Noise Ratio Test: Measure signal-to-noise ratio of complete system at normal gain settings as follows:
 - a. Disconnect microphone at connector or jack closest to it and replace it in the circuit with a signal generator using a 1000-Hz signal. Replace all other

microphones at corresponding connectors with dummy loads, each equal in impedance to microphone it replaces. Measure signal-to-noise ratio.

- b. Repeat test for each separately controlled zone of loudspeakers.
 - c. Minimum acceptance ratio is 50 dB.
 5. Distortion Test: Measure distortion at normal gain settings and rated power. Feed signals at frequencies of 50, 200, 400, 1000, 3000, 8000, and 12,000 Hz into each preamplifier channel. For each frequency, measure distortion in the paging and all-call amplifier outputs. Maximum acceptable distortion at any frequency is 3 percent total harmonics.
 6. Acoustic Coverage Test: Feed pink noise into system using octaves centered at 500 and 4000 Hz. Use sound-level meter with octave-band filters to measure level at five locations in each zone. For spaces with seated audiences, maximum permissible variation in level is plus or minus 2 dB. In addition, the levels between locations in same zone and between locations in adjacent zones must not vary more than plus or minus 3 dB.
 7. Power Output Test: Measure electrical power output of each power amplifier at normal gain settings of 50, 1000, and 12,000 Hz. Maximum variation in power output at these frequencies must not exceed plus or minus 1 dB.
 8. Signal Ground Test: Measure and report ground resistance at public address equipment signal ground. Comply with testing requirements specified in Section 270526 "Grounding and Bonding for Communications Systems."
 - C. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified. Prepare a list of final tap settings of paging speaker-line matching transformers.
 - D. Public address system will be considered defective if it does not pass tests and inspections.
 - E. Prepare test and inspection reports.
 1. Include a record of final speaker-line matching transformer-tap settings and signal ground-resistance measurement certified by Installer.
- 3.6 STARTUP SERVICE
- A. Engage a factory-authorized service representative to perform startup service.
 1. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements.
 2. Complete installation and startup checks according to manufacturer's written instructions.
- 3.7 ADJUSTING
- A. On-Site Assistance: Engage a factory-authorized service representative to provide on-site assistance in adjusting sound levels, resetting transformer taps, and adjusting controls to meet occupancy conditions.
 - B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to four visits to Project during other-than-normal occupancy hours for this purpose.
- 3.8 DEMONSTRATION
- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the public address system and equipment.

- B. Provide a minimum of eight (8) hours of complete "in service" instructions of system operation to school personnel. Assist in programming of telephone system.
- C. Installer shall provide programming documentation that reflects the relation to each port, station identifier, and physical location of station.

END OF SECTION

SECTION 27 5123

EDUCATIONAL INTERCOMMUNICATIONS AND PROGRAM SYSTEMS

1.1 RELATED DOCUMENTS

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

1.2 DOCUMENT INFORMATION

- A. The specifications provided in the section that follows are provided **FOR REFERENCE** as New Hanover County School System Standard Specifications. These specifications are provided in their entirety as received from New Hanover County School System. Inclusion here is not intended to represent that these specification sections are the work of Cheatham and Associates, P.A. Contact the Engineer for clarification of conflicts that may arise by inclusion of these specifications.

1.3 CONTENTS

- A. New Hanover County School System Standard Specifications:
 - 1. Division 275123.50 – Educational Intercommunications & Program Systems.

END OF SECTION

SECTION 27 51 23.50

EDUCATIONAL INTERCOMMUNICATIONS AND PROGRAM SYSTEMS

PART 1 - GENERAL

1.1 SCOPE OF WORK:

- A. Furnish and install all equipment accessories and materials in accordance with these specifications to provide a complete and operational system. The paging system shall generate building wide announcements, bell schedule tones, and life safety warnings.

1.2 RELATED WORK/SECTIONS:

- A. In addition to this section, the Contractor shall refer to other specification sections and drawings to ascertain the extent of work included. This shall include, but not be limited to, the following:
 - 1. Division 1.
 - 2. All other Division 260000 sections.
- B. See section on Substitutions.

1.3 WORK INCLUDED:

- A. The contractor shall furnish all equipment, accessories, and material required for the installation of a comprehensive communication system in strict compliance with these specifications and applicable contract drawings. Any material and/or equipment necessary for the proper operation of the system, which is not specified or described herein, shall be deemed part of this specification.
- B. The communications system shall bear the label of a Nationally Recognized Testing Laboratory (NRTL) such as E.T.L., D.S.&G., or UL and be listed by their re-examination service. All work must be completed in strict accordance with all applicable electrical codes, including N.E.C. Section 800-51 (i), under direction of a qualified and factory approved distributor, to the approval of the Owner.
- C. The system is to be designed and configured for maximum ease of service and repair. All major components of the system shall be designed as a standard component of one type of card cage. All internal connections of the system shall be with factory keyed plugs designed for fault-free connection. The printed circuit card of the card cage shall be silk screened to indicate the location of each connection.

1.4 SUBMITTALS:

- A. Submit catalog cuts, layout drawings, diagrams, and calculations for approval in accordance with Section 260000, GENERAL PROVISIONS.

- B. Shop Drawings: Submit accurately scaled (1/8"=1'0") layout drawings of system components and accessories. Layout drawings, diagrams and calculations shall be completed by the manufacturer and presented in CAD format. Manual drafting is not acceptable.
- C. Include an elevation (front) view of each equipment rack and applicable backboard locations denoting the equipment to be installed, pertinent termination and numbering information, and labeling instructions.
- D. The specific item proposed and its area of application shall be marked on the catalog cuts.
- E. Wiring Diagrams: Submit interconnection wiring diagrams for systems including connection diagrams for signal cabling. Clearly differentiate between portions of wiring that are manufacturer installed and portions that are field installed.

1.5 SUBSTITUTIONS:

- A. Any system and/or equipment proposed as an equal to that specified must be proven to conform to the standards contained herein. The contractor must obtain the architect's or engineer's approval in writing, prior to bidding equipment other than that specified no later than ten (10) days prior to the Bid Date. The manufacturer's name, model numbers, and three (3) copies of shop/working drawings complete with catalog sheets, technical and installation data shall be submitted for approval.
- B. Within thirty-five (35) calendar days after the date of award of the contract, the contractor shall submit to the Architect for review, eight (8) copies of a complete submission. The submission shall consist of five (5) major sections, with each section separated with insertable index tabs. The first section shall be the "Index", which shall include the project title and address, name of the firm submitting the proposal and the name of the Architect. Each page in the submission shall be numbered chronologically and shall be summarized in the index. The second section shall include a copy of the authorized distributor's valid State Contractors License, letters of factory authorization and guaranteed service, list of projects of equal scope and list of proposed instrumentation to be used by the contractor. The third section shall contain the comparative specification listing, including a complete listing of the characteristics of the equipment to be furnished. The fourth section shall contain an original factory data sheet for every piece of equipment in the specifications. The fifth section shall contain a wiring destination schedule for each circuit leaving each piece of equipment.

1.6 QUALIFICATIONS:

- A. The system shall be supplied by the manufacturer's authorized contractor who is qualified in the proper installation, operation, and service of the system. Certification shall be submitted verifying that the contractor is the manufacturer's authorized.
- B. Upon request of the Architect/Engineer, the system proposed as an equal shall be made available for demonstration. The demonstration shall be coordinated with the Architect/Engineer and the end-user.
- C. Contractor shall attend mandatory job walk.

1.7 EQUIPMENT WARRANTY:

- A. The contractor shall warrant the equipment to be new and free from defects in material and workmanship, and will, within one year from date of installation, repair or replace any equipment found to be defective. This warranty shall not apply to any equipment that has been subject to misuse, abuse, negligence, accident, or unauthorized modification.

1.8 SERVICE FACILITIES:

- A. The contractor shall make available, and maintain a satisfactory service department capable of furnishing equipment inspection and service. The contractor shall be prepared to offer a service contract for the maintenance of the system beyond the warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURER:

- A. The manufacturer shall be a United States manufacturer, who has been regularly engaged in the manufacture of communication systems for at least thirty (30) years.
- B. The equipment described herein, and furnished per these specifications shall be the product of one manufacturer. All reference to model numbers and other detailed descriptive data is intended to establish standards of design, performance, and quality, as required. Specification is based on Bogen Quantum Multicom IP, manufactured by Bogen Communications, Inc.

2.2 SYSTEM DESCRIPTION:

- A. The communication system shall be a Bogen Quantum Multicom IP, and shall provide a comprehensive communication network between administrative areas and staff locations throughout the facility. Nonvolatile memory shall store permanent memory and field-programmable memory. A system, which uses a battery to maintain system configuration information, shall not be acceptable.

The system shall provide no less than the following features and functions:

1. Telephonic communication (complete with DTMF signaling, dial tone, ringing and busy signals, and data display) on administrative stations shall use two wires. Systems that use more than two wires for communication, tones and data display shall not be acceptable.
2. Amplified-voice communication with loudspeakers shall use a shielded audio pair (shield can be used as one of the two required conductors for administrative phone or call-in switch).
3. The system shall be available in the following configurations:
 - a. MC2K Wall-mounted in a custom enclosure Quantum. Station capacity shall be from 24 to 130 stations each Node. All stations shall have the ability to support displays.
 - b. MC2KR Rack-mounted Quantum. Station capacity shall be from 24 to 250 stations each Node. All telephone stations shall have the ability to support displays.

- c. QRC24 & QRC48 Compact Quantum Rack System. Station capacity shall be from 24 to 48 stations per node. All stations shall have the ability to support displays, with an option to add up to 8 Central Office phone lines.
- d. 2223/2233 MC2KR Rack-mounted and integrated with Bogen Multi-Graphic Series 2223 or Series 2233 equipment. In this configuration, Quantum Multicom IP system station capacity shall be expandable up to 240 stations in increments of 24 per node. All telephone stations shall have the ability to support displays. The Multi-Graphic system equipment provides the following: backup fail safe intercom and paging functions (Note: the systems operate independently; if one were to fail, the other provides intercom for student safety), plus two additional program channels, and additional Multi-Graphic functions. It shall be possible, by use of a separate call-in switch, to annunciate only to the Multi-Graphic portion of the system without using additional station ports within the Quantum Multicom IP system. For switch banks to work effectively the equipment must be centrally located for switch-bank operation.

The above system configurations represent a single processor in the Quantum Multicom IP. Each processor can be combined with up to 63 additional systems (nodes) for a total single facility capacity of up to 16,000 stations.

- 4. The system shall consist of any combination of the following: Administrative Display Phones, Administrative VoIP Phones, and Administrative Phones.
 - a. Staff Classroom Stations shall consist of wall- or ceiling-mounted loudspeakers with call-in switches or handsets.
 - b. Administrative phone stations shall consist of VoIP phones, display phones, or DTMF dialing 2500 analog-style telephone sets.
 - c. Administrative Display Phones shall be DTMF-dialing digital telephone sets with a 4x16 character LCD display panel. They shall be equipped with a standard 12-key push-button dialing keypad. Phones requiring external LCD displays shall not be accepted as an equal. Optionally, a loudspeaker may be connected at each administrative station location.
 - 1. Up to 5 Administrative Wall Displays may be added to the Administrative Station for large office areas.
 - d. Administrative Display Phones, Administrative VoIP Phones, and Administrative Phones shall have the option of including a loudspeaker.
 - e. All types of stations except administrative VoIP phones shall utilize the same type of field wiring. Future station alterations shall only require the station type to be changed and the proper software designation to be selected. Alterations shall not require field wiring or system head-end alterations. All field wiring and system head-end equipment shall support any type of station, at the time of installation. All contractor proposals shall reflect this capacity. Failure to submit and bid this project in this manner will be deemed as being in direct conflict of these specifications and will be rejected.
 - f. There shall be no limit to the number of administrative display stations within the total capacity of the system.

- g. It shall be possible at any time to change the type of station at any location without equipment or wiring changes except for administrative VoIP phones that utilize existing LAN connections. Systems that limit the quantity of each station type or require future additional equipment and/or system expansion to provide additional administrative telephones shall not be accepted as an equal.
- 5. The system shall be a global switching system, providing up to 512 unrestricted simultaneous private telephone paths per facility. The system shall also be capable of providing up to 512 amplified intercom paths per facility. One amplified intercom path shall automatically be provided with each increment of 24 stations of system capacity. All hardware, etc., required to achieve the necessary number of amplified-voice intercom channels for this system shall be included in this submittal. Amplified-voice intercom channels shall provide voice-activated switching. Systems requiring the use of a push-to-talk switch on administrative telephones shall not be acceptable. There shall be an automatic level control for return speech during amplified-voice communications. The intercom amplifier shall also provide control over the switch sensitivity and delay times of the VOX circuitry.
- 6. The system shall provide 911 Dial-Through with specific outside line(s) dedicated only for this function to ensure that the line is available all the time for 911 calls. The 911 Dial-Through is available to any station that can dial.
 - a. The 911 CO lines will be pre-configured and reserved. If the 911 reserved lines are busy, the normal CO lines will be connected to route the 911 calls. If all the normal CO lines are busy, the ongoing call shall be disconnected and the 911 call shall be placed.
 - b. When 911 is dialed from a Administrative VoIP Phone or Administrative Phone its Administrative Display Phone or Wall Display will receive a message that that room dialed 911.
- 7. It is of utmost importance that emergency calls from staff stations receive prompt attention. Therefore, it is important that there be an alternate destination in case the emergency call does not get answered at the primary location. To this end:
 - a. Staff-generated Emergency calls shall be treated as the second highest system priority. Therefore, all Emergency calls shall annunciate at the top of the call queue of their respective administrative display phone. Should that emergency call go unanswered for 15 seconds, the call shall be re-routed to an alternate speaker station then a tone prompts the caller to make a verbal call for help. During the transfer, the original administrative telephone shall continue to ring the distinctive Emergency Ring. Should the Emergency Transfer to Station have an associated administrative telephone, it too shall ring the distinctive Emergency ring.
 - b. The Emergency Transfer to Station shall be field programmable.
 - c. Should the original administrative display phone be engaged in a non-emergency conversation, its conversation shall be automatically terminated, indicated with an alert tone, and then reconnected to the station that generated the Emergency Call.
 - d. Should the administrative display phone be engaged in an emergency conversation, successive emergency calls shall log into the call queue as well as transfer to the

Emergency Transfer Station for their verbal call for help. Upon termination of the initial emergency conversation, the next one shall immediately ring the administrative telephone.

- e. Systems failing to transfer unanswered Emergency calls or failing to immediately connect to the administrative display phone shall not be deemed as equal.
8. There shall be a System-Wide Facility Emergency All-Call feature. The Emergency All-Call shall be accessed from designated administrative phones or by the activation of an external contact closure which shall give the third audio program input emergency status. The Emergency All-Call function shall have the highest system priority and shall override all other loudspeaker-related functions including Time Tones, Normal All-Call or Zone Pages or Audio Distribution.
- a. Considering that emergencies calls are to be treated with the highest level of concern. Systems which do not regard Emergency-All-Call page from an administrative station with the highest priority shall not be deemed as equal.
 - b. Upon picking up the receiver and dialing "9", a menu shall appear on the display prompting the user to enter each subsequent digit. In this way, the user shall not be required to memorize complicated key sequences in order to access emergency functions.
 - c. The Emergency All-Call shall capture complete system priority, and shall be transmitted over all speakers in the facility. It shall also activate an external relay, which can be used to automatically override volume controls and other systems.
 - d. Systems without Emergency All-Call, or systems with All-Call that cannot be activated by external means, or which do not capture complete system priority or activate an external relay, shall not be acceptable.
9. There shall be at least four Dedicated Emergency Alarm Tones. Each may be accessed by dialing a three-digit number from designated administrative display phone. These emergency tones should be separate from the time tones. Systems using external alarm generators, or having less than four emergency alarm tones shall not be acceptable.
- a. Upon picking up the receiver and dialing "9", a menu shall appear on the display prompting the user to enter each subsequent digit. In this way, the user shall not be required to memorize complicated key sequences in order to access Emergency Alarm Tones.
10. There shall be four (4) External-Function Relay Driver Outputs, accessible from designated Quantum Commander User or Administrative Display Telephones by dialing a four-digit number. These outputs remain set until accessed and reset at a later time. The user shall have the ability to review the status of each relay driver. A plain English menu, prompting the user through the fields without requiring the user to remember any dialing sequences shall support this feature. Systems that require the user to remember complicated dialing schemes or prompt the user via cryptic commands shall not be deemed equal.
- a. The stations shall be capable of being programmed for security contact relays for use with magnetic locks, motion detectors, cameras or any low-voltage, dry contact creating

device. System using security stations for control of external functions shall not be acceptable.

- b. Upon picking up the receiver and dialing "9", a menu shall appear on the display prompting the user to enter each subsequent digit. In this way, the user shall not be required to memorize complicated key sequences in order to access external relay functions.
11. There shall be a program-material interface included with each node, which shall accept up to four (4) Bogen Power Vector Series program modules. Systems requiring an external program source interface shall not be acceptable.
12. There shall be an outside line feature. The circuitry shall interface with the station ports of an external telephone system, and shall provide facilities for up to 960 incoming lines per facility which shall be designated by the user to ring "day" and "night" administrative display stations or administrative stations. Where an administrative display station is designated to receive outside line calls, the phone shall ring with a unique tone and the outside line number shall appear on the display panel. The option shall also provide the ability to make outside line calls from Administrative Display Stations or Administrative Stations. This ability shall be programmable for each phone and there shall be thirty-two Classes of Service available to any station. This feature shall be capable of supporting DID, DISA, and a Security DISA function.
 - a. Cellular system access for Security is of the utmost concern. Wireless security page offers a password-protected Security DISA feature that shall be accessible only from authorized Police, Fire, Emergency personal or an off-premise security office, which monitors the facility's security system. It shall function as follows: upon confirmation of the password DISA number, the system shall allow security personnel to dial access any station and monitor the activity without pre-announce tone or the privacy tone. This will then allow the security office to determine exactly what the conditions are in the station and the actions need to be taken.
13. The system shall provide for field-programmable three-, four-, five-, or six-digit architectural station numbers.
14. There shall be an automatic level control for return speech during amplified-voice communications.
15. Each station loudspeaker shall be assignable to any one, any combination, or all of 64 Multi-purpose zones or any of the 16,000 hard-wired zones per facility.
 - a. Each station loudspeaker shall be assignable to any one, any combination, or all of 64 Multi-purpose zones. Systems with less than 64 Multi-purpose zones shall not be acceptable.
16. There shall be thirty-two (32) Flexible Time-Signaling Schedules with a total of 1024 user-programmed events per facility. Each event shall sound one of user-selected tones or external audio. It shall be possible to assign each schedule to a day of the week, or manually change schedules from an authorized Quantum Commander User via Web browser. Systems, which do not provide a minimum of thirty-two (32) flexible time-signaling schedules or a choice of eight (8) time tones plus external audio, shall not be acceptable.

17. An internal program clock (with battery backup) shall be included, allowing a total of 1024 user-programmed events per facility. It shall be possible to synchronize the internal program clock with an external master clock. Systems, which do not provide an internal program clock and/or can not synchronize with an external master clock to meet these specifications, are not equal.
 - a. There shall be thirty-two (32) flexible time-signaling schedules. It shall be possible to assign each schedule to a day of the week, or manually change schedules from an authorized Quantum Commander User via Web browser on the LAN.
 - b. The built-in Master Clock **corrects time by accessing the LAN NTP time server.**
 - c. The Quantum Processor is capable of adjusting **the Daylight Savings Time automatically.**
 - d. Each event shall be able to be directed to any one or more of the sixty-four (64) Multi-purpose time-signaling zones.
 - e. Each of the **64 Multi-purpose zones** shall have a programmable "tone duration" unique unto itself. For example: the gymnasium shall receive a time tone for ten (10) seconds while the rest of the facility receives a tone for five (5) seconds.
 - f. Each event shall sound one of eight (8) user-selected tones or external audio. Each event may utilize a different custom tone. It shall be utilized to send the gymnasium, shop classes, and pool (if necessary), a separate time tone to indicate "clean up." Minutes later the entire facility can then receive the same time tone to indicate class change.
 - g. Each of the eight (8) Distinct Time Tone Signals may be manually activated by selected Administrative Display Phones or an authorized Quantum Commander User via web-browser. These tone signals shall remain active as long as the telephone remains off-hook, or until canceled from the keypad or Quantum Commander.
 1. Upon picking up the receiver and dialing "9", a menu shall appear on the display prompting the user to enter the next digit. In this way, the user shall not be required to memorize complicated key sequences in order to access manual time-tone functions.
 2. Systems that do not provide at least thirty-two (32) flexible time signaling schedules or do not provide automatic activation of schedules shall not be acceptable.
18. There shall be a zone-page/all-page feature that is accessible by selected administrative VoIP phones and administrative phones.
 - a. There shall be automatic muting of the loudspeaker in the area where a page is originating.
 - b. There shall be a pre-announce tone signal at any loudspeaker selected for voice paging.
19. There shall be a voice-intercom feature that is accessible by selected administrative phones, administrative VoIP phones and all administrative display phones.

- a. There shall be a periodic privacy tone signal at any loudspeaker selected for amplified-voice communication.
 - b. There shall be a pre-announce tone signal at any loudspeaker selected for voice-intercom communication.
 - c. Privacy and pre-announce tone signals shall be capable of being disabled during system initialization.
 - d. There shall be an automatic switchover to private telephone communication should the person at the loudspeaker pick up his handset.
 - e. By picking up the receiver and dialing the first digit of the number of the station to be called, that number shall appear on the display along with a loudspeaker symbol, prompting the user to enter the next digits. There shall be no confusion as to the type of conversation that is to be established.
20. There shall be a telephonic communication feature, which is accessible by all Administrative VoIP Phones, Administrative Phones, and Administrative Display Phones.
- a. There shall be an audible ring signal announcing that a call has been placed to that station.
 - b. Upon picking up the receiver and dialing * (star), a telephone symbol shall appear on the display, prompting the user to enter the number of the station to be called. There shall be no confusion as to the type of conversation that is to be established.
 - c. There shall be an automatic disconnect of Staff Handsets left off-hook to prevent them from tying up communications channels. The station shall receive a busy signal and shall automatically disconnect after 45 seconds. Systems shall also be capable of doing off hook emergency call-in.
 - d. There shall be an automatic disconnect of Administrative Display Phones and Administrative Phones to prevent them from tying up communications channels. When a phone goes off-hook and does not initiate a call within ten seconds, the station shall receive a busy signal and shall automatically disconnect after 45 more seconds.
 - e. Staff and Administrative Phone Stations may be programmed to ring an Administrative Display Phone during day hours and another Administrative Display Phone during night hours. Day and Night Hours shall be user-programmable. Assignment of Staff Stations shall not be restricted to any particular Administrative Station. Systems that limit the number and assignment of staff call-in to particular Administrative Display Station of Administrative Stations shall not be acceptable.
21. Each staff call station shall be programmable for one of three call-in types, as follows:

Normal / Emergency
Urgent / Emergency
Emergency

- a. Staff Call Stations programmed for access Normal / Emergency or Urgent / Emergency shall be able to initiate an emergency call by repeated flashing of the hook switch or repeated pressing of the call-in switch. Systems, which require additional switches and/or conductors to initiate an emergency call, shall not be acceptable.
 - b. Emergency Calls from Administrative VoIP Phones, Administrative Phones or Staff Call Switch Stations shall interrupt a non-emergency call in progress at the designated Administrative Display Phone. The administrator shall receive a warning tone and be connected to the emergency caller. The disconnected party shall receive a busy signal. Systems which do not provide emergency call interrupt shall not be acceptable.
 - c. It shall be possible to connect a single push emergency call-in switch to any Administrative Phone, without effecting normal station operation. This feature is not available with the Administrative VoIP Phone.
 - d. Normal and Urgent calls shall be logged into queue for the designated administrative display phones.
 - e. Administrative Display Phones shall ring for a period of 45 seconds when they receive a call, and then stop ringing.
 - f. Each queue shall first be sorted according to call priority (emergency calls, then urgent calls, and then normal calls). Calls are sorted within each priority level on a first-in, first-out basis. When a call is answered, it shall automatically be removed from the queue. Systems, which do not sort calls according to priority and order received, shall not be acceptable. 1) The display shall simultaneously show up to four (4) Staff Call Switch Station Calls pending. Additional calls, beyond four (4), shall be indicated by an arrow pointing down thus prompting the user that additional calls are waiting.
 - g. It shall be possible to answer any incoming call simply by picking up the handset while it is ringing. It shall not be necessary to hit any buttons to answer a call unless the call has dropped into the queue.
22. Administrative VoIP Phones shall receive dial tone upon going off-hook. Outgoing calls are made by dialing the desired station. Incoming calls can be directed to the telephone or to the associated loudspeaker for a hands-free reply. There shall be a switchover from loudspeaker to private telephone communication when a person picks up the handset and dials ##### and enter (check mark).
- a. Administrative VoIP Phones shall be able to make a normal call to any Administrative Display Phone by dialing the number. They shall also be able to initiate an Emergency Call by dialing ****. Emergency Calls shall ring the Designated Day/Night Administrative Display Phone. The system shall provide for each station to have a PIN Numbers. By dialing the PIN at any system telephone, the administrator shall have access to emergency paging regardless of the restrictions on the particular phone being used.
23. Administrative Phones MCESS or MCWESS shall receive dial tone upon going off-hook. Outgoing calls are made by dialing the desired station. Incoming calls can be directed to the telephone or to the associated loudspeaker for a hands-free reply. There shall be an automatic switchover from loudspeaker to private telephone communication should the person pick up the handset.

- a. Administrative Phones shall be able to make a normal call to any Administrative Phone by dialing the number. They shall also be able to initiate an Emergency Call by flashing the hook switch four times. Emergency Calls shall ring the Designated Day/Night Administrative Display Phone and then their speaker will be connected to the emergency link station if not answered within a predetermined time period. The system shall provide for each station to have a PIN Numbers. By dialing the PIN at any system telephone, the administrator shall have access to emergency paging regardless of the restrictions on the particular phone being used.

24. Student Phone

- a. Student Phone shall be supported. The Student Phone can only make 10-digit (7 digit or less than or equal to 10 digit), 0 local and 911 calls. The call duration shall be set to 5 minutes. The dial tone shall be fed momentarily at 00:04:30, 00:04:40, 00:04:50, then at five minutes, calls are disconnected. The student phone can not receive any incoming calls.
- b. The Station is not allowed to dial the same number within 30 minutes and a busy signal shall be fed to the Station if the number is dialed.

25. Administrative Display Phones shall be equipped with a 4x16 character alphanumeric display panel.

- a. Administrative Display Phones shall receive dial tone upon going off-hook. Outgoing calls are made by dialing the desired stations. Incoming calls can be directed to the telephone or to the associated loudspeaker for a hands-free reply. There shall be an automatic switchover from loudspeaker to private telephone communication should the person pick up his handset.
- b. The display shall normally show the time of day and day of week, the current time signaling schedule, and the numbers of up to four stations calling in along with the call-in status of each station (normal, urgent, emergency). When dialing from the Administrative Display Phone, the display shall indicate the station number and type of station (loudspeaker or handset) being dialed.
- c. The display shall also provide user-friendly menu selections to assist the operator when paging and distributing program material. Displays shall be in English with internationally recognized symbols for maximum ease of use. Systems, which require the operator to memorize long lists of operating symbols or control codes, shall not be acceptable.
- d. Administrative Display Phones shall be programmable for one of 3 station types for system access, as follows:
 - 1. Shall permit dialing any station in the system; turn program material on/off at their location; scroll, erase and auto-dial call-waiting queue; make conference calls and transfer calls; call forward to other administrative stations; make all-zone pages and emergency all-zone pages; have access to outside lines and be designated to receive outside line calls.

2. Select and distribute or cancel program material to any combination of stations, paging zones, or all zones; set/reset alarm/external functions and zone paging.
 3. Bump or join a conversation in progress, manually initiate time tones.
 - e. Program selection, and its distribution or cancellation shall be accomplished from a designated administrative display telephone, with the assistance of the menu display system. Distribution and cancellation shall be to any one, or combination of speakers, or any zone(s), or all zones. It shall be possible to provide three program channels at the same time.
 - f. It shall be possible, via an Administrative Display telephone, to manually initiate any of eight (8) tones or any of the emergency tones. The tones shall be separate and distinctly different from the emergency tones. The tone selected shall continue to sound until it is canceled, or until the administrative display phone is placed back on-hook.
 - g. Each Administrative Display Phone shall maintain a unique queue of all stations calling that particular phone.
26. System programming shall be from an authorized Quantum Commander User via Web browser. All system programming data shall be stored in nonvolatile memory. A valid username and password shall be required to gain access to the following programmable functions:
- a. Station Initialization shall be accomplished from an authorized Quantum Commander User via web browser. All station initialization data shall be stored in nonvolatile memory. A password (separate from the password necessary for system programming) shall be required to gain access to the following station initialization parameters:
 - i. Programming and diagnostics shall be built into the Quantum Commander web server browser and be accessible only by authorized personnel. Diagnostics shall indicate passes and failures of system memory, system clock, all audio busses, tone generators, DTMF generators and decoders and the integrity of the field wiring.
 - ii. Systems not capable of supporting web-based diagnostics and any computer interface for programming and diagnostics, nor supportive of built-in diagnostics for the end user shall not be deemed as equal.**
27. Rollover EOL (End-Of-Line Device)
- a. This feature shall be supported for all the Stations (Admin Display/Admin VoIP/Admin) configured with a loudspeaker. Based on the dialed sequence, (*xxx, xxx) the call will be connected to the corresponding station/speaker. If the speaker/station is busy, the call is rolled over to the station/speaker corresponding to that station.
 - b. If a handset station, configured with this feature, is busy when an Admin User calls the station, the call shall be rolled over to the associated speaker. If the speaker is also busy in this case, then the Admin call can bump the conversation.

- c. Rollover End-of-Line features not applicable with the Station with Call Switch or Station without the speaker.
- d. For calls initiated by a call switch or a non-dial handset, rollover to the admin speaker shall not happen.

28. Admin AAA Group (Always An Answer)

- a. This is an Administrative Display Phone feature. This feature shall be programmed from the Bogen Commander. A maximum of 10 Administrative Display Phones will be supported in an Admin Group and there shall be a maximum of 32 Admin Groups per facility. Administrative Display Phones assigned to an Admin Group cannot also be assigned as day or night admin phones for any stations in the system.
- b. Once the Admin Group is set:
 - 1. For normal calls, if the primary Day/Night Admin Phone is busy/no answer, all the phones in the Admin Group shall ring.
 - 2. For emergency calls, if the primary day/night phone does not answer, all the phones in the Admin Group shall ring.
 - 3. On no answer from any of the admin phones and if the emergency announce link is configured, the call shall be transferred to the emergency announce link as per the existing procedures. Administrative VoIP Phones do not have the emergency announce link functionality.
 - 4. On answer from any of the Admin Group Phones, all the other phones shall stop ringing.

2.3 EQUIPMENT:

A. CONSOLE

- 1. Rack-mounted equipment shall be Bogen Model TCPER
 - a. 77" Rack (Lowell model L262-77)
- 2. MCRMP / MCMP / QRC24-48 (Compact Rack System)

Rack Mount full, Mini-System, or Wall Mount panel. Shall include the following components:

Quantum Processor Card QSPC1
 Analog Cards
 Station Cards
 Telephone Interface Cards (for eight phone connections)
 5 volt / 12 volt Power Supply
 26 volt Power Supply(s)
 Audio Program Module Interface Assembly

3. MCRMF / MCMF / QRC24-48

- a. MCRMF Rack mounting mainframe. Includes built-in ventilation fans and the following circuit cards:
 - Quantum Processor Card
 - Analog Card
 - Station Card
 - Telephone Interface Card
 - Ribbon Cable Assembly
- b. MCMF Wall Mount mounting mainframe. Utilizes convection cooling and the following circuit cards:
 - Quantum Processor Card
 - Analog Card
 - Station Card
 - Telephone Interface Card
- c. QRC24 / QCR48 Compact Quantum Rack System Mainframe (1 per Mini-System). Includes built-in ventilation fan and the following circuit cards:
 - Quantum Processor Card
 - Analog Card
 - Station Card
 - Telephone Interface Card

4. MCRRP / MCRRC / MCRC

- 1. Relay Module/Card

5. MCRCA

- a. Ribbon Cable Assemblies

6. Program Sources

- a. Install one (1) AM/FM/Compact Disc unit w/ Aux-In Capability

7. Power Amplifiers (as required)

- a. 60-Watt Amplifier
- b. 125-Watt Amplifier
- c. 250-Watt Amplifier

8. Station Equipment (as required)

- a. Administrative Display Phone
- b. Administrative VoIP Phone
- c. Administrative Wall-Mount Phone
- d. Administrative Desktop Phone

2.4 COMPONENTS AND DESCRIPTIONS:

- A. The Quantum Multicom IP must be capable of supporting the existing Multicom 2000 hardware and functions as well as the new features across the Quantum Processor's interfaced over the LAN. The VoIP capabilities of the QSPC1 Quantum Processor Card will enable the support of the features across the various processors' nodes. The sections below cover how the system will handle each of the existing and the new features in the QSPC1 product. Systems that do not allow the reuse of existing equipment or are not backwards compatible shall not be deemed acceptable. **Systems that don't allow processors to be seamlessly integrated via the LAN are not considered equal.**
- B. Quantum Multicom IP
1. The Quantum facility shall have a minimum of one node/processor and a maximum of 64 interconnected nodes/processors. A maximum of 99 facilities can be interconnected into a district.
 2. The station numbers, program buses, etc. shall be identified with a QSPC1#, Station card# and port# or QSPC1#, program#.
 3. Audio Information will be transmitted between the processors on the LAN using VoIP technology. Quantum will utilize all of the existing Multicom 2000 hardware except the current processor card. Thus making Quantum Multicom IP backwards-compatible with existing Multicom 2000 systems.
 4. The processor software shall be upgradeable via Quantum Commander. The Quantum automatically reboots after it installs the software upgrade. If for some reason the newly installed software will not boot properly, the system shall revert to the previous working load.
 5. It shall be possible for Quantum schools to exchange 'station-to-station' calls and 'inter-facility All-Call paging' to a single facility or all facilities in a district using VoIP technology.
 6. The primary QSPC1 shall be configured to act as a Gateway for facility point-to-point calls. Using Quantum Commander, every facility shall be configured with the IP addresses of the primary QSPC1 systems of all the other known facilities (maximum of 98 additional), and an organizationally private multicast IP address (i.e. 239.x.y.z series), which shall be used for inter-facility paging.
 7. The maximum number of simultaneous inter-facility point-to-point calls supported is based on the actual performance of the network and the CPU load. The voice quality of the inter-facility calls may vary based on the network conditions.
 8. The system shall facilitate the playing of short audio clips repetitively played until stopped by the Quantum Commander User or administrative display phone MCDS4 whichever occurs earlier.
 9. A built-in Master Program Clock, with battery backup, shall be included to automatically control class change or other signals. The Master Program Clock shall have 1024 events that may be programmed into any of the 32 time signaling schedules, and/or 32 flexible holiday schedules. Systems that rely on external master clock shall not be considered equivalent.

10. Network Time Synchronization. The system shall be capable of periodic update/synchronization of the processor's time with a Network Time Server via the school's LAN network. Systems that do not provide Network Time Synchronization will not be deemed equivalent.

C. Quantum Commander

1. **The processor utilizes a web-based programming tool.** The Quantum Commander is built into the QSPC1 processor card and upon boot up, users can login to the Quantum Commander Web Server via their web browser.
2. The Quantum Commander shall be broken into three access levels depending on user access credentials. Systems that do not provide at least three (3) levels of access are not equal.
3. Only the Administrator and Technician shall have access to add/delete/modify the database objects.
4. Users shall have display only access to see the data objects that include configuration, alarms, and performance data and perform certain operations based on the user's CoS (Class of Service).

D. Administrative Display Phone

1. Administrative Display Phones shall be Bogen Model MCDS4. The administrative telephone display panel shows the time of day and day of week, the current time signaling schedule, and the station numbers and call-in priority of staff stations that have called that particular station. A 3-key response is used to scroll the display, and answer or erase normal, urgent, and security calls. Depending upon the system programming, an administrative station can use display menus to activate zone pages, alarm signals and external functions, as well as select program sources and distribute or cancel a program to any or all speakers or zones.
2. Administrative Display Phones shall have the ability to dial and have the option of dialing either the loudspeaker or phone at each station location. The system shall automatically switch from phone-to-intercom communication to phone-to-phone communication when the staff handset or enhanced staff phone on the receiving end of the call is lifted.
3. The Administrative Display Phone shall display the classroom number of any station that calls 911. This feature will notify the main office when a classroom has dialed 911 emergency centers so that administrators can direct emergency personnel to the correct physical location in the building when they arrive. Systems that do not provide this feature will not be deemed equal.

E. Administrative Wall Display

1. Administrative wall display shall be a Bogen Model MCWD. The wall display shows the time of day, current time signaling schedule that is running, and the station numbers and call-in priority of call switches, and emergencies from Administrative VoIP Phone and Administrative Phones.

2. The Administrative Wall Display shall display the classroom number of any station that calls 911. This feature will notify the main office when a classroom has dialed the 911 emergency centers so that administrators can direct emergency personnel to the correct physical location in the building when they arrive. Systems that do not provide this feature will not be deemed equal.

F. Administrative Phone

1. Classroom phones shall be one of the following Bogen Model(s)
2.
 - a. MCWESS – Administrative Wall Phone.
3. The Station goes Off-Hook and dials the 3- to 6-digit (preceded by an * if calling a telephone instead of loudspeaker) number of the desired station. The call is routed to any station (admin/staff). The classroom phone shall be capable of the following features:
 - a. Emergency Call involves going off hook and flash hook the switch at least four times. The Call is then switched to the assigned Admin Phone. This requires the display of the architectural number on the Administrative Display phone and or Wall Display. Systems that do not provide this feature are not equivalent.
 - b. Alarm Distribution
 - c. Audio Program toggle On/Off
 - d. Call Forward activation for All-Calls/Busy/No Answer/Busy or No Answer
 - e. Cancel Call Forward
 - f. Conference Calling
 - g. Transfer Call
 - h. Dial administrative display phone, dial the station number to call to the speaker or dial the station number preceded with * to call the phone. The call shall be routed to the administrative display phone and/or administrative wall display showing the architectural number that is calling.
 - i. Emergency All-Call shall be broadcasted to all the stations in the facility.
 - j. Place Outside Call
 - k. Remote Answer
 - l. Single-Zone/All-Station Page
 - m. Call Waiting Tone for Outside Calls, and it shall be possible to feed the call waiting tone to the Administrative Phone during a conversation.

G. Intercom System Speakers

2. Classroom Speakers shall be Bogen:
 - a. Ceiling Speakers: CSD2X2VR Drop-In Ceiling Speakers
 - b. Wall Speakers: WBS8T725V Metal Box Speakers
3. Hallway Speakers shall be Bogen:
 - a. Ceiling Speakers: CSD2X2VR Drop-In Ceiling Speakers
 - b. Wall Speakers: MB8TSQ/SL Metal Box Speakers
4. Outdoor / Gym / Locker Room Speakers shall be Bogen:
 - a. FMH15T mounted in BBSM6 surface-mounted vandal-resistant enclosure/BBFM6 flush-mounted vandal-resistant enclosure with FMHAR8 adapter ring and SGHD8 heavy duty grille
 - b. KFLDS30T Wide Dispersion Reentrant Horn Loudspeakers

H. Quantum Commander

2. The processor utilizes a web-based programming tool. The Quantum Commander is built into the QSPC1 processor card, and upon boot up, user can login to the Quantum Commander Web Server.
3. The Quantum Commander shall be broken into three access levels depending on user access credentials. Systems that do not provide at least three (3) Levels of access are not equivalent. The three levels are:
 - a. User
 - b. Administrator
 - c. Technician
4. Only the Administrator and Technician shall have access to add/delete/modify the database objects.
5. Users shall have display only access to see the data objects that include configuration, alarms, and performance data and perform certain operations based on the user's CoS (Class of Service).
6. The following Menu Items must be available on the Multicom IP Quantum Commander:
 - a. File - Open Database, New System, Save, Delete, Report and Exit, Upload Database, Download Database, Download Software, Diagnostics, Tones and Announcements, Relay Configuration, Program Distribution, Media Assignment, List Passwords, Add Password, and Change Password.

2.5 CONDUCTORS:

- A. All classrooms, staff rooms, and locations other than hallways that require a station shall be home run using Belden 5500FE.

2.6 SURGE SUPPRESSION:

- A. Provide surge suppression protectors for any intercom cables that enter from outside the building.

PART 3 - EXECUTION

3.1 DIVISION OF WORK:

- A. While all work included under this specification is the complete responsibility of the contractor, the division of actual work listed following shall occur.
- B. The conduit, outlets, terminal cabinets, etc., which form part of the rough-in work shall be furnished and installed completely by the electrical contractor. The balance of the system, including installation of speakers and equipment, making all connections, etc., shall be performed by the manufacturer's authorized representative. The entire responsibility of the system, its operation, function, testing and complete maintenance for one (1) year after final acceptance of the project by the owner, shall also be the responsibility of the manufacturer's authorized representative.

3.2 EQUIPMENT MANUFACTURER'S REPRESENTATIVE:

- A. All work described herein to be done by the manufacturer's authorized representative shall be provided by a documented factory authorized representative of the basic line of equipment to be utilized.
- B. The manufacturer's representative shall have completed at least ten (10) projects of equal scope, giving satisfactory performance and have been in the business of furnishing and installing sound systems of this type for at least five (5) years. The manufacturer's representative shall be capable of being bonded to assure the owner of performance and satisfactory service during the guarantee period.
- C. The manufacturer's representative shall provide a letter with submittals from the manufacturer of all major equipment stating that the manufacturer's representative is an authorized distributor. This letter shall also state the manufacturer guarantees service performance for the life of the equipment, and that there will always be an authorized distributor assigned to service the area in which the system has been installed.
- D. The contractor shall furnish a letter from the manufacturer of the equipment, which certifies that the equipment has been installed according to factory intended practices, that all the components used in the system are compatible and that all new portions of the systems are operating satisfactorily. Further, the contractor shall furnish a written unconditional guarantee, guaranteeing all parts and all labor for a period of one (1) year after final acceptance of the project by the owner.

3.3 INSTALLATION:

- A. Cabling shall be routed as high as possible and above other building facilities in the path with the least obstructions in the ceiling space while maintaining the separation requirements of TIA/EIA 568B1,2,3, TIA/EIA 569A, and NFPA 70 (NEC). There shall be a minimum distance of three inches between the cable and ceiling grid and cable

pathways shall be clear of all possible EMF and RFI interference. Specifically cables shall be at least 2 feet away from all fluorescent lights and other potential EMF sources. Any violations of this shall be corrected at the contractor's expense. Cables shall not be run parallel with electrical conduits or strapped to them. Cinch plastic cable ties shall not be used during any part of the installation process. All cabling required to support the system shall be terminated in an approved manner and not be "cut back" to the cabling sheath or "wrapped" around the cabling sheath. Interconnect between the system and the station cabling shall be terminated in a cross connect method.

- B. Cabling installed through "holes, cracks, HVAC duct spaces, etc." is not acceptable and shall be properly sleeved.
- C. Cabling shall be installed appropriately within a sleeve when wall penetrations are required. If using an existing sleeve, contractor is responsible for maintaining any fire stopping system and requirements for fill ratio of sleeve. If existing sleeve is not fire stopped, contractor shall notify owner for direction or install the appropriate sleeve for the installation of the contractor's cable.
- D. Cable Identification:
 - 1. All wires shall be permanently identified at each wire end utilizing a self-laminated wire or cable marker comprised of a white label with black lettering and clear laminate area, in a manner approved by the Owner.
- E. Splicing:
 - 1. Splicing of cables is not permitted between terminations.
- F. Wall and Floor Penetrations:
 - 1. All penetrations through floors and walls shall be sleeved. All sleeves shall have permanently installed bushings.
 - 2. Sleeves shall be sized to accept 50% growth.
 - 3. All sleeves shall installed per manufacturer's instructions and shall protrude 3 inches on each side of the penetration.
 - 4. Sleeves through floors shall be supported with conduit riser clamp.
 - 5. Existing sleeves can be used with the following exceptions:
 - a. Use of any sleeve containing emergency signaling cable is prohibited
 - b. Using any sleeve, when doing so would exceed 40% fill ratio, is prohibited.
- D. Firestopping:
 - 1. Firestopping material shall be installed inside all riser conduit sleeves to form smoke barriers after installation of the cabling is completed. Malleable foam-type bricks cut to fit should be used where possible (Hilti FS-fire block, or

equal). Intumescent putty shall be used in an UL approved assembly when fire bricks are not feasible.

E. Cable Installation:

1. Do not pull wire or cable through any box fitting or enclosure where change of raceway alignment or direction occurs; do not bend conductors to less than recommended radius. Employ temporary guides, sheaves, rollers, and other necessary items to protect cables from excess tension, abrasion, or damaging bending during installation. Care shall be taken not to bend, crush or kink cables.
2. All cable shall be installed in a complete, neat, and orderly fashion. Cables shall not be twisted or have any damage to the cable jacket.
3. Cables shall be installed parallel or at 90 degree angles to the building walls. Diagonal, beeline, or non-supported cable routing is unacceptable.

F. Equipment Cabinets or Racks:

1. Comb straight and form in a neat and orderly manner all conductors located within equipment cabinets in the head end room or remote locations, and wiring harnesses in the head end room. Tie as required using Velcro cable ties of appropriate type and size.
2. Service Loops:
 - a. Provide 10 foot service loops at each termination so that plates, panels, and equipment can be dismounted for service and inspection.

G. Plug disconnect: All major equipment components shall be fully pluggable by means of multi-pin receptacles and matching plugs to provide for ease of maintenance and service.

H. Protection of cables: Cables within terminal cabinets, equipment racks, etc., shall be grouped and bundled (harnessed) as to type and laced with No. 12 cord waxed linen lacing twine or velcro. Edge protection material ("cat-track") shall be installed on edges of holes, lips of ducts or any other point where cables or harnesses cross metallic edge.

I. Cable identification: Cable conductors shall be color-coded and individual cables shall be individually identified. Each cable identification shall be a unique number located approximately 1-1/2" from cable connection at both ends of cable. Numbers shall be approximately 1/4" in height. These unique numbers shall appear on the As-Built Drawings provided by the installer and these drawings shall be mounted in each equipment room used to support any part of the entire system.

J. Shielding: Cable shielding shall be connected to common ground at point of lowest audio level and shall be free from ground at any other point. Cable shields shall be terminated in same manner as conductors.

3.4 TRAINING:

- A. Provide a minimum of eight (8) hours of complete "in service" instructions of system operation to school personnel. Assist in programming of telephone system.

- B. Installer shall provide programming documentation that reflects the relation to each port, station identifier, and physical location of station.

END OF SECTION

SECTION 28 1300

VIDEO INTERCOM AND ACCESS CONTROL SYSTEM

PART 1 -GENERAL

1.1 SECTION INCLUDES

- A. Hands-free color video system with pan, tilt, and zoom.

1.2 REFERENCES

- A. ISO 9001:2008 – Quality Management Systems – Requirements.

1.3 SYSTEM DESCRIPTION – HANDS-FREE COLOR VIDEO INTERCOM MASTER MONITOR STATION

A. Answering Door Call in Hands-Free Mode:

1. Press CALL button.
2. Chime tone sounds, caller is seen on video monitor, and outside sound is heard.
3. Audio and video turn off after approximately 45 seconds if not answered.
4. Press TALK button momentarily, and after beep, communicate hands free. Red transmit LED lights when you talk, and goes off as you listen to caller or hear outside sounds.
5. After finishing communication, press OFF button and communication will end after beep.

B. Answering Door Call in Press-to-Talk (PTT) Mode:

1. Press CALL button.
2. Chime tone sounds, caller is seen on video monitor, and outside sound is heard.
3. Audio and video turn off after approximately 45 seconds if not answered.
4. Press and hold TALK button for minimum of 1 second. Beep sounds, and after approximately 1 second another beep sounds, which indicates PTT mode is engaged. If TALK button is pressed less than 0.5 seconds, PTT mode is not engaged.
5. When communicating, keep TALK button pressed. To hear caller's voice, release TALK button.
6. After finishing communication, press OFF button and communication will end after beep.

C. Instant-Voice-Call Function:

1. Press CALL button.
2. Even without answering, door area can be seen and heard with video and audio for approximately 45 seconds. Inside sound is not heard outside.

D. Activating Door Release:

1. Press DOOR RELEASE button.
2. Open door while release mechanism is activated. During release, red DOOR RELEASE LED flashes.

E. Entrance Monitoring:

1. Press MONITOR button in standby mode.
2. Video monitor displays image from door station and incoming audio is heard. If you do not press TALK button, caller will not hear sounds from inside station.

-
3. Press OFF button to end communication.
- F. Room-to-Room Communication:
1. Press CALL button to talk with other person.
 2. Call-in is sent to sub master station.
 3. Reply of other person is not heard.
 4. If other person presses TALK button, hands-free communication is possible.
 5. Press and release OFF button to end communication.
- G. Wide/Zoom Switching:
1. Press ZOOM/WIDE button when picture is displayed.
 2. Switching between wide and zoom occurs each time button is pressed.
- H. Pan/Tilt Operation:
1. When zoom picture is displayed, press UP, DOWN, LEFT, and RIGHT buttons.
 2. Moving diagonally is also possible.
- I. Zoom Picture Preset:
1. Picture can be set to display using set zoom picture position for when call is received from door station.
 2. When switching from wide picture to zoom picture, zoom picture displays at preset position.
 3. When zoom picture is displayed, press UP, DOWN, LEFT, and RIGHT buttons.
 4. While viewing picture, set desired picture position.
 5. Press ZOOM/WIDE button for minimum of 2 seconds.
 6. Beep will sound and position setting will be completed.
- J. Night Illumination:
1. At night, door station illuminator LED lights up during calling or communication.
 2. When Call is Made from Door Station:
 - a. If CALL button of door station is pressed, illuminator LED lights up.
 - b. When communication ends, illuminator LED will go out.
 3. Light Up Illuminator LED During Entrance Monitoring:
 - a. When TALK button is pressed during entrance monitoring, communications starts and illuminator LED will light up.
 - b. Inside sound can be heard at entrance.
 - c. When communication ends, illuminator LED will go out.
- K. Backlight Adjustment, Night Sensitivity Adjustment:
1. To perform adjustment, press ADJUST button when image is difficult to see. Automatic adjustment to more visible screen is performed.
 2. To cancel adjustment, press ADJUST button during adjustment.
- L. Automatic Recording:
1. If a call is received from video door station, unit starts recording automatically.

-
2. Red record LED flashes during recording.
 3. Recording starts approximately 2 seconds after CALL button of video door station is pressed.
 4. Maximum length of approximately 6 seconds (6 shots) can be recorded, with 1 picture and 1 shot for each second.
 5. Maximum of 40 images can be recorded (combined total of automatic recording and manual recording images).
 6. If 40 images are exceeded, images are overwritten starting from image with oldest recording date.
 7. Initial setting is for recording to be done with first 3 pictures as zoom pictures at a preset position, and next 3 pictures as wide pictures.
- M. Manual Recording:
1. Display video image with operation such as entrance monitoring.
 2. Press REC button. Red record LED flashes 6 times and recording starts.
 3. Maximum length of approximately 6 seconds (6 shots) can be recorded, with 1 image and 1 shot for each second.
 4. Maximum of 40 images can be recorded (combined total of automatic recording and manual recording images).
 5. When 40 images are exceeded, new images overwrite old images starting from oldest recorded date.
- N. Play Recorded Picture:
1. Press PLAY button in standby mode to display picture with most recent date.
 2. Press PLAY button on play-waiting screen. Recorded image is played. When play of 1 image ends, next image is displayed.
 3. To advance play screen frame-by-frame, press PLAY button during playback to pause. Play moves forward frame-by-frame each time DOOR RELEASE button is pressed. When frames of 1 image end, next picture is displayed.
 4. Press OFF button to end.
- O. Save Recorded Picture:
1. Display picture that you want to save in play-waiting screen. Press MENU button to display save/erase selection screen.
 2. Press PLAY button. If image is saved, key symbol is displayed. If image has already been saved, save is cancelled. Each time PLAY button is pressed, operation switches between save and cancel.
- P. Erase Recorded Picture:
1. Display picture that you want to erase in play screen. Press MENU/MEMO button to display save/erase selection screen.
 2. Press MENU button to erase.
 3. Press REC button to stop erasing.
 4. Once picture is erased, it cannot be restored.

1.4 SYSTEM DESCRIPTION – HANDS-FREE COLOR VIDEO INTERCOM SUB MONITOR STATION

A. Answering Door Call in Hands-Free Mode:

1. Press CALL button.
2. Chime tone sounds, caller is seen on video monitor, and outside sound is heard.
3. Audio and video turn off after approximately 45 seconds if not answered.
4. Press TALK button momentarily, and after beep, communicate hands free. Red transmit LED lights when you talk, and goes off as you listen to caller or hear outside sounds.
5. After finishing communication, press OFF button and communication will end after beep.

B. Answering Door Call in Press-to-Talk (PTT) Mode:

1. Press CALL button.
2. Chime tone sounds, caller is seen on video monitor, and outside sound is heard.
3. Audio and video turn off after approximately 45 seconds if not answered.
4. Press and hold TALK button for minimum of 1 second. Beep sounds, and after approximately 1 second another beep sounds, which indicates PTT mode is engaged. If TALK button is pressed less than 0.5 seconds, PTT mode is not engaged.
5. When communicating, keep TALK button pressed. To hear caller's voice, release TALK button.
6. After finishing communication, press OFF button and communication will end after beep.

C. Instant-Voice-Call Function:

1. Press CALL button.
2. Even without answering, door area can be seen and heard with video and audio for approximately 45 seconds. Inside sound is not heard outside.

D. Activating Door Release:

1. Press DOOR RELEASE button.
2. Open door while release mechanism is activated. During release, red DOOR RELEASE LED flashes.

E. Entrance Monitoring:

1. Press MONITOR button in standby mode.
2. Video monitor displays image from door station and incoming audio is heard. If you do not press TALK button, caller will not hear sounds from inside station.
3. Press OFF button to end communication.

F. Room-to-Room Communication:

1. Press CALL button to talk with other person.
2. Call-in is sent to master monitor station.
3. Reply of other person is not heard.
4. If other person presses TALK button, hands-free communication is possible.
5. Press and release OFF button to end communication.

G. Wide/Zoom Switching:

-
1. Press ZOOM/WIDE button when picture is displayed.
 2. Switching between wide and zoom occurs each time button is pressed.
- H. Pan/Tilt Operation:
1. When zoom picture is displayed, press UP, DOWN, LEFT, and RIGHT buttons.
 2. Moving diagonally is also possible.
- I. Night Illumination:
1. At night, door station illuminator LED lights up during calling or communication.
 2. When Call is Made from Door Station:
 - a. If CALL button of door station is pressed, illuminator LED lights up.
 - b. When communication ends, illuminator LED will go out.
 3. Light Up Illuminator LED During Entrance Monitoring:
 - a. When TALK button is pressed during entrance monitoring, communications starts and illuminator LED will light up.
 - b. Inside sound can be heard at entrance.
 - c. When communication ends, illuminator LED will go out.
- J. Backlight Adjustment, Night Sensitivity Adjustment:
1. To perform adjustment, press ADJUST button when image is difficult to see. Automatic adjustment to more visible screen is performed.
 2. To cancel adjustment, press ADJUST button during adjustment.
- K. If Optional Units Installed:
1. When separately installed sensor detects malfunction or CALL button is pressed, alarm sound occurs and red transmit LED flashes.
 2. Press OFF button to stop alarm sound.
- 1.5 SUBMITTALS
- A. Comply with Section 01 33 00 – Submittal Procedures.
- B. Product Data: Submit manufacturer's product data, including installation instructions.
- C. Shop Drawings: Submit the following:
1. Wiring Diagrams: Indicate wiring for each item of equipment and interconnections between items of equipment.
 2. Include manufacturer's names, model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts.
- D. Installation and Operation Manuals:
1. Submit manufacturer's installation and operation manual, including operation instructions and component wiring diagrams.
 2. Provide detailed information required for Owner to properly operate equipment.
- E. Warranty: Submit manufacturer's standard warranty.

1.6 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: ISO 9001:2008 certified company.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Storage: Store materials in clean, dry area indoors in accordance with manufacturer's instructions.
- C. Handling: Protect materials during handling and installation to prevent damage.

1.8 WARRANTY

- A. Warranty Period: Two years from date of Substantial Completion.

PART 2 -PRODUCTS

2.1 MANUFACTURER

- A. The equipment specified is based on equipment as manufactured by Aiphone Corporation. A preferred alternate bid will be obtained for Design Basis equipment and components as identified in this specification.
 - 1. Base bid pricing is acceptable with other manufacturers; EntryVue, Nortek, Panasonic, Siedle, and SVAT; whose products meet this specification.
- B. Where equipment is specified herein or on drawings, by manufacturers' names or numbers as a Design Basis, this shall denote minimum requirements as to quality, type, capacity, function, and performance.
 - 1. Where a specific model may have been discontinued, the manufacturer's intended replacement shall be substituted. Such substitutions shall be identified in the submittals.

2.2 VIDEO INTERCOM AND ACCESS CONTROL SYSTEM

- A. Hands-Free Color Video System with Pan, Tilt, and Zoom: Design Basis: Aiphone JP Series.
- B. Hands-Free Color Video Intercom Master Monitor Station: Design Basis: Model JP-4MED.
 - 1. Power: 24 V DC.
 - 2. Current Consumption: 400 mA maximum.
 - 3. Calling: Chime and image, approximately 45 seconds.
 - 4. Communication:
 - a. Hands-Free Mode: Automatic voice activation.
 - b. Handset: Simultaneous communication.
 - 5. Video Monitor:
 - a. 7-inch direct-view TFT color, touchscreen LCD.
 - b. Pixels: 800 x 480.
 - 6. Door Release Contact: 24 V AC/DC, 500 mA (N/O dry closure contact L, L).
 - a. Minimum Contact: 100 mV DC, 0.1 mA.
 - 7. Operating Temperature: 32 deg F to 104 deg F (0 deg C to 40 deg C).
 - 8. Microphone.
 - 9. Multi-color status LED.

-
10. DOOR RELEASE button.
 11. Settings button.
 12. MENU button.
 13. PAN/TILT button.
 14. ZOOM/WIDE button.
 15. ADJUST button.
 16. CALL button.
 17. Option button.
 18. Home button.
 19. TALK button.
 20. OFF button.
 21. MONITOR button.
 22. PLAY button.
 23. RECORD button.
 24. Speaker.
 25. Screen brightness control.
 26. Receive volume control.
 27. Chime tone volume.
 28. SDHC memory card: 64 GB minimum, 95 MB/s minimum.
- C. Hands-Free Color Video Intercom Sub Monitor Station: Design Basis: Model JP-4HD.
1. Power: 18 V DC.
 2. Current Consumption: 200 mA maximum.
 3. Calling: Chime and image, approximately 45 seconds.
 4. Communication:
 - a. Hands-Free Mode: Automatic voice activation.
 - b. Handset: Simultaneous communication.
 5. Video Monitor:
 - a. 7-inch TFT color touchscreen LCD.
 - b. Pixels: 800 x 480.
 6. Operating Temperature: 32 deg F to 104 deg F (0 deg C to 40 deg C).
 7. Microphone.
 8. Settings button.
 9. DOOR RELEASE button.
 10. ZOOM/WIDE button.
 11. ADJUST button.
 12. PAN/TILT button.
 13. CALL button.

14. Option button.
15. TALK button.
16. OFF button.
17. MONITOR button.
18. Speaker.
19. Screen brightness control.
20. Receive volume control.
21. Chime tone volume.

D. Vandal-Resistant Video Door Station: Design Basis: Model JP-DVF-HID.

1. Faceplate: Stainless steel.
2. Flush mount.
3. Microphone.
4. Speaker.
5. Camera:
 - a. Complementary metal oxide semiconductor (CMOS).
 - b. Scanning Lines: 525.
 - c. Minimum Subject Illumination: 5 Lux at 50-cm (1-foot 6-inch) distance.
6. CALL button.
7. Card reader.
8. Vandal resistant.
9. Weather resistant.
10. Operating Temperature: 14 degrees F to 140 degrees F (minus 10 degrees C to 60 degrees C).

2.3 ACCESSORIES

- A. Electric Door Strike: Design Basis: Model HES 1006 Series or door strike suitable for door being released.
 1. 12 V AC, 0.45 A, continuous duty.
 2. 12 V DC, 0.25 A, continuous duty.
- B. Form C Door Release Relay: Design Basis: Model RY-18L.
 1. For 1 door.
- C. DC Power Supply: Design Basis: Model PS-2420UL.
- D. Door Strike Power Supply: Design Basis: Model PS-914.
- E. Desk Mount Stand: Design Basis: Model MCW-S/A.
- F. #18, 2-Conductor Cable: Design Basis: Model 871802.
- G. #18, 4-Conductor Cable: Design Basis: Model 871804.

PART 3 -EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive hands-free color video system with pan, tilt, and zoom.
- B. Notify Architect of conditions that would adversely affect installation or subsequent use.
- C. Do not begin installation until unacceptable conditions are corrected.

3.2 INSTALLATION

- A. Install hands-free color video system with pan, tilt, and zoom in accordance with manufacturer's instructions at locations indicated on the Drawings.
- B. Mount equipment plumb, level, square, and secure.

3.3 ADJUSTING

- A. Adjust hands-free color video system with pan, tilt, and zoom for proper operation in accordance with manufacturer's instructions.

3.4 DEMONSTRATION AND TRAINING

- A. Demonstration:
 - 1. Demonstrate that hands-free color video system with pan, tilt, and zoom functions properly.
 - 2. Perform demonstration at final system inspection by qualified representative of manufacturer.
- B. Instruction and Training:
 - 1. Provide instruction and training of Owner's personnel as required for operation of hands-free color video system with pan, tilt, and zoom.
 - 2. Provide hands-on demonstration of operation of system components and complete system, including user-level program changes and functions.
 - 3. Provide instruction and training by qualified representative of manufacturer.

3.5 PROTECTION

- A. Protect installed hands-free color video system with pan, tilt, and zoom from damage during construction.

END OF SECTION

SECTION 28 1600

INTRUSION DETECTION

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. Intrusion detection systems with communication links to perform monitoring, alarm, and control functions.
 - a. One system is dedicated to the Kitchen zone of the school.
 - b. The other system covers the remainder of the school.
 - 2. Duress / panic alarm system.

1.3 DEFINITIONS

- A. PIR: Passive infrared.
- B. Control Unit: System component that monitors inputs and controls outputs through various circuits.
- C. Protected Zone: A protected premises or an area within a protected premises that is provided with means to prevent an unwanted event.
- D. Standard Intruder: A person who weighs 100 lb or less and whose height is 60 inches or less; dressed in a long-sleeved shirt, slacks, and shoes.
- E. Standard-Intruder Movement: Any movement, such as walking, running, crawling, rolling, or jumping, of a "standard intruder" in a protected zone.
- F. Zone. A defined area within a protected premises. It is a space or area for which an intrusion must be detected and uniquely identified. The sensor or group of sensors must then be assigned to perform the detection, and any interface equipment between sensors and communication must link to master control unit.

1.4 ACTION SUBMITTALS

- A. Product Data: Components for sensing, detecting, and control, including dimensions and data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: Detail assemblies of standard components that are custom assembled for specific application on this Project.
 - 1. Functional Block Diagram: Show single-line interconnections between components including interconnections between components specified in this Section and those furnished under other Sections. Indicate methods used to achieve systems integration. Indicate control, signal, and data communication paths and identify control interface devices and media to be used. Describe characteristics of network and other data communication lines.
 - a. Describe methods used to protect against power outages and transient voltages including types and ratings of isolation and surge suppression devices used in data, communication, signal, control, and ac and dc power circuits.

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2. Device Address List: Coordinate with final system programming.
 3. System Wiring Diagrams: Include system diagrams unique to Project. Show connections for all devices, components, and auxiliary equipment. Include diagrams for equipment and for system with all terminals and interconnections identified.
 4. Details of surge-protection devices and their installation.
 5. Sensor detection patterns and adjustment ranges.
- C. Equipment and System Operation Description: Include method of operation and supervision of each component and each type of circuit. Show sequence of operations for manually and automatically initiated system or equipment inputs. Description must cover this specific Project; manufacturer's standard descriptions for generic systems are unacceptable.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For Contractor.
 - B. Qualification Data: For Installer.
 - C. Field quality-control reports.
 - D. Warranty: Sample of special warranty.
- 1.6 CLOSEOUT SUBMITTALS
- A. Operation and Maintenance Data: For intrusion detection system to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 1. Data for each type of product, including features and operating sequences, both automatic and manual.
 2. Control-unit hardware and software data.
- 1.7 MAINTENANCE MATERIAL SUBMITTALS
- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Intrusion Detection Devices: Furnish quantity equal to five percent of the number of units of each type installed, but no fewer than two of each type.
 2. Fuses: Three of each kind and size.
 3. Tool Kit: Provide three sets of tools for use with security fasteners, each packaged in a compartmented kit configured for easy handling and storage.
- 1.8 QUALITY ASSURANCE
- A. Contractor Qualifications: Licensed as a Burglar Alarm Business with an Alarm Systems Business License by the North Carolina Alarm Systems Licensing Board.
 - B. Installer Qualifications:
 1. Holds a North Carolina Electrical Contractors License in one of the following categories: Unlimited, Limited, Intermediate or SP-Low Voltage.
 2. Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
 3. Registered with a Burglar Alarm Business with an Alarm Systems Business License by the North Carolina Alarm Systems Licensing Board.

- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Control Units, Devices, and Communications with Monitoring Station: Listed and labeled by a
- E. Comply with NFPA 70.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer and Installer agree to repair or replace components of intrusion detection devices and equipment that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. A preferred alternate bid will be obtained for the Design Basis equipment and components as identified in this specification.
- B. Other Manufacturers: Altronis, Bosch, Crow, GE, Optex, Rokonet, Stealth, Visonic.

2.2 FUNCTIONAL DESCRIPTION OF SYSTEMS

- A. Description: Hard-wired, modular, microprocessor-based controls, intrusion sensors and detection devices, and communication links to perform monitoring, alarm, and control functions.
- B. Supervision: System components shall be continuously monitored for normal, alarm, and trouble conditions. Indicate deviations from normal conditions at any location in system. Indication includes identification of device or circuit in which deviation has occurred and whether deviation is an alarm or malfunction.
 - 1. Alarm Signal: Display at master control unit and actuate audible and visual alarm devices.
 - 2. Trouble Condition Signal: Distinct from other signals, indicating that system is not fully functional. Trouble signal shall indicate system problems such as battery failure, open or shorted transmission line conductors, or control-unit failure.
- C. System Control: Control units shall directly monitor intrusion detection units and connecting wiring.
- D. System shall automatically reboot program without error or loss of status or alarm data after any system disturbance.
- E. Response Time: Two seconds between actuation of any alarm and its indication at master control unit.
- F. Circuit Supervision: Supervise all signal and data transmission lines, links with other systems, and sensors from master control unit. Indicate circuit and detection device faults with both protected zone and trouble signals, sound a distinctive audible tone, and illuminate an LED. Maximum permissible elapsed time between occurrence of a trouble condition and indication at master control unit is 20 seconds. Initiate an alarm in response to opening, closing, shorting, or grounding of a signal or data transmission line.
- G. Manual Secure-Access Control: Coded entries at manual stations shall change status of associated protected zone between secure and access conditions.

2.3 SYSTEM COMPONENT REQUIREMENTS

- A. Compatibility: Detection devices and their communication features, connecting wiring, and master control unit shall be selected and configured with accessories for full compatibility with the following equipment:
 - 1. Door hardware specified in Section 087100 "Door Hardware."
- B. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor entry connection to components.
 - 1. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Lines: Listed and labeled by a qualified testing agency for compliance with NFPA 731.
- C. Intrusion Detection Units: Listed and labeled by a qualified testing agency for compliance with UL 639.
- D. Interference Protection: Components shall be unaffected by radiated RFI and electrical induction of 15 V/m over a frequency range of 10 to 10,000 MHz and conducted interference signals up to 0.25-V rms injected into power supply lines at 10 to 10,000 MHz.

2.4 ENCLOSURES

- A. Interior Sensors: Enclosures that protect against dust, falling dirt, and dripping noncorrosive liquids.
- B. Interior Electronics: NEMA 250, Type 12.
- C. Screw Covers: Where enclosures are readily accessible, secure with security fasteners of type appropriate for enclosure.

2.5 SECURE AND ACCESS DEVICES

- A. Keypad and Display Module:
 - 1. Arranged for entering and executing commands for system-status changes and for displaying system-status and command-related data.
 - 2. Design Basis: Honeywell #6148.

2.6 DOOR SWITCHES

- A. Description: Balanced-magnetic switch, complying with UL 634, installed on frame with integral overcurrent device to limit current to 80 percent of switch capacity. Bias magnet and minimum of two encapsulated reed switches shall resist compromise from introduction of foreign magnetic fields.
- B. Flush-Mounted Switches: Unobtrusive and flush with surface of door and window frame. Metal doors shall employ contacts and magnets designed for use with metal doors.

2.7 PIR SENSORS

- A. Listed and labeled by a qualified testing agency for compliance with SIA PIR-01.
- B. Description: Sensors detect intrusion by monitoring infrared wavelengths emitted from a human body within their protected zone and by being insensitive to general thermal variations.
 - 1. Ceiling-Mounted Unit Spot-Detection Pattern, full 360-degree conical, 60' range. Design Basis: Honeywell/Interlogix AP 669
 - 2. Ceiling/Wall-Mounted Unit Directional Pattern, wide range use, 89 degree x 50' detection range minimum. Design Basis: Honeywell/Interlogix AP450

3. Ceiling/Wall-Mounted Unit Directional Pattern, 200' long range corridor use. Design Basis: Honeywell/Interlogix AP633

C. Device Performance:

1. Sensitivity: Adjustable pattern coverage to detect a change in temperature of 2 deg F (1 deg C) or less, and standard-intruder movement within sensor's detection patterns at any speed between 0.3 to 7.5 fps (0.09 to 2.3 m/s) across two adjacent segments of detector's field of view.
2. Test Indicator: LED test indicator that is not visible during normal operation. When visible, indicator shall light when sensor detects an intruder. Locate test enabling switch under sensor housing cover.

2.8 INTRUSION DETECTION CONTROL UNITS

- A. Description: Supervise sensors and detection subsystems and their connecting communication links, status control (secure or access) of sensors and detector subsystems, activation of alarms and supervisory and trouble signals, and other indicated functions.
 1. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
 2. Include a real-time clock for time annotation of events on the event recorder.
- B. Comply with UL 609; listed by ETL or UL.
- C. Console Controls and Displays: Arranged for interface between human operator at control unit. Display alarm, supervisory, and component status messages and the programming and control menu.
 1. Annunciator and Display: LCD.
 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.
 3. Control-Unit Network: Automatic communication of alarm, status changes, commands, and other communications required for system operation. Communication shall return to normal after partial or total network interruption such as power loss or transient event. Total or partial signaling network failures shall identify the failure and record the failure at the annunciator display and at the system printer. Minimum 2 partition capable.
 4. Field Device Network: Communicate between the control unit and field devices of the system. Communications shall consist of alarm, network status, and status and control of field-mounted processors. Each field-mounted device shall be interrogated during each interrogation cycle.
 5. Operator Controls: Manual switches and push-to-test buttons that do not require a key to operate. Prevent resetting of alarm, supervisory, or trouble signals while alarm or trouble condition persists. Include the following:
 - a. Acknowledge alarm.
 - b. Silence alarm.
 - c. System reset.
 - d. LED test.

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- 6. Alarm Indication: Audible signal sounds and an LED lights at control unit identifying the protected zone originating the alarm. Annunciator panel displays a common alarm light and sounds an audible tone.
 - 7. Alarm activation sounds a bell or siren and strobe.
 - D. Protected Zones: Quantity of alarm and supervisory zones as indicated, with capacity for expanding number of protected zones by a minimum of 25 percent.
 - E. Power Supply Circuits: Master control units shall provide power for remote power-consuming detection devices. Circuit capacity shall be adequate for at least a 25 percent increase in load.
 - F. Transmission to Monitoring Station: A communications device to automatically transmit alarm, supervisory, and trouble signals to the monitoring station, operating over a standard voice grade telephone leased line.
 - G. Design Basis: Honeywall #VISTA-20P.
- 2.9 AUDIBLE AND VISUAL ALARM DEVICES
- A. Siren: 30-W speaker with siren driver, rated to produce a minimum sound output of 117 dB at 30 feet. Coordinate location with Owner/Architect.
 - 1. Self-contained outdoor horn with choice of two tones – steady and yelp.
 - 2. Enclosure: Weather-resistant with mounting swivel.
 - 3. Design Basis: Honeywell #ZR830EC.
- 2.10 DURESS / PANIC ALARM SYSTEM
- A. Automatic Voice / Pager Dialer:
 - 1. Design Basis for Preferred Alternate Bid: United Security Products #AD-2001.
 - B. Power Supply:
 - 1. Design Basis for Preferred Alternate Bid: United Security Products #PB12P.
 - C. Duress / Panic Alarm Switches:
 - 1. Description: A switch with a shroud over the activating lever that allows an individual to covertly send a duress signal to master control unit, with no visible or audible indication when activated. Switch shall lock in activated position until reset with a key.
 - a. Push Button: Finger activated, suitable for mounting on horizontal or vertical surface.
 - 2. Design Basis for Preferred Alternate Bid:
 - a. Switch: Honeywell 270
 - b. Reset Tool: K4563.
 - D. Switch Covers:
 - 1. Design Basis for Preferred Alternate Bid: STI Mini Stopper #STI-65XX Series.
- 2.11 SECURITY FASTENERS
- A. Operable only by tools produced for use on specific type of fastener by fastener manufacturer or other licensed fabricator. Drive system type, head style, material, and protective coating as required for assembly, installation, and strength.
 - B. Drive System Types: Pinned Torx-Plus, pinned Torx, or pinned hex (Allen).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of intrusion detection.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations of intrusion detection connections before intrusion detection installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of intrusion detection.
- D. Inspect built-in and cast-in anchor installations, before installing intrusion detection, to verify that anchor installations comply with requirements. Prepare inspection reports.
 - 1. Remove and replace anchors where inspections indicate that they do not comply with requirements. Reinspect after repairs or replacements are made.
 - 2. Perform additional inspections to determine compliance of replaced or additional anchor installations. Prepare inspection reports.
- E. For material whose orientation is critical for its performance as a ballistic barrier, verify installation orientation.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SYSTEM INSTALLATION

- A. Comply with UL 681 and NFPA 731.
- B. Install wall-mounted equipment, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

3.3 WIRING INSTALLATION

- A. Wiring Method: Install wiring in metal raceways according to Section 260533 "Raceways and Boxes for Electrical Systems," except in accessible indoor ceiling spaces. Conceal raceways and wiring except in unfinished spaces and as indicated. Minimum conduit size shall be 3/4 inch. Control and data transmission wiring shall not share conduit with other building wiring systems.
- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Use lacing bars and distribution spools. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer. Install conductors parallel with or at right angles to sides and back of enclosure. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- C. Wires and Cables:
 - 1. Conductors: Size as recommended in writing by system manufacturer unless otherwise indicated.
 - 2. Control and Signal Transmission Conductors: Install unshielded, twisted-pair cable unless otherwise indicated or if manufacturer recommends shielded cable.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

- E. Install power supplies and other auxiliary components for detection devices at control units unless otherwise indicated or required by manufacturer. Do not install such items near devices they serve.
- F. Identify components with engraved, laminated-plastic or metal nameplate for master control unit and each terminal cabinet, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Electrical Identification."

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with identification requirements in Section 260553 "Electrical Identification."
- B. Install instructions frame in a location visible from master control unit.

3.5 GROUNDING

- A. Ground the master control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to master control unit.
- B. Ground system components and conductor and cable shields to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

3.6 FIELD QUALITY CONTROL

- A. Pretesting: After installation, align, adjust, and balance system and perform complete pretesting to determine compliance of system with requirements in the Contract Documents. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new ones and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.
 - 1. Report of Pretesting: After pretesting is complete, provide a letter certifying that installation is complete and fully operable; include names and titles of witnesses to preliminary tests.
- B. Perform tests and inspections.
- C. Tests and Inspections: Comply with provisions in NFPA 731, Ch. 9, "Testing and Inspections."
 - 1. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.
 - 2. Test Methods: Intrusion detection systems and other systems and equipment that are associated with detection and accessory equipment shall be tested according to Table "Test Methods" and Table "Test Methods of Initiating Devices."
- D. Documentation: Comply with provisions in NFPA 731, Ch. 4, "Documentation."
- E. Tag all equipment, stations, and other components for which tests have been satisfactorily completed.

3.7 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other-than-normal occupancy hours for this purpose. Visits for this purpose shall be in addition to any required by warranty.

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain the intrusion detection systems and panic alarm system. Comply with documentation provisions in NFPA 731, Ch. 4, "Documentation and User Training."

END OF SECTION

SECTION 28 2300

VIDEO SURVEILLANCE

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 DOCUMENT INFORMATION

- A. The specifications provided in the Appendix that follows are provided **FOR REFERENCE** as New Hanover County School System Standard Specifications. These specifications are provided in their entirety as received from New Hanover County School System. Inclusion here is not intended to represent that these specification sections are the work of Cheatham and Associates, P.A. Contact the Engineer for clarification of conflicts that may arise by inclusion of these specifications.

1.3 CONTENTS

- A. New Hanover County School System Standard Specifications:

- 1. Section 282300A, Electronic Video Surveillance.

1.4 DEVIATIONS, ADDITIONS, DELETIONS FROM STANDARD SPECIFICATIONS

- A. Add 1.4.F. Qualification Data for Contractor:

- 1. Licensed as a Burglar Alarm Business with an Alarm Systems Business License by the North Carolina Alarm Systems Licensing Board.
 - 2. A letter from the manufacturer of all major equipment stating that the manufacturer's representative is an authorized distributor. This letter shall also state the manufacturer guarantees service performance for the life of the equipment, and that there will always be an authorized distributor assigned to service the area in which the system has been installed.

- B. Add 1.4.G. Qualification Data for Installer:

- 1. Holds a North Carolina Electrical Contractors License in one of the following categories: Unlimited, Limited, Intermediate or SP-Low Voltage.
 - 2. Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

- C. Modify 2.01.A. Axis, Bosch, Panasonic, and Pelco.

- D. Add 2.01.C. Panasonic I-Pro Series components will be bid as a Preferred Alternate. Items specified by specific manufacturer and model number include:

- 1. System: Panasonic I-Pro Series.
 - 2. High Performance Network Disk Recorder: Panasonic #WJ-ND400.
 - 3. Network Cameras: Panasonic #WV-SF438, WV-SF458, WV-SF538, WV-SF611L.
 - 4. View Software: Panasonic #WV-ASM2000.

END OF SECTION

SECTION 28 2300A

ELECTRONIC VIDEO SURVEILLANCE SYSTEM

PART 1 – GENERAL

1.0 GENERAL GUIDELINES

- A. New Hanover County Schools is standardizing to the Panasonic I-Pro Series. Proposal shall include solution utilizing equipment within the Panasonic I-Pro Series only. Equipment proposed within the Panasonic I-Pro Series shall be able to perform the following:
1. Progressive scan mega pixel camera able to provide high quality usable security picture in extreme low light conditions down to as low as .08 lux in black & white mode.
 2. Auto back focus allowing the camera to automatically re-focus the image every time the camera alternates between color and black & white.
 3. Wide dynamic range progressive scan camera able to give a usable picture when viewing a scene with extreme bright and dark content simultaneously.
 4. Able to deliver a live view of 24 to 30 images per second at one megabit of bandwidth using H.264 compression allowing more useable images per second at a lower bandwidth and enabling a resource savings in both bandwidth and storage space.
 5. Indoor and outdoor rated camera with heater, blower, and dehumidifier that is fully supported by power over Ethernet (POE).
 6. Vandal rating that addresses both external and internal components with a protective shock absorbing mechanism for the camera.
 7. Ability to automatically adjust the recorded resolution of a head shot/image to maximize facial details.
 8. Ability to provide mega pixel resolution over the entire lens view.
 9. Pan/Tilt/Zoom camera that provides auto-tracking capability
 10. Ability to create an instant J-PEG file/snapshot from a live camera view without the need to search the network video recorder.
 11. Must allow for an 8 or 16 multi-camera view from a single camera without software and the need to be connected to the network video recorder.
 12. Ability to send alerts both locally to the network video recorder and through email in the event that the camera view is altered by moving, blocking, spray painting etc.
 13. Ability to automatically stabilize the image when camera is installed in an environment where vibration is likely to occur. (ex. outside on a windy day)
 14. Must have SD/SDHC card backup at the camera level along with the ability to buffer the stored video back to a camera compatible network video recorder should a network failure occur.
 15. Ability to process video motion detection at the camera level.
 16. Cameras must carry a 3 year warranty on parts and labor.
 17. Network video recorder must have a separate processor to allow the processing of large numbers of cameras with video motion detection for consistent error free playback.
 18. Network video recorder must allow the registering and recording of up to 64 cameras in H.264 or M-PEG4 with no camera license fees.

19. Network video recorder software/firmware upgrades shall not have a fee and be available via the internet.
20. Network video recorder shall have the ability to "hot swap" hard drives and be expandable from 9 terabytes to 54 terabytes
21. Network video recorder shall use industry standard and recognized hard drives for storage and also carry a 3 year warranty.

1.1 SCOPE OF WORK

- A. Furnish and install all equipment accessories and materials in accordance with these specifications to provide a complete and operational system. The Electronic Video Surveillance System shall include but not be limited to Network Video Recorder, IP Cameras, Housings and Power Supplies.

1.2 RELATED WORK/SECTIONS

- A. In addition to this section, the Contractor shall refer to other specification sections and drawings to ascertain the extent of work included. This shall include, but not be limited to, the following:
 1. Division 1.
 2. All other Division 280000 sections.
- B. See section on Substitutions.

1.3 WORK INCLUDED

- A. The contractor shall furnish all equipment, accessories, and material required for the installation of a comprehensive IP Video System in strict compliance with these specifications and applicable contract drawings. Any material and/or equipment necessary for the proper operation of the system, which is not specified or described herein, shall be deemed part of this specification.
- B. The IP Video System shall bear the label of a Nationally Recognized Testing Laboratory (NRTL) such as E.T.L., D.S.&G., or UL and be listed by their re-examination service. All work must be completed in strict accordance with all applicable electrical codes, including N.E.C. Section 800-51 (i), under direction of a qualified and factory approved distributor, to the approval of the Owner.
- C. The system is to be designed and configured for maximum ease of service and repair. All major components of the system shall be designed as a standard component of IP Camera Systems.

1.4 SUBMITTALS

- A. Submit catalog cuts, layout drawings, diagrams, and calculations for approval in accordance with Section 280000, GENERAL PROVISIONS.
- B. Shop Drawings: Submit accurately scaled (1/8"=1'0") layout drawings of system components and accessories. Layout drawings, diagrams and calculations shall be completed by the manufacturer and presented in CAD format. Manual drafting is not acceptable.
- C. Include an elevation (front) view of each equipment rack and applicable backboard locations denoting the equipment to be installed, pertinent termination and numbering information, and labeling instructions.
- D. The specific item proposed and its area of application shall be marked on the catalog cuts.

- E. Wiring Diagrams: Submit interconnection wiring diagrams for systems including connection diagrams. Clearly differentiate between portions of wiring that are manufacturer installed and portions that are field installed.

1.5 SUBSTITUTIONS

- A. Any system and/or equipment proposed as an equal to that specified must be proven to conform to the standards contained herein. The contractor must obtain the architect's or engineer's approval in writing, prior to bidding equipment other than that specified no later than ten (15) days prior to the Bid Date. The manufacturer's name, model numbers, and three (3) copies of shop/working drawings complete with catalog sheets, technical and installation data shall be submitted for approval.
- B. Within thirty-five (35) calendar days after the date of award of the contract, the contractor shall submit to the Architect for review, eight (8) copies of a complete submission. The submission shall consist of five (5) major sections, with each section separated with insert able index tabs. The first section shall be the "Index", which shall include the project title and address, name of the firm submitting the proposal and the name of the Architect. Each page in the submission shall be numbered chronologically and shall be summarized in the index. The second section shall include a copy of the authorized distributor's valid State Contractors License, letters of factory authorization and guaranteed service, list of projects of equal scope and list of proposed instrumentation to be used by the contractor. The third section shall contain the comparative specification listing, including a complete listing of the characteristics of the equipment to be furnished. The fourth section shall contain an original factory data sheet for every piece of equipment in the specifications. The fifth section shall contain a wiring destination schedule for each circuit leaving each piece of equipment.

1.6 QUALIFICATIONS

- A. The system shall be supplied by the manufacturer's authorized contractor who is qualified in the proper installation, operation, and service of the system. Certification shall be submitted verifying that the contractor is the manufacturer's authorized. All contractors must be a Panasonic Partner and hold a current i-Pro Certification. Submit proof with your response.
- B. Upon request of the Architect/Engineer, the system proposed as an equal shall be made available for demonstration. The demonstration shall be coordinated with the Architect/Engineer and the end-user.
- C. Contractor shall attend mandatory job walk.

1.7 EQUIPMENT WARRANTY

- A. The contractor shall warrant the equipment to be new and free from defects in material and workmanship, and will, within three years from date of installation, repair or replace any equipment found to be defective. This warranty shall not apply to any equipment that has been subject to misuse, abuse, negligence, accident, or unauthorized modification.

1.8 SERVICE FACILITIES

- A. The contractor shall make available, and maintain a satisfactory service department capable of furnishing equipment inspection and service. The contractor shall be prepared to offer a service contract for the maintenance of the system beyond the warranty period.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Panasonic System Solutions Company.
- B. Provide High Performance Network Disk Recorder for Panasonic i-Pro Network Cameras.

2.01 HIGH PERFORMANCE NETWORK DISK RECORDER FOR PANASONIC I-PRO
NETWORK CAMERAS

- A. The WJ-ND400 recorder shall be capable of connecting to up to 64 network cameras without extra license fees and their images can be recorded simultaneously.
- B. The recorder shall be equipped with 9 hot plug HDD slots. It shall allow up to 27TB HDD storage to be installed in the main unit. The WJND400 recorder shall have the capability of expansion up to 162 TB with five optional WJ-HDE400 Hard Disk Extension Units, each with 9 HDD slots.
- C. The recorder shall support the following Panasonic i-Pro Network Cameras:
 - WV-SF438
 - WV-SF458
 - WV-SF538
 - WV-SFV611L
- D. The recorder shall have Intelligent VMD search function that allow motions in a specified area in the recorded images of the compatible i-Pro cameras* to be quickly searched.
- E. The recorder shall be the equipment with an embedded real-time operating system and shall not be based on a Microsoft Windows OS. The OS must reside completely in the hardware and not be installed on the hard disk drives. Installed disk drives must be dedicated to recording videos.
- F. The recorder shall support MPEG-4 and JPEG multi format.
- G. The recorder shall provide Various Recording Mode: Manual, Schedule, Event (Pre/Post), Emergency, and External Timer. It shall have the capabilities to control: Pan/Tilt, Zoom, Focus, Brightness and Preset Positions. It shall be able to search using: Time & Date, Event Type and Camera number.
- H. The recorder shall have up to 8 recording programs including individual recording mode for each camera, and 6 time schedules per day.
- I. The recorder shall have up to 64 audio capabilities and can be recorded and played back at G.726 (ADPCM) 32 kbps.
- J. The recorder shall have various alarm sources such as 32x Terminal inputs, 64x Camera alarm, Panasonic Alarm Protocol. The alarm actions shall include Alarm recording, E-mail notification, Alarm message, Camera positioning, FTP image transfer, Terminal output, Panasonic alarm protocol output, Buzzer and LED.
- K. The recorder shall have 2x built-in Gigabit network interfaces (10Base-T / 100Base-TX / 1000Base-T) for camera recording and client access.
- L. The recorder shall have the quick discovery and IP setup function for Panasonic i-Pro network cameras.
- M. The recorder shall have the capabilities to transfer recorded images to FTP server upon alarm and/or live image periodically. Images recorded in the SD memory card in the i-Pro network cameras can be transferred to the recorder automatically even when the recorder is in recording status.
- N. The recorder shall have User/Host authentication, 4 programmable user levels, 16 user priorities and User-Camera View/Control partitioning setup for sophisticated user management. It shall be capable of up to 32 user registrations.

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- O. The recorder shall have Alteration detection and recorded data encryption for data security.
- P. Multi recorder, Multi site systems shall be connected with the optional WV-ASM100 i-Pro Management Software.
- Q. The recorder shall have RAID5/6 redundant recording for data security. The RAID6 feature allows the recorder to recover from a two-disk failure without any loss of data (minimum four HDDs are required). With hot plug support, drives can be replaced without any downtime, allowing 24/7 operations. It shall have Disk partitioning to include Normal, Event, Pre-Event and Copy for flexible record management.
- R. The recorder shall be viewable from any properly connected PC using Microsoft Internet Explorer version 6.0 or later
- S. The recorder shall provide user authentication and support different user privileges based on logon ID. From the client the user should (with proper authentication) be able to do the following:
- Setup cameras
 - Define live viewing, recording rates and quality settings
 - Define recording programs and schedules
 - View live video in either single or quad views
 - Search and playback recorded video
 - Download selected recorded video
 - Control connected PTZ cameras
- T. The recorder shall work with the optional viewer software WV-ASM200 which is capable of viewing multiple cameras from multiple recorders on a single screen and provide the following features:
- Software shall be able to manage up to 100 networks connected ND300s, ND400s and/or HD300A recorders.
 - Software shall be able to display live video from any camera on any connected recorder.
 - Software shall be able to display 1, 2x2, 3x3 or 4x4 multiplexed video.
 - Software shall show registered recorders as icons in a drop down menu. Cameras will be shown as icons on the same menu, indented under the attached recorder.
 - Software shall enable user to assign any video from any recorder into any window on the multiplexed display
 - Software shall permit to register up to 32 users and each password and provide up to 5 different levels of user privileges.
 - Software shall permit the remote operation of properly configured PTZ cameras according to the user privilege level.
 - Software shall provide search functions for registered recorders and allow search by Event, Mark or Motion. It must apply these search criteria across multiple recorders.
 - Software shall permit the simultaneous playback of up to 16 videos.
 - Software must run on an IBM-PC/AT compatible computer with the following minimum specifications:

1. OS: Microsoft Windows XP Home SP2/ XP Professional SP2/ 32bit Vista Ultimate.
 2. CPU: Intel Core 2 Duo 2.66 GHz or faster
 3. RAM: 1 GB or more
 4. VRAM: 64 MB or more
 5. Microsoft DirectX 9.0c or later
 6. Graphics Card supporting more than 1024 x 768 resolution
 7. 100/1000 Ethernet Network Card
 8. Internet Explorer 6.0 SP2 or later
 9. Mouse, Keyboard, 1x USB port
- U. Supported protocols: TCP/IP, UDP/IP, HTTP, FTP, SMTP, DHCP, DNS, DDNS, NTP, SNMP.
- V. The power source shall be 120VAC, 60Hz at approx. 170W.

2.03 CAMERAS

- A. Provide the following Cameras based on application. (Choose cameras to include based on applications)
1. Interior standard 360 Degree Cameras shall be Model WV-SF438 with double panorama, panorama, quad PTZ or Single PTZ Viewing modes. 3.1 megapixel, progressive scan.
 2. Interior Vandal Resistant 360 Degree Cameras shall be Model WV-SF458 with double panorama, panorama, quad PTZ or Single PTZ Viewing modes. 3.1 megapixel, progressive scan.
 3. Interior Standard Dome Camera shall be model WV-SF538 with progressive scan, day night feature, adaptive black stretch, 2.8-10 mm vari-focal lens. 3.1 megapixel.
 4. Interior or Exterior Vandal Resistant Dome Camera shall be model WV-SFV611L with progressive scan, day night feature, IR LED Light, super Dynamic, adaptive black stretch, 2.8-10 mm vari-focal lens. 3.1 megapixel. Exterior or Interior locations that require a wall mount shall use a PWM484S bracket.
 5. All cameras shall be provided with SDHC cards installed and configured to allow for back up recording in the event of a network failure and the card shall buffer the event s back to the recorder when network is reestablished.

2.4 CABLE

- A. Cable for cameras will be installed by Division 27 contractor. This contractor shall supply all patch cables for cameras.

PART 3 - EXECUTION

3.1 DIVISION OF WORK

- A. While all work included under this specification is the complete responsibility of the contractor, the division of actual work listed following shall occur.
- B. The conduit, outlets, terminal cabinets, etc., which form part of the rough-in work shall be furnished and installed completely by the electrical contractor. The entire responsibility of the system, its operation, function, testing and complete maintenance for three (3) years after final acceptance of the project by the owner, shall also be the responsibility of the manufacturer's authorized representative.

3.2 EQUIPMENT MANUFACTURER'S REPRESENTATIVE:

- A. All work described herein to be done by the manufacturer's authorized representative shall be provided by a documented factory authorized representative of the basic line of equipment to be utilized.
- B. As further qualification for bidding and participating in the work under this specification the manufacturer's representative shall hold a valid NC Low Voltage Contractor's License issued by the Contractor's State License Board of North Carolina and a valid NC Alarm License. The manufacturer's representative shall have completed at least ten (10) projects of equal scope, giving satisfactory performance and have been in the business of furnishing and installing IP Camera Systems of this type for at least five (5) years. The manufacturer's representative shall be capable of being bonded to assure the owner of performance and satisfactory service during the guarantee period.
- C. The manufacturer's representative shall provide a letter with submittals from the manufacturer of all major equipment stating that the manufacturer's representative is an authorized distributor. This letter shall also state the manufacturer guarantees service performance for the life of the equipment, and that there will always be an authorized distributor assigned to service the area in which the system has been installed.
- D. The contractor shall furnish a letter from the manufacturer of the equipment, which certifies that the equipment has been installed according to factory intended practices, that all the components used in the system are compatible and that all new portions of the systems are operating satisfactorily. Further, the contractor shall furnish a written unconditional guarantee, guaranteeing all parts and all labor for a period of three (3) years after final acceptance of the project by the owner.

3.3 INSTALLATION:

- A. Cabling shall be routed as high as possible and above other building facilities in the path with the least obstructions in the ceiling space while maintaining the separation requirements of TIA/EIA 568B1,2,3, TIA/EIA 569A, and NFPA 70 (NEC). There shall be a minimum distance of three inches between the cable and ceiling grid and cable pathways shall be clear of all possible EMF and RFI interference. Specifically cables shall be at least 2 feet away from all fluorescent lights and other potential EMF sources. Any violations of this shall be corrected at the contractor's expense. Cables shall not be run parallel with electrical conduits or strapped to them. Cinch plastic cable ties shall not be used during any part of the installation process. All cabling required to support the system shall be terminated in an approved manner and not be "cut back" to the cabling sheath or "wrapped" around the cabling sheath. Interconnect between the system and the station cabling shall be terminated in a cross connect method.
- B. Cabling installed through "holes, cracks, HVAC duct spaces, etc." is not acceptable and shall be properly sleeved.
- C. Cabling shall be installed appropriately within a sleeve when wall penetrations are required. If using an existing sleeve, contractor is responsible for maintaining any fire stopping system and requirements for fill ratio of sleeve. If existing sleeve is not fire stopped, contractor shall notify owner for direction or install the appropriate sleeve for the installation of the contractor's cable.
- D. Cable Identification:
 - 1. All wires shall be permanently identified at each wire end utilizing a self-laminated wire or cable marker comprised of a white label with black lettering and clear laminate area, in a manner approved by the Owner.

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- E. Splicing:
1. Splicing of cables is not permitted between terminations.
- F. Wall and Floor Penetrations:
1. All penetrations through floors and walls shall be sleeved. All sleeves shall have permanently installed bushings.
 3. Sleeves shall be sized to accept 50% growth.
 4. All sleeves shall installed per manufacturer's instructions and shall protrude 3 inches on each side of the penetration.
 5. Sleeves through floors shall be supported with conduit riser clamp.
 6. Existing sleeves can be used with the following exceptions:
 - a. Use of any sleeve containing emergency signaling cable is prohibited
 - b. Using any sleeve, when doing so would exceed 40% fill ratio, is prohibited.
- G. Fire stopping:
1. Fire stopping material shall be installed inside all riser conduit sleeves to form smoke barriers after installation of the cabling is completed. Malleable foam-type bricks cut to fit should be used where possible (Hilti FS-fire block, or equal). Intumescent putty shall be used in an UL approved assembly when fire bricks are not feasible.
- H. Cable Installation:
1. Do not pull wire or cable through any box fitting or enclosure where change of raceway alignment or direction occurs; do not bend conductors to less than recommended radius. Employ temporary guides, sheaves, rollers, and other necessary items to protect cables from excess tension, abrasion, or damaging bending during installation. Care shall be taken not to bend, crush or kink cables.
 2. All cable shall be installed in a complete, neat, and orderly fashion. Cables shall not be twisted or have any damage to the cable jacket.
 3. Cables shall be installed parallel or at 90 degree angles to the building walls. Diagonal, beeline, or non-supported cable routing is unacceptable.
- I. Equipment Cabinets or Racks:
1. Comb straight and form in a neat and orderly manner all conductors located within equipment cabinets in the head end room or remote locations, and wiring harnesses in the head end room. Tie as required using Velcro cable ties of appropriate type and size.
 2. Service Loops:
 - a. Provide 10 foot service loops at each termination so that plates, panels, and equipment can be dismounted for service and inspection.
- J. Plug disconnect: All major equipment components shall be fully pluggable by means of multi-pin receptacles and matching plugs to provide for ease of maintenance and service.
- K. Protection of cables: Cables within terminal cabinets, equipment racks, etc., shall be grouped and bundled (harnessed) as to type and laced with No. 12 cord waxed linen lacing twine or Velcro. Edge protection material ("cat-track") shall be installed on edges of holes, lips of ducts or any other point where cables or harnesses cross metallic edge.
- L. Cable identification: Cable conductors shall be color-coded and individual cables shall be individually identified. Each cable identification shall be a unique number located

approximately 1-1/2" from cable connection at both ends of cable. Numbers shall be approximately 1/4" in height. These unique numbers shall appear on the As-Built Drawings provided by the installer and these drawings shall be mounted in each equipment room used to support any part of the entire system.

3.4 TRAINING:

- A. Provide a minimum of eight (8) hours of complete "in service" instructions of system operation to school personnel.

END OF SECTION APPENDIX

SECTION 28 3111

DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SYSTEM DESCRIPTION

- A. Microprocessor controlled, intelligent reporting fire detection and alarm system.

1.3 SUMMARY

- A. Section Includes:
 - 1. Fire-alarm control unit.
 - 2. Manual fire-alarm boxes.
 - 3. System smoke detectors.
 - 4. Heat detectors.
 - 5. Notification appliances.
 - 6. Magnetic door holders.
 - 7. Remote annunciator.
 - 8. Addressable interface device.
 - 9. Power supplies.
 - 10. Digital alarm communicator transmitter.
 - 11. System printer.

1.4 DEFINITIONS

- A. AHJ: Authority Having Jurisdiction.
- B. AHU: Air Handler Unit.
- C. IR: Infrared.
- D. LED: Light-emitting diode.
- E. NICET: National Institute for Certification in Engineering Technologies.
- F. NRTL: Nationally Recognized Testing Laboratory.
- G. UV: Ultraviolet.

1.5 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the North Carolina State Building Code.
- B. Comply with applicable provisions of NFPA 70, National Electrical Code.
- C. Comply with applicable provisions of NFPA 72, National Fire Alarm Code.
- D. Equipment supplied shall be specifically listed for its intended use and shall be installed in accordance with the manufacturer's instructions.
- E. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.6 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Firms shall be regularly engaged in the manufacture of fire alarm systems of the types, sizes, and electrical characteristics required for this project.
2. The system shall comply with provisions of UL safety standards pertaining to fire detection and alarm systems. Products and components shall be Listed and Labeled.
3. Fire detection and alarm systems and accessories shall be FM approved.
4. Firms shall maintain factory authorized service organization. Firms shall maintain spare parts stock.

B. Designer for Preparation of Shop Drawings and Calculations Qualifications:

1. Personnel shall be trained and certified by manufacturer for system design required for this Project.
2. Personnel shall be certified by NICET as fire-alarm Level III (minimum) technician.

C. Installer Qualifications:

1. Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
2. Supervisor of installation shall be certified by NICET as fire-alarm Level II (minimum) technician.
3. Supervisor of installation shall be certified as an authorized representative of the equipment manufacturer.
4. Minimum of 5 years of experience installing fire detection and alarm systems similar in size and scope to this project.

D. Manufacturer's Field Service Technician Qualifications:

1. Personnel shall be trained and certified by manufacturer for installation of units specifically required for this Project within the most recent 36 months.
2. Personnel shall be certified by NICET as fire-alarm Level II (minimum) technician.
3. If not trained by the manufacturer within 36 months (as noted in 1 above), but within 48 months, NICET fire alarm Level III (minimum) technician certification is required.

E. Source Limitations for Fire-Alarm System and Components:

1. Obtain fire-alarm system equipment and components from a single source.
2. For facilities with existing functional systems in place, new components shall be compatible and listed for use with, and operate as, an extension of existing system.

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

G. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.7 SUBMITTALS

A. Qualification Data:

1. Designer:
 - a. As part of this submittal list the system designer's name.
 - b. Submittals without the following documentation will not be accepted:
 - 1) Manufacturer training certification.
 - 2) NICET certification
2. Installer:
 - a. As part of this submittal list the system installer's name.
 - b. Submittals without the following documentation will not be accepted:
 - 1) Manufacturer training certification.
 - 2) NICET certification.
 - 3) Authorized representative of equipment manufacturer certification.
 - 4) Experience documentation; 5 years of similar size & scope projects.
3. Manufacturer Field Service Technician:
 - a. As part of this submittal list the manufacturer field service technician's name
 - b. Submittals without the following documentation will not be accepted:
 - 1) Manufacturer training certification.
 - 2) NICET certification.

B. Product Data:

1. Manufacturer data for each type of product, equipment, device, etc. proposed.
2. For devices, include milliamp (mA) draw and listed minimum voltage required to operate for each type of device.
3. For panels and power supplies, include voltage drop allowed for the panel and power supplies.
4. For panels and power supplies, include voltage drop for individual Notification Appliance Circuits (NAC).
5. For linear beam smoke detectors, include manufacturer's calibration chart giving Smoke Sensitivity versus Operating Distance for all sensitivity settings. Chart shall include 3rd party listed sensitivity limits for the entire range of operating distances.

C. Shop Drawings: For fire-alarm system to demonstrate compliance with project drawings and specifications. Include plans, elevations, sections, details, and attachments to other work.

1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
2. Provide floor plans with:
 - a. Final equipment and device locations, including address of each addressable device and notification appliance.
 - b. Wiring diagrams with proposed conduit routing and conductors/cables in each conduit section.

- c. Distances for NAC circuitry sections.
3. Provide typical riser diagrams showing connections for all device types.
4. Provide voltage drop calculations for notification appliance circuits. Voltage drop at EOL device shall not exceed 14% of the battery voltage. Worst case voltage at each notification appliance shall be no less than the minimum listed operating voltage.
5. Provide battery calculations.
6. System Response Matrix: Indicate fire alarm system's actions (outputs) required for each type of alarm, supervisory, and trouble signal.
7. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
- D. Installation Instructions: Manufacturer's detailed installation instructions for Fire Alarm Control Unit, supervisory switches, and similar items which require mechanical installation.
- E. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- F. Field quality-control reports.
- G. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section "Operation and Maintenance Data," include the following:
 1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
 3. System Status and Programming Report.
 4. Record copy of site-specific software on CD and USB flash drive (thumb drive).
 5. As-built documents.
 - a. Provide duplicates of the shop drawing plans, wiring diagrams, and riser diagrams showing comprehensive and clear field revisions. Include loop numbers, device addresses, terminal numbers where connected to equipment, and wire color codes.
 - b. Provide a drawing with submitted battery and voltage drop calculations. Include a field for entering actual metered values during system testing.
 6. Technical literature for all control equipment, devices, isolation modules, relays, power supplies, alarm/supervisory signal initiating devices, etc. Include maintenance data and parts lists. Include circuit diagrams of all control panels, modules, annunciators, communications panels, etc.
 7. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:

- a. Frequency of testing of installed components.
 - b. Frequency of inspection of installed components.
 - c. Requirements and recommendations related to results of maintenance.
 - d. Manufacturer's user training manuals.
8. Manufacturer's required maintenance related to system warranty requirements.
9. Abbreviated operating instructions, framed and mounted at fire-alarm control unit.
- 1.8 SOFTWARE SERVICE AGREEMENT
 - A. Comply with UL 864.
 - B. Technical Support: Beginning with Final Acceptance, provide software support for one year.
 - C. Upgrade Service:
 1. Update software to latest version at Project completion.
 2. The manufacturer and authorized distributor of the system installed shall maintain software records on the system installed.
 3. At no charge, install and program software upgrades that become available within one year from date of Final Acceptance and for the life of the warranty period. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
 4. For new software versions that correct operating problems or bugs, free upgrades shall be provided during the life of the system.
 5. Provide 30 days notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.
- 1.9 EXTRA MATERIALS
 - A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Manual Fire Alarm Boxes: 2% of installed quantity, but no fewer than 1 unit of each type.
 2. Addressable Control Relays: 4% of installed quantity, but no fewer than 1 unit of each type.
 3. Indoors Horn/Strobes: 4% of installed quantity, but no fewer than 1 unit of each type.
 4. Indoor Strobes: 4% of installed quantity, but no fewer than 1 unit of each type.
 5. Monitor Modules (Addressable Interface): 4% of installed quantity, but no fewer than 1 unit of each type.
 6. Isolation Modules: 4% of installed quantity, but no fewer than 1 unit of each type.
 7. Addressable Heat Detectors: 4% of installed quantity, but no fewer than 1 unit of each type.
 8. Smoke Detectors, Fire Detectors: 6% of installed quantity, but no fewer than 1 unit of each type.
 9. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but no fewer than 1 unit of each type.

10. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
11. Keys and Tools: One extra set for access to locked and tamper-proofed components.
12. Fuses: Two of each type and rating installed in the system.
13. Interconnection cable, where required, for connecting the FACU to a personal computer.

1.10 WARRANTY

- A. Provide parts and labor warranty of one year from the date of final inspection and/or acceptance by the Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Notifier. Notifier will be bid as a Design Basis Preferred Alternate.
 2. Other Manufacturers: EST and Siemens systems that comply with the specifications.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
 1. Manual stations.
 2. Heat detectors.
 3. Smoke detectors.
 4. Fire-extinguishing system operation.
- B. Fire-alarm signal shall initiate the following actions:
 1. Record events in the system memory.
 2. Continuously operate alarm notification appliances, including voice evacuation notices, until initiating device and control unit have been reset.
 3. Identify alarm at fire-alarm control unit with flashing LED, audible piezo-electric signal, and LCD display of alarm point and location.
 4. Identify alarm at fire-alarm remote annunciator with flashing LED, audible piezo-electric signal, and LCD display of alarm point and location.
 5. Identify alarm at local operators console.
 6. Transmit an alarm signal to the remote alarm receiving station.
 7. Unlock electric door locks in designated egress paths.
 8. Release fire and smoke doors held open by magnetic door holders.
 9. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
 10. Shutdown of all HVAC equipment will be initiated.
 11. Activate emergency lighting control.
 12. Activate voice/alarm communication system.
 13. The PTT function of the voice/alarm communication system shall override automated messages and shunt adjacent speaker(s) to prevent feedback onto the system.

- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
 - 1. Supervisory switch or device.
 - D. Carbon monoxide detection signal shall initiate the following actions:
 - 1. Record events in the system memory.
 - 2. Continuously operate alarm notification appliances until initiating device and control unit have been reset.
 - 3. Identify alarm at fire-alarm control unit with flashing LED, audible piezo-electric signal, and LCD display of alarm point and location.
 - 4. Identify alarm at fire-alarm remote annunciator with flashing LED, audible piezo-electric signal, and LCD display of alarm point and location.
 - 5. Transmit an alarm signal to the remote alarm receiving station.
 - 6. Unlock electric door locks in designated egress paths.
 - 7. Release fire and smoke doors held open by magnetic door holders.
 - 8. Activate voice/alarm communication system.
 - a. Separate voice alarm messages are required for fire alarm evacuation and carbon monoxide detection evacuation. Specific message requirements are to be coordinated with the Owner and Fire Marshal prior to system programming.
 - E. System trouble signal initiation shall be by one or more of the following devices and actions:
 - 1. Open circuits, shorts, and grounds in designated circuits.
 - 2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
 - 3. Ground or a single break in fire-alarm control unit internal circuits.
 - 4. Break in standby battery circuitry.
 - 5. Failure of battery charging.
 - 6. Abnormal position of any switch at fire-alarm control unit or annunciator.
 - 7. Loss of primary power or abnormal ac voltage at fire-alarm control unit.
 - 8. HVAC bypass defeat switch in bypass position.
 - 9. Voice signal amplifier failure.
 - F. System Trouble and Supervisory Signal Actions:
 - 1. Initiate annunciation at fire-alarm control unit and remote annunciators.
 - 2. Provide adjustable time delay capability of 0 to 60 minutes to delay transmission of the trouble signals. The delay for loss of primary power or abnormal ac voltage shall be 1 to 3 hours.
 - 3. System troubles shall be programed as tracking and will self-restore when trouble condition clears.
- 2.3 FIRE-ALARM CONTROL UNIT
- A. General Requirements for Fire-Alarm Control Unit (FACU):
 - 1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.

- a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
 - b. Include a real-time clock for time annotation of events on the event recorder. Time of day and date shall be retained upon loss of system primary and secondary power.
 - c. The system shall have multiple access levels for Owner authorized personnel to disable individual alarm inputs or normal system responses for alarms, without changing the system's programming.
 - d. Programming and editing of the existing program shall be possible without special equipment and without interrupting alarm monitoring functions.
2. Enclosure:
 - a. 3rd party listed cabinet suitable for surface, flush, or semi-flush mounting.
 - b. Finish: Rust resistant primer and manufacturer standard finish.
 - c. Door hinged on either right or left side (field selectable).
 - d. Door with key lock and glass opening for viewing all indicators.
 - e. Manufacturer's trim kit for flush or semi-flush mounting.
3. Addressable initiation devices that communicate device identity and status (normal, trouble, and alarm conditions).
 - a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at fire-alarm control unit.
 - b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.
 - c. Alarm Verification: The system shall provide, as a feature, an alternate signal processing algorithm to verify the presence of smoke. The algorithm shall be selectable when programming. The total effective delay created by the algorithm shall not exceed 60 seconds. Alarm Verification shall only be enabled by direction of the AHJ, otherwise shall remain disabled.
4. Addressable control circuits for shutdown of mechanical equipment.
5. Annunciation points: 2048 minimum.
6. Signaling Line Circuits (SLC) Interface Boards:
 - a. Integral microprocessor with capability of operating locally in the event of FACU main microprocessor.
 - b. Provides power and communication with devices on SLC circuit loop.
 - c. 198 intelligent/addressable devices minimum per circuit; 99 analog detectors and 99 monitor or control modules.
 - d. Receives and processes analog information from all detectors with software to automatically maintain detectors' desired sensitivity levels
 - e. Automatic detector testing and determination of detector maintenance requirements.

7. The system shall retain historical data and device parameters including device sensitivity measurement testing results. The system shall have the capability to display and print device data, parameters, and sensitivity test results. Trouble indication shall be initiated when any smoke detector approaches 80% of its alarm threshold due to gradual contamination.
- B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
 1. Annunciator and Display: Liquid-crystal type, backlit, 3 lines (minimum) of 80 characters, minimum.
 2. Individual, color-coded system status LEDs for AC POWER, SYSTEM ALARM, SYSTEM TROUBLE, and SIGNAL SILENCE.
 3. Keypad: Alphanumeric; arranged to permit entry and execution of field programming, display, and control commands.
 4. Operator interface functions:
 - a. Acknowledge Switch.
 - b. Alarm Silence Switch with a Subsequent Alarm resound feature.
 - c. System Reset Switch.
 - d. System Test Switch.
 - e. Lamp Test Switch.
- C. Circuits:
 1. Notification Appliance Circuits (NAC):
 - a. NFPA 72 Class B.
 - b. End of line (EOL) resistors shall be installed for FACU supervision of circuit integrity. Locate EOL resistors as follows:
 - 1) Where accessible to fire alarm system maintenance personnel.
 - 2) Where maintenance or testing at the EOL resistor location will not be disruptive to the normal use of the facility.
 - 3) Where not easily accessible to the normal building occupants.
 - 4) Where no higher than 9' AFF or lower than 7' AFF.
 - 5) Not in stairwells or restrooms.
 - c. NAC circuits shall not exceed 75% of maximum load current allowed.
 2. Signaling Line Circuits (SLC): NFPA 72 Class A, no "T" taps, and a minimum of 20% spare addresses.
 3. Initiating Device Circuits (IDC): NFPA 72 Class A.
 4. Digital electronic signals shall utilize check digits or multiple polling to prevent a single ground or open on any NAC, SLC, or IDC from causing system malfunction, loss of operating power, or the ability to report an alarm.
 5. Isolation Modules:

- a. Isolation modules shall automatically isolate wire-to-wire shorts on an SLC circuit.
 - b. Install isolation modules at the following locations:
 - 1) In or adjacent to the FACU at each end of addressable loops.
 - 2) After each 20 initiating devices and control points on an addressable loop.
 - 3) For addressable loops with less than 20 devices and control points, install isolators at the middle of the loop in addition to those at the FACU.
 - 4) At the point where an addressable loop extends outside of the building.
 - 5) In terminal cabinets on each floor where addressable loops cover more than one floor level.
 - c. Isolation modules shall be readily accessible, not located above ceilings, and clearly labeled. Record drawings shall indicate isolator module locations.
 - d. Provide an LED that flashes to indicate the isolation module is operational and that burns steady to indicate that a short circuit condition has been detected and isolated.
6. Serial Interfaces:
- a. Two RS-232 ports for printers.
 - b. One RS-232 port for voice evacuation interface.
7. Wiring Methods:
- a. All fire alarm circuitry shall be in $\frac{3}{4}$ " minimum metal conduit or metal clad fire alarm Type MC cable where concealed. Use surface metal raceway where exposed. Junction boxes and covers not in finished areas shall be painted red. PVC conduit may be used underground, in concrete, or in locations subject to severe corrosion.
 - b. SLC addressable loop circuits shall be wired with type FPL/FLLR/FPLP fire alarm cable, 18 AWG minimum, low capacitance, copper, twisted pair. Cable jacket shall have a red jacket with red and black conductor insulation. For underground circuits, use type TC or PLTC cable (PE insulated).
 - c. Speaker audio circuits shall be wired with twisted, shielded pair, copper audio cable.
 - d. All other circuits shall be wired with 14 AWG minimum, stranded copper, type THHN/THWN conductors. Color codes follow:
 - 1) Initiating Circuits, General: Red(+) / White(-).
 - 2) Initiating Circuits, Smoke Only: Violet(+) / Gray(-).
 - 3) Notification Appliance / alarm initiating circuits: Blue(+) / Black(-).
 - 4) AHU Shutdown Circuits: Yellow(+) / Brown(-).
 - 5) Door Control Circuits (magnet power): Orange(+) / Orange/White(-).
 - 6) Separate 24 VDC operating power (for equipment): Yellow(+) / Brown(-).
 - 7) Circuits from zone adapter modules (ZAMs) to monitored devices: Violet(+) / Gray(-).
 - e. Conduits that penetrate exterior walls shall be sealed with non-hardening electrical putty to prevent condensation infiltration.

- f. Splices are allowed only at device terminals or on terminal blocks in cabinets.
 - g. For multistory buildings, circuits shall be routed through terminal cabinets at each floor. Cabinets shall be hinged cover enclosures with terminal blocks for circuitry connections. Cabinets shall typically be accessible at floor level. If the building layout prevents installation for floor level access; with approval of the Owner and Engineer, a terminal cabinet may be located above a suspended ceiling. Its location shall be clearly and permanently identified with a placard legible from the floor.
 - h. Terminal block screws shall have pressure wire connectors of the self-lifting or box lug type.
 - i. Permanent wire markers shall be used to label connections at the FACU, other control equipment, power supplies, and in terminal cabinets.
 - j. Branch circuit breakers supplying 120 VAC to system equipment shall be physically protected with a breaker handle lock and identified with a 1/4" permanent red dot applied to the breaker handle or exposed body area.
- D. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values for O&M documentation.
- E. AHU Shutdown Defeat Toggle Switch: A supervised toggle switch shall be provided in/adjacent to the Fire Alarm Control Unit, or as a key operated function in a Remote Annunciator. If installed at the Remote Annunciator, provide an engraved label at the FACU with AHU Shutdown Defeat Switch location. When placed in the Shutdown Defeat position, a system "trouble" signal shall be initiated.
- F. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.
- G. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.
 - 1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.
 - 2. 120V power supply entry point to the FACU enclosure shall be where designated by the manufacturer.
 - 3. 120V branch breaker shall be physically protected with a handle lock and identified with a 1/4" diameter permanent red dot applied to the breaker handle or exposed body area.
- H. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
 - 1. Batteries:
 - a. Gel-cell, sealed, plate nickel cadmium, maintenance free.
 - b. Minimum of 60 hours standby capacity plus:
 - 1) 15 minutes of voice evacuation full alarm load.
 - 2. Charger: Dual-rate charging techniques for fast battery recharge.

- I. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.
- J. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators.
 - 1. Indicated number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711 and be listed by an NRTL.
 - a. Allow the application of and evacuation signal to indicated number of zones and, at same time, allow voice paging to the other zones selectively or in any combination.
 - b. Programmable tone and message sequence selection.
 - c. Standard digitally recorded messages for "Evacuation" and "All Clear."
 - d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification appliance circuits of fire-alarm control unit.
 - 2. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.
 - 3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.

2.4 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes:
 - 1. Comply with UL 38.
 - 2. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
 - 3. Positive, visual indication of operation.
 - 4. Station Test and Reset: Key-operated switch.
 - 5. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
 - 6. Where new devices are shown utilizing existing device conduit and/or back box locations, temporarily hang or support existing devices in a manner that allows full functionality of the existing device while the new device is installed and brought online.
 - 7. Pull Station Cover with Horn: Provide cover for all manual pull stations.
 - a. Clear, tamperproof, polycarbonate cover hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
 - b. Listed for outdoor use for outdoor pull stations.
 - c. Flush mount cover for recessed boxes. Surface mount cover with conduit spacer for applications requiring surface mounted conduit.

2.5 SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall typically be two-wire type for connection to an SLC. Four-wire type detectors may be required if connecting to an existing four-wire system.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
4. Integral Visual-Indicating Lights: Provide both alarm and power LEDs, flashing under normal conditions. LEDs shall burn steady, controlled by the FACU, to indicate an alarm condition.
5. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring. Provide terminals in the fixed base for connection of a remote alarm LED.
6. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
8. Test Means: Provide a means to simulate an alarm condition and report to the FACU. Test shall be initiated at the detector (activation of a magnetic switch) or initiated remotely on command from the FACU when in "test" condition.
9. Detectors shall store an identifying device type code for FACU identification of devices as either ION, PHOTO, or THERMAL.
10. Sounder Bases: Provide bases with integral sounder rated 85 dB minimum, measured at 10 feet.

B. Photoelectric Smoke Detectors:

1. Use photoelectric / light scattering principal to measure smoke density and send data to the FACU representing analog level of smoke density.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).

C. Linear Beam Smoke Detectors

1. Detectors shall have a minimum of three calibrated sensitivity settings capable of maintaining sensitivity between 1.0% and 2.0% per meter obscuration, at any operating distance between 10 and 60 meters.

2. Detectors shall be rated for continuous operation up to 122 deg F and 95% relative humidity.
3. Compensation circuits shall be provided in detectors to maintain normal sensitivity as environmental conditions change and as dust builds up on lenses. When the limits of compensation are reached, a "trouble" condition shall be initiated.
4. Horizontal and vertical adjustment capability shall be provided on both transmitters, receivers, and reflectors for alignment of the detection beam. Adjustment of 7.5 degrees from the center axis in any direction shall be accommodated.
5. The detection beam shall be modulated to assure reliable operation in the presence of high ambient light or background IR.
6. Abrupt, maintained blockage of the detection beam shall result in a "trouble" condition, not alarm, being initiated within an adjustable time span of 10 seconds minimum to 60 seconds.
7. Provide remote test switches for each beam detector.

2.6 HEAT DETECTORS

A. General Requirements for Heat Detectors:

1. Comply with UL 521.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
3. Integral Visual-Indicating Lights: Provide both alarm and power LEDs, flashing under normal conditions. LEDs shall burn steady, controlled by the FACU, to indicate an alarm condition.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring. Provide terminals in the fixed base for connection of a remote alarm LED.
5. Use electronic sensor to measure thermal conditions caused by fire and send data to the FACU representing analog level of such thermal conditions.

B. Heat Detector, Combination Type:

1. Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.
2. Fixed-temperature sensing shall be independent of rate-of-rise sensing.
3. Mounting: Twist-lock base interchangeable with smoke-detector bases.
4. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 194 deg F.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.

2.7 MULTI-SENSOR DETECTORS

- A. Detectors employing two or more detection types with integrated operating principals, computations, and algorithms to discriminate between normal changes in a building and changes associated with a fire.
- B. Detector type: Photoelectric smoke detection / rate of rise thermal detection.

2.8 CARBON MONOXIDE DETECTORS

- A. General Requirements for Intelligent Carbon Monoxide (CO) Detectors:
 - 1. CO detector shall be an addressable device capable of initiating a separate and distinct signal for carbon monoxide (CO) detection per UL 2075 standards.
 - 2. The detector may be part of a multi-criteria detector comprised of other detection and sensing elements, including a photoelectric particulate sensor, an electrochemical CO sensor, and/or a thermal sensor. The device shall be able to indicate distinct CO, smoke, and thermal alarms.
 - 3. The CO detector shall be capable of a functional gas test using a canned test agent to test the functionality of the CO sensing cell.
 - 4. The detector shall indicate CO trouble conditions, including six months of sensor life remaining, sensor life has expired, and CO self-test failure.
 - 5. The detector shall include a LED to provide visual device status. The LEDs shall indicate both standby and alarm status. The detector must be capable of connecting to a sounder base that provides both temporal 3 and temporal 4 patterns for fire and CO alarm.
 - 6. The detector must be capable of initiating a CO alarm signal to the control panel to initiate a separate and distinct Carbon Monoxide voice alarm evacuation signal.
 - 7. The detector shall be plug-in mounted into a twist-lock base. The detector shall be constructed of UV-resistant polymer and shall be detachable from the mounting base to simplify installation, service and maintenance. Mounting base wiring connections shall be made by means of screws with a capture plate or washer. The mounting base shall be available to mount to standard junction boxes.
 - 8. Meets Agency Standards
 - a. ANSI/UL 268 -Smoke Detectors for Fire Alarm Signaling Systems
 - b. CAN/ULC-S529- Smoke Detectors for Fire Alarm Systems
 - c. FM 3230-3250- Smoke Actuated Detectors for Automatic Fire Alarm Signaling
 - d. UL 2075 – Gas and Vapor Detector and Sensors – Systems Connected

2.9 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, equipped for mounting as indicated and with screw terminals for system connections.
 - 1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections. Comply with requirements for both visual and audible notification appliances.
- B. Visible Notification Appliances (Strobes):
 - 1. Xenon strobe lights complying with UL 1971, 24-V dc nominal.

2. Rated Light Output: 15/30/75/110 cd, selectable in the field.
 3. Flashing shall be in a temporal pattern, synchronized with other units. Maximum pulse duration: 0.2 seconds.
 4. Clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" shall be engraved in minimum 1-inch high letters on the lens.
 5. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
 6. Strobe Leads: Factory connected to screw terminals.
 7. Mounting Faceplate: Factory finished, white.
- C. Bells: 10" diameter vibrating type, 24V dc nominal. Bells located outdoors shall be listed for use in wet locations.
- D. Voice/Tone Notification Appliances (Speakers):
1. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.
 2. Speakers shall operate at 70.7V or 25V dc nominal.
 3. High-Range Units: Rated 2 to 15 Watt (W).
 4. Low-Range Units: Rated 1 to 2 W.
 5. Include taps at $\frac{1}{4}$ W, $\frac{1}{2}$ W, 1W, and 2W.
 6. Matching Transformers: Tap range matched to acoustical environment of speaker location.
 7. Provide back boxes for all speakers.
 8. Wattage settings indicated on the drawings are designer selections for sound and intelligibility level requirements. Contractor selected wattage settings that are lower may be subject to field changes required by the Fire Marshal, Owner, or Engineer for acceptable sound and intelligibility. Any upgrades to power supplies and/or amplifiers as a result of these field changes from proposed submittal configurations will be the responsibility of the Contractor at no additional cost to the Owner.
- 2.10 ADDRESSABLE INTERFACE DEVICES
- A. Monitor Modules:
1. For use in providing a system address for alarm-initiating devices for wired applications with normally open dry contacts.
 2. Provide an LED that flashes under normal conditions, indicating that the monitor module is operational and in regular communication with the FACU.
 3. Modules installed in non-conditioned spaces shall be tested, listed, and marked for continuous duty across the range of temperatures and humidity expected at their installed locations.
- B. Control Modules:
1. For use in auxiliary control functions, operating as a dry contact relay.
 2. Typical equipment control functions would include direct signals to: an elevator controller to initiate elevator recall, to a circuit-breaker shunt trip for power shutdown, or to a lighting control system for lighting control scenario under fire alarm conditions.
 3. For use in supervising and controlling the operation of one NAC.

4. Provide an LED that flashes under normal conditions, indicating that the monitor module is operational and in regular communication with the FACU.

2.11 MAGNETIC DOOR HOLDERS

- A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
 1. Electromagnet: Requires no more than 3 W to develop 25-lbf (111-N) holding force. Holding force of the magnet shall be appropriate for the door to be held open.
 2. Provide associated hardware such as keepers, door chains, and other accessories required to properly hold doors open.
 3. Operation in a fail safe manner to release doors upon failure of voltage to the device. Doors shall close after a power loss of 60 seconds.
 4. Wall-Mounted Units: Flush mounted in a single gang electrical device box unless otherwise indicated.
 5. Rating: 24-V dc, supplied from FACU or supervised system power supply.
 6. Control from the FACU, not local smoke detector contacts.
- B. Material and Finish: Match door hardware.

2.12 REMOTE ANNUNCIATOR / INDICATOR LIGHTS (RAIL)

- A. Provide 24V dc RAILS with an associated key-type switch for testing of the annunciated device.

2.13 AUXILIARY POWER SUPPLIES

- A. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module.
 1. Alarm current draw of entire supplied circuitry loads shall not exceed 80 percent of the power-supply module rating.
 2. 120V branch breaker shall be physically protected with a handle lock and identified with a ¼" diameter permanent red dot applied to the breaker handle or exposed body area.
- B. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
 1. Batteries:
 - a. Gel-cell, sealed, plate nickel cadmium, maintenance free.
 - b. Minimum of 60 hours standby capacity plus:
 - 1) 15 minutes of voice evacuation full alarm load.
 - c. Add battery capacity for a 25% safety factor.
 2. Charger: Dual-rate charging techniques for fast battery recharge.
 3. Battery cabinet enclosures shall be twice the size of the batteries contained.
- C. Auxiliary power supplies shall be individually monitored by the FACU and protected by a smoke detector.
- D. Coordinate installation location with the Owner and Engineer. Do not install above ceilings or in non-conditioned spaces.

2.14 DIGITAL ALARM COMMUNICATOR TRANSMITTER (DACT)

- A. Digital alarm communicator transmitter, 4-channel minimum, shall be compatible with and acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.
- B. Functional Performance:
 - 1. Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a central station, remote supervising station, or proprietary supervising station.
 - 2. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line.
 - 3. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.
 - 4. Precedence of signals transmitted to the supervising station shall be: (1) Fire Alarm, (2) Supervisory Signal, (3) Trouble Signal, (4) Security Alarm.
- C. Local functions and display at the digital alarm communicator transmitter shall include the following:
 - 1. Verification that both telephone lines are available.
 - 2. Programming device.
 - 3. LED display.
 - 4. Manual test report function and manual transmission clear indication.
 - 5. Communications failure with the central station or fire-alarm control unit.
- D. Digital data transmission shall include the following:
 - 1. Address of the alarm-initiating device.
 - 2. Address of the supervisory signal.
 - 3. Address of the trouble-initiating device.
 - 4. Loss of ac supply or loss of power.
 - 5. Low battery.
 - 6. Abnormal test signal.
 - 7. Communication bus failure.
- E. Secondary Power: Integral rechargeable battery and automatic charger.
- F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.
- G. In lieu of a DACT, an addressable network is acceptable for signal transmission. If other means of signal transmission may be necessary, coordinate suitability with the AHJ.

2.15 SURGE PROTECTION

- A. AC Input:
 - 1. Mount in listed enclosure adjacent to branch circuit panelboard. Wind small coil (5 to 10 turns) in branch circuit conductor just downstream of the suppressor connection.

2. Install feed through branch circuit transient suppressor (Ditek #DTK-120S20A, Leviton #51020-WM/DIN, or approved equivalent that is UL 1449 2nd Edition Listed).

B. DC Circuits Extending Outside Building:

1. Mount inside the building, near the point of entry to or exit from each building in a labeled enclosure.
2. Provide "pi"-type filter on each conductor, consisting of primary arrestor, series impedance, and fast-acting secondary arrestor that clamps at 30-40V.
3. A minimum of 36" of conductor length shall be provided between the "pi"-type filter and the first system device in the building.
4. Acceptable models: Citel America #B280-24V, Ditek #DTK-2MHLP24B, Northern Technologies #DLP-42, Simplex #2081-9027/9028, Transtector #TSP8601.

2.16 REMOTE ANNUNCIATOR

- A. Description: Annunciator functions utilizing an alphanumeric display and LED indicating lights shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual control functions shall match those of fire-alarm control unit; including acknowledge, silence, reset, and test for alarm supervisory, and trouble signals.

1. Mounting: Flush cabinet, NEMA 250, Type 1.
2. Alarm signal with alarm resound feature.
3. Communication via two-wire EIA-485 interface.
4. The fire alarm system shall be capable of supporting a minimum of four remote annunciators.

2.17 LOCAL OPERATING CONSOLE (LOC)

- A. Description: For applications that require full control of the voice audio system from remote locations within a facility; for live All Call or vectored paging of both emergency and non-emergency events and pre-recorded message activation

1. Compatible with the Emergency Voice Evacuation Panel for fire protection applications and mass notification.
2. Built-in microphone with push-to-talk feature that can be used for ALL CALL paging.
3. Switch control for panel messages.
4. Function controls such as Global HVAC shutdown.
5. Simple and straightforward user interface.
6. Keyed lock cabinet design to prevent unauthorized access.
7. UL 864 (Emergency Voice Evacuation for Fire) listed.
8. Exact location of the LOCs shall be coordinated with the Owner & AHJ prior to installation.

2.18 DEVICE GUARDS

- A. For device protection in gymnasiums, multi-purpose rooms, and other spaces where exposed to physical damage.
- B. Wire Guards: Welded wire mesh of size and shape for the manual station, smoke detector, notification appliance, or other device requiring protection.

1. Heavy gauge steel wire.
 2. Finish: Coated with corrosion resistant polyester, color to match the protected device.
 3. Guards for beam detector transmitters and receivers shall be configured with openings to accommodate detector function
- C. Protective Shield:
1. Clear, UV stabilized, polycarbonate cover for strobes.
- 2.19 SNAP EDGE FRAMES
- A. Description: Mountable Front Load Easy Open Snap Frame
1. Outside edges flip open for quick document changes.
 2. Non-glare plastic cover.
 3. Design Basis: U-Line #S-2132 Series.
 4. For use with operator's instructions and device map.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment.
- B. Equipment and Device Mounting:
1. Install fire-alarm control unit with tops of cabinets not more than 72 inches above the finished floor.
 2. Install equipment and devices securely attached to walls, ceilings, floors, building structure. Hardware and supports shall be suitable for the load supported. Ceiling mounted devices shall not be supported solely by suspended ceilings.
 3. Comply with requirements for seismic-restraint devices specified in Section "Vibration and Seismic Controls for Electrical Systems."
- C. Smoke- or Heat-Detector Spacing:
1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
 2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
 3. HVAC: Locate detectors not closer than 3 feet (1 m) from air-supply diffuser or return-air opening.
 4. When installed in a room, orient so that the alarm LED is visible from the nearest door to the corridor.
- D. Detector Protection:
1. Unless suitably protected from dust, paint, etc.; detectors shall not be installed until final construction clean-up is complete. If contaminated, detectors shall be replaced.
 2. Where accidental damage or deliberate abuse is anticipated, provide a protective guard that is listed for use with the detector and is acceptable to the AHJ.
- E. Audible Alarm-Indicating Devices: Unless ceiling mounted, install not less than 6 inches below the ceiling. Install speakers on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

- F. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn; and unless ceiling mounted, install at least 6 inches below the ceiling.
- G. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- H. Annunciator: Install with top of panel not more than 72 inches above the finished floor.
- I. Control Selector Switches:
 - 1. Toggle switches with LED status indicator lights.
 - 2. Hand in "up" position with amber LED. Auto in "center" position with green LED. Off in "down" position with red LED.

3.2 CONNECTIONS

- A. Fire and Life Safety Doors:
 - 1. Where any exit or exit access doors are locked to delay egress, they must immediately unlock upon any fire alarm signal or loss of 24V-dc fire alarm system power.
 - 2. Power failure to smoke and fire doors shall cause their mechanisms to default to egress mode with normal mechanical latching.
 - 3. Smoke or fire doors shall drop the door hold open magnet within 60 seconds of AC power loss, or their load shall be included in standby battery calculations.
- B. Make addressable connections with a supervised interface device to the following devices and systems and any others indicated on the drawings. Install the interface device less than 3 feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
 - 1. Alarm-initiating connection to activate emergency lighting control.
 - 2. Alarm-initiating connections at Carbon Monoxide detection systems.
 - 3. Supervisory connections at kitchen hood shunt trip breaker(s).

3.3 REMOTE ALARM TRANSMISSION

- A. The Contractor shall program the DACT, connect telephone lines, install & connect required networking cables, coordinate signal transmission with the supervising station, and verify proper signal receipt by the supervising station.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section "Identification for Electrical Systems."
- B. Detectors, appliances, and modules shall be labeled with unique numbers that are indicated on as-built drawings and permanently mounted on device bases. Labels shall be legible from floor level. Detectors shall be labeled uniquely and sequentially starting at the FACU with both SLC and device designations. Labels shall be printed black lettering on clear background and attached to the device base.
- C. Junction and pull box covers shall be labeled to indicate the circuits or function of the conductors contained in the boxes. Labels shall be neatly applied with black lettering on clear background.
- D. Conductors shall be labeled with permanent wire markers at connections at the FACU, other control equipment, power supplies, and terminal cabinets. Hand written labels shall not be

accepted. Wire markers utilizing permanent adhesive shall printed on a nylon type media or other media specifically designed to adhere to non-uniform (circular) surfaces.

- E. Install framed basic operating instructions in a location visible from fire-alarm control unit. Optionally, with Owner concurrence, the instructions may be affixed to the inside of the FACU door.
- F. Floor plans of the fire alarm system installation shall be provided at the FACU.
 - 1. Provide a locked box adjacent to the FACU for plan book storage. Key to match FACU. Box shall be labeled, "FIRE ALARM SYSTEM RECORD DOCUMENTS"
 - 2. Floor plans shall include device locations and addresses. Indicate equipment, module, and EOL locations.
 - 3. Provide a legend for symbols used.
 - 4. A separate page shall be provided for each floor. Laminate individual pages and bind all pages in a book form.
- G. NFPA 72 Record of Completion documentation shall be kept inside the Fire Alarm Documents enclosure, or its kept location shall be permanently indicated inside the FACU on an engraved label.
- H. At all equipment with a 120 VAC power source, provide an engraved label indicating panelboard ID, branch circuit number, and panelboard location. At the FACU, provide an additional engraved label inside the FACU.

3.5 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.6 FIELD QUALITY CONTROL

- A. Final field tests shall be witnessed by authorities having jurisdiction.
- B. Manufacturer's Field Service: Engage a factory-authorized service technician to make connections to the FACU; to program the system; to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Tests and Inspections:
 - 1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
 - b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
 - 2. Conductor Testing: All conductors shall be tested for grounds, opens and shorts prior to termination at panels and installation of detector heads. Conductors shall be megger tested for a minimum of 10 megohms from conductor to ground and conductor to conductor. Provide record of test results to Engineer in advance of acceptance inspection.
 - 3. Test mounting and anchorage devices according to requirements in Section "Seismic Controls for Electrical Work." Prepare and provide test reports.

4. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 5. Test 100% of alarm initiating devices, all software functions, all other system functions including DACT communication, and verify system operational matrix. Notify Owner and Engineer 2 weeks in advance of this test to permit witness observation.
 6. Print a System Status and Programming Report with settings for each alarm indicating device, the current sensitivity of each analog addressable smoke detector, and detailed system operational matrix.
 7. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion", NFPA 72, Figure 1-6.2.1 in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72. Submit "Fire Alarm System Record of Completion" to Engineer for delivery to Owner. The ROC shall be submitted to the Engineer for review prior to final signatures. All forms shall be typed; hand-written alterations shall not be accepted.
 8. After 100% system test and submission of "Fire Alarm System Record of Completion", request Engineer to schedule an AHJ acceptance inspection, a minimum of 2 days after completion of system testing.
 9. For AHJ acceptance inspection, perform sampling testing as directed by AHJ for detectors and functional tests. Provide 2-way radios, ladders, smoke source, and other materials needed for testing the system.
- D. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- E. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.
- 3.7 TRAINING / DEMONSTRATION
- A. Engage a factory-authorized service representative to train Owner's maintenance personnel for a minimum of 8 hours to adjust, operate, and maintain fire-alarm system. Training schedule must be coordinated to meet the Owner's schedule. Training location will be provided by the Owner.
- B. As a minimum, training shall cover:
1. System software multiple access levels via password protection for accommodating Owner capability for disabling individual alarm inputs or normal outputs for alarms without modifying the system programming or affecting operation of the remainder of the system.
 2. Overall system concepts, capabilities, and functions. Training shall be of sufficient detail so that the Owner shall be able to remove any device from service and return to service without the need for the Manufacturer's approval or assistance.
 3. Methods and means of troubleshooting and replacement of all field wiring devices.
 4. Methods and means of troubleshooting the main FACU and field devices for programming, bussing systems, internal panel and unit wiring, circuitry, and interconnections.

5. Preventative maintenance service techniques and schedules, including historical data trending of alarm and trouble records.
 6. Training documentation and actual system software used for training shall be provided in digital form and left with the Owner at the completion of training.
 - C. Provide two bound copies of training information.
- 3.8 EXISTING SYSTEM DEMOLITION
- A. The existing fire alarm system shall be removed.
 - B. Existing fire alarm system equipment and enclosures shall be removed.
 1. Where equipment is removed from exposed, visible locations; walls shall be patched and painted to match existing.
 2. Conduits connected to existing equipment shall be terminated at with junction boxes.
 3. Verify with the Owner whether equipment is to be turned over to the Owner or removed from the site.
 - C. Existing fire alarm devices shall be removed.
 1. Quantities of NAC devices will require field investigation by the Contractor to determine the extent of demolition work required.
 2. Verify with the Owner whether all or a portion of the devices removed are to be turned over to the Owner. Any devices not retained by the Owner shall be removed from the site.
 3. Where devices are removed from flush, wall mounted boxes; blank covers shall be provided that completely cover wall openings. See drawing details for suggested cover installations.
 4. Where devices are removed from gypboard ceilings, blank covers shall be provided that completed cover wall openings.
 - D. Abandoned power conductors shall be removed back to their source.
 - E. Abandoned fire alarm cable and conductors shall be removed in their entirety.

END OF SECTION

SECTION 31 10 00 - SITE CLEARING
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Standards set forth by the North Carolina Department of Environment and Natural Resources (NCDENR) Division of Land Resources, Land Quality Section.

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 Architect. 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.

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 NOT respread as landscape mulch.
- 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 nonsoil 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 15 and 16 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.
- 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.

- 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 and 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.
- D. Recycling: Contractor shall not dispose of excess soil and land clearing debris in landfills. 100% of soil and land clearing debris shall be recycled. Provide documentation verifying 100% recycling of cleared trees and stumps and excess soil materials. Refer to Division 01 section – Construction Waste Management for additional requirements.

END OF SECTION 311000

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. Subsurface Exploration Report.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Preparing and grading subgrades.
 - 2. Excavating 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 311000 "Site Clearing" for site stripping, grubbing, topsoil removal, and tree protection.
 - 3. Division 33 Section 3341000 "Storm Drainage Utilities" for storm drainage, foundation drainage connections outside of building and roof drainage connections outside of building.
 - 4. Division 32 Section 329000 "Planting" for finish grading, including placing and preparing topsoil for permanent and temporary grass seeding.
 - 5. Division 31 "Soil Erosion and Sediment Control", 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 the greater of 24 inches wider than pipe diameter or 42 inches wide.
 - 6. Additional rock removed beyond the limits outlined above to accommodate trench boxes or other removal methods shall not be included in the payment volume.
- 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:
- 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. 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 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 (irregardless 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.
 - c. In-place densification by vibratory rolling of existing soils at exposed subgrades, as described herein, shall be considered General Excavation.
 - 2. Unsuitable Soil Excavation: Removal and disposal of soil materials or other debris encountered at or 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.
- 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 backhoe 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 removeable 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 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 backhoe 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 at less 10 cubic yards material.
5. Classified excavation requirements:

- a. Excavations more than 10 feet in width and pits more than 30 feet in either length or width are defined as open excavations. Excavations less than 10 feet in width and pits less than 30 feet in both length and width 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 unclassified 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 01 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.
- 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.
 1. Off-site borrow material, if any, shall be tested and inspected prior to its use. All soil tests done to qualify off-site fill material for use on-site shall be paid by the Contractor as well as compaction retests required due to failure of the original tests.
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 01.

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 in excess of the project allowances 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: Rock excavation in excess of the project allowances 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; with a Plasticity Index 25 or less and a Liquid Limit less than 50.
 1. Soils free of organics and having a plasticity index greater than 25 and a liquid limit greater than 50 may be used as fill in approved non-structural areas.
 2. Satisfactory soil materials obtained from off-site borrow sources shall meet all requirements listed in paragraph B above, however Plasticity Index shall be less than 20 and contain at least 20% fines.

3. CH and MH soils having plasticity indices greater than 20 may also be used as fill in deep fill sections placed at -1% to +3% of optimum and at least 3-ft below planned subgrade elevations in pavement or other structural areas.
- C. Unsatisfactory Soil Materials: ASTM D 2487 soil classification groups MH, ML, CH, CL OL, OH, and PT. Soils having a Plasticity Index greater than 9 and a Liquid Limit greater than 35 are also unsatisfactory within structural (building and pavement) areas.
- D. Unsuitable Soil: Existing, in-place soil, materials or other debris encountered at or below proposed subgrade elevations deemed unsuitable by the Architect or the Owner's independent testing agency to remain in place and/or for use as fill or backfill material or subgrade. Soil material which, in the opinion of the Architect or Owner's independent testing agency, can be repaired by scarifying, drying and recompacting and/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 material 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. Topsoil shall not be considered unsuitable regardless of thickness from the existing ground surface.
- F. Backfill and Fill Materials: Satisfactory soil materials.
- G. Base Course Material: Type A, B or C aggregate base course meeting the requirements of NCDOT "Standard Specifications for Roads and Structures."
- H. 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.
- I. Bedding Material: #57 washed stone.
- J. Drainage Fill: #57 washed stone.
- K. Filtering Material/Stone: #57 washed stone.
- L. Filter Sand: Washed, coarse to very coarse sand, 1.0 mm to 2.0 mm particles.

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

- G. Gravel Pathway Screenings: Decomposed Granite, or 3/8" or 1/4" crushed aggregate screenings in accordance with ASTM C 136, to meet the requirements of the stabilizer (binder) manufacturer.

2.3 ACCESSORIES

- A. Drainage (Filter) Fabric: Nonwoven geotextile, specifically manufactured as a drainage geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:

1. Grab Tensile Strength: 110 lbf (490 N); ASTM D 4632.
2. Tear Strength: 40 lbf (178 N); ASTM D 4533.
3. Puncture Resistance: 50 lbf (222 N); ASTM D 4833.
4. Water Flow Rate: 150 gpm per sq. ft. (100 L/s per sq. m); ASTM D 4491.
5. Apparent Opening Size: No. 50 (0.3 mm); ASTM D 4751.

- B. Separation Fabric: Woven geotextile, specifically manufactured for use as a separation 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-11, 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 insure 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: Do not use explosives without written permission of local authorities. Contractor shall provide all consultation, engineering, supervision, expertise, experience, and test blasting as required to protect surrounding structures and to meet the performance requirements of the local authorities.

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 when excavations have reached required subgrade.
- B. After stripping is complete the exposed subgrade shall be proofrolled with a fully loaded dual wheel tandem axial dump truck or similar construction equipment. Four passes shall be made in each orthogonal direction. The proofrolling operation shall be observed by the Architect. 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 and/or densified in-place with a vibratory roller. Repeat proofrolling operations.
- C. When Architect or Owner's independent testing agency determines that unforeseen unsatisfactory 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 01 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, dampproofing, 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 and copper wire 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, 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. 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. Pond embankments, use impervious fill.
- D. 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.

3.14 MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 3 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 6-8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill materials evenly on all sides of structures to required elevations. 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 95% of the standard Proctor Density (ASTM D-698).
 - b. Compact each layer of the final 12-in of backfill material in building and pavement areas at 98% of the standard Proctor Density (ASTM D-698).
 - c. Moisture content of the fill during placement shall be kept within +/-2% of optimum.
 - d. 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 90 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).

3.17 SUBSURFACE / FOUNDATION DRAINAGE

- A. Drainage Piping: Drainage pipe is specified in Division 33 Section "Storm Utility Drainage Piping."
- B. Subsurface and Foundation Drains: Place a layer of drainage fabric around perimeter of drainage trench. 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.

3.20 FIELD QUALITY CONTROL

- A. Testing Agency Services: Allow testing agency to inspect 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 field in-place density tests according to ASTM D 1556 (sand cone method), or equal.
 - 2. Paved Areas (including courts and tracts): At subgrade and at each compacted fill and backfill layer, perform at least one field in-place density test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests. Observe proofrolling of finished subgrade and aggregate base course.
 - 3. Trench Backfill: Perform at least one field in-place density test per 2 feet of backfill per 200 linear feet or less of trench, but no fewer than two tests per trench per day.

4. 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. Monitor use of impervious fill as embankment materials.
 5. Non-Structural Areas: Field density and moisture content tests shall be performed on the fill and backfill at a rate of one test per every 5,000 square yards of fill per lift, per day
- 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.
- 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 axial 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. Perform evaluation of soils to be used as embankment fill.

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; 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, excess topsoil, 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. NCG01000 can be viewed at:
<https://files.nc.gov/ncdeq/Energy%20Mineral%20and%20Land%20Resources/Stormwater/NPDES%20General%20Permits/NCG01%20Permit%20Renewal%202016.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. 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.

- E. 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.
- F. 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.
- G. 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 CHANNEL AND SLOPE MATTING

- A. Slope and Channel Matting: Erosion Control blankets 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. Slope matting and 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 $\frac{3}{4}$ " x $\frac{3}{4}$ ".
 - 2. Coconut Mat (Turf Reinforcement Mat):
 - a. Fiber: 100% coconut fiber (0.5-lbs./sq.yd.)
 - b. Top Netting: 100% biodegradable jute (9.3-lbs/1000-sq.ft. approx. weight.)
 - c. Bottom Netting: 100% biodegradable jute (7.7-lbs/1000-sq.ft. approx. weight.)
 - d. C125BN by North American Green or approved equal.
 - 3. Synthetic Mat (Polypropylene):
 - a. Fiber: 100% UV stabilized polypropylene fiber matrix (0.5-lbs./sq.yd.)
 - b. Top and Bottom Netting: UV stabilized polypropylene (24-lbs/1000-sq.ft. approx. weight.)
 - c. Middle Netting: Corrugated UV stabilized polypropylene (24-lbs/1000-sq.ft. approx. weight.)

- d. P550 by North American Green or approved equal.
- 4. Synthetic Mat (Straw/Coconut):
 - a. Fiber: 70% Straw fiber matrix (0.35-lbs./sq.yd.), 30% Coconut fiber matrix (0.15-lbs./sq.yd.)
 - b. Top and Bottom Netting: UV stabilized polypropylene (5-lbs/1000-sq.ft. approx. weight.)
 - c. Middle Netting: Corrugated UV stabilized polypropylene (24-lbs/1000-sq.ft. approx. weight.)
 - d. SC250 by North American Green or approved equal.
- 5. Wire Staples: 16-gauge steel wire, with minimum of 3" top and 6" long legs. 1.75 staples per square yard of matting minimum.

2.4 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 3116

TERMITE CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Chemical soil treatment.

1.2 REFERENCE STANDARDS

- A. Title 7, United States Code, 136 through 136y - Federal Insecticide, Fungicide and Rodenticide Act; 1947 (Revised 2001).

1.3 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Indicate toxicants to be used, composition by percentage, dilution schedule, intended application rate.
- C. Manufacturer's Instructions: Indicate caution requirement.
- D. Record date and rate of application and areas of application.
- E. Maintenance Data: Indicate re-treatment schedule .
- F. Warranty: Submit warranty and ensure that forms have been completed in Owner's name.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing this type of work and:
 - 1. Having minimum of three (3) years documented experience.
 - 2. Licensed in North Carolina .

1.5 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year installer's warranty against damage to building caused by termites.
 - 1. Include coverage for repairs to building and to contents damaged due to building damage. Repair damage and, if required, re-treat.

PART 2 PRODUCTS

2.1 CHEMICAL SOIL TREATMENT

- A. Toxicant Chemical: EPA (Title 7, United States Code, 136 through 136y) approved; synthetically color dyed to permit visual identification of treated soil.
- B. Diluent: Recommended by toxicant manufacturer.
- C. Manufacturers:
 - 1. BASF; Termidor: www.bsaf.pestcontrol.us.
 - 2. Bayer Environmental Science Corp; Product Premise PRO: www.backedbybayer.com/pest-management/#sle.
 - 3. Syngenta; Product Altriset: www.syngentapmp.com.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- D. Mixes: Mix toxicant to manufacturer's instructions.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that soil surfaces are unfrozen, sufficiently dry to absorb toxicant, and ready to receive treatment.
- B. Verify final grading is complete.

3.2 APPLICATION - CHEMICAL TREATMENT

- A. Comply with requirements of U.S. EPA and applicable state and local codes.
- B. Spray apply toxicant in accordance with manufacturer's instructions.
- C. Apply toxicant at following locations:
 - 1. Under Slabs-on-Grade.
 - 2. At Both Sides of Foundation Surface.
- D. Under slabs, apply toxicant up to 12 hours prior to installation of vapor barrier.
- E. At foundation walls, apply toxicant immediately prior to finish grading work outside foundations.
- F. Apply extra treatment to structure penetration surfaces such as pipe or ducts, and soil penetrations such as grounding rods or posts.
- G. Re-treat disturbed treated soil with same toxicant as original treatment.
- H. If inspection or testing identifies the presence of termites, re-treat soil and re-test.

3.3 PROTECTION

- A. Do not permit soil grading over treated work.

END OF SECTION

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 01 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 01 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.

1.4 SITE CONDITIONS

- A. Weather Limitations: Apply prime and tack coats when ambient temperature is above 50 deg F and when temperature has not been below 35 deg F for 12 hours immediately prior to application. Do not apply when base is wet or contains an excess of moisture.
- B. Construct hot-mixed asphalt surface course when atmospheric temperature is above 50 deg F and when base is dry. Base course may be placed when air temperature is above 30 deg F and rising.
- 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. All asphalt mixes shall include at least 20% recycled asphalt product.
- B. Aggregate Base Course (ABC): Type A, B or C 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. Seal Coat Surface Treatment: Sand seal shall be comprised of the application of an asphalt emulsion followed by and sand aggregate cover over existing asphalt pavement.
 - 1. Asphalt Emulsion: Grade CRS-2 or CRS-2P conforming to NCDOT Standard 1020-7 as compatible with specified aggregate.
 - 2. Aggregate: Clean sand free from clay or organic material, suitable for the purpose of sand seals. 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
#100

5-15
0-5

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. Crack Filling: Remove debris from cracks or joints to a depth of 1/4 inch.
 - 1. Clean cracks and joints in existing asphalt pavement with compressed air.
 - 2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.
 - 3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.
- G. 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.

H. Allow to dry until at proper condition to receive paving.

I. Exercise care in applying bituminous materials to avoid smearing of adjoining concrete surfaces. Remove and clean damaged surfaces.

J. 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, I-19.0B, B-25.0B: 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.

3.5 PATCHING

- A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompress existing unbound-aggregate base course to form new subgrade.
- A. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd.
 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- B. Patching: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.6 SEALCOATING OF EXISTING ASPHALT PAVEMENT

- A. Preparation: Existing pavement surfaces shall be cleaned of all dust and dirt and any loose materials. Apply asphalt material only when the surface to be treated is dry and when the atmospheric temperature is above 60-deg F in the shade. Do not apply asphalt material in fog or rain weather conditions.
- B. Apply approximately 0.22-0.30 gal. per sq.yd. of asphalt material to the existing surface immediately followed by the application of 12-15 lbs. per sq.yd. of blotting sand. Uniformly spread the full required amount of sand in one application and correct all non-uniform areas prior to rolling. Contractor may mix asphalt emulsion and sand aggregate prior to application of sand seal surface treatment.
- C. Immediately after the sand has been uniformly spread, perform rolling with pneumatic tired rollers until the aggregate is thoroughly keyed into the liquid asphalt. Use rollers designed to prevent picking up the material.

3.7 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 01 Section "Quality Control." Repair or remove and replace unacceptable paving as directed by Architect.
 - 1. 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 shall be tested in accordance with ASTM D 3549. Results shall be considered unacceptable if 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, 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."
 - 3. ACI 330R, "Guide for the Design and Construction of Concrete Parking Lots."
 - 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.

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. 20% by weight of required cement content, with 1.2-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.
 1. Available Products:
 - a. Axim Concrete Technologies; Cimfilm.
 - b. Burke by Edeco; BurkeFilm.
 - c. ChemMasters; Spray-Film.
 - d. Conspec Marketing & Manufacturing Co., Inc.; Aquafilm.
 - e. Dayton Superior Corporation; Sure Film.
 - f. Euclid Chemical Company (The); Eucobar.
 - g. Kaufman Products, Inc.; Vapor Aid.
 - h. Lambert Corporation; Lambco Skin.
 - i. L&M Construction Chemicals, Inc.; E-Con.
 - j. MBT Protection and Repair, ChemRex Inc.; Confilm.
 - k. Meadows, W. R., Inc.; Sealtight Evapre.

- l. Metalcrete Industries; Waterhold.
- m. Nox-Crete Products Group, Kinsman Corporation; Monofilm.
- n. Sika Corporation, Inc.; SikaFilm.
- o. Symons Corporation; Finishing Aid.
- p. Vexcon Chemicals, Inc.; Certi-Vex EnvioAssist.

E. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

1. Available Products:

- a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
- b. Burke by Edoko; Aqua Resin Cure.
- c. ChemMasters; Safe-Cure Clear.
- d. Conspec Marketing & Manufacturing Co., Inc.; W.B. Resin Cure.
- e. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).
- f. Euclid Chemical Company (The); Kurez DR VOX.
- g. Kaufman Products, Inc.; Thinfilm 420.
- h. Lambert Corporation; Aqua Kure-Clear.
- i. L&M Construction Chemicals, Inc.; L&M Cure R.
- j. Meadows, W. R., Inc.; 1100 Clear.
- k. Nox-Crete Products Group, Kinsman Corporation; Resin Cure E.
- l. Symons Corporation; Resi-Chem Clear.
- m. Tamms Industries Inc.; Horncure WB 30.
- n. Unitex; Hydro Cure 309.
- o. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.

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, nonglazing, 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.
- F. 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.

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): 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: 20 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.

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.
- 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. 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: 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.
 - 1. When joining existing paving, place transverse joints to align with previously placed joints, unless indicated otherwise.
- B. Contraction 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 1/3 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: Locate contraction joints at 10-ft max. intervals, each way in concrete pavement; 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.)
- 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. Locate expansion joints in curbs and sidewalks at intervals of 30 feet, each way, unless indicated otherwise.
 - 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.

- 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 1/4-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 TRAFFIC MARKINGS

- A. Cleaning: Sweep and clean surface to eliminate loose material and dust.
- B. 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.

3.9 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.

3.10 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 14 00 - UNIT PAVERS
PART 1 - GENERAL

1.1 WORK INCLUDED

A. This Section includes the following:

1. Unit pavers set in aggregate setting bed.
2. Unit pavers set in mortar bed.
3. Edge restraints for unit pavers.

1.2 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. Related Sections include the following:

1. Division 31 Section "Earth Moving" for compacted subgrade and subbase course, if any, under unit pavers.
2. Division 32 Section "Concrete Paving" for cast-in-place concrete curbs and gutters serving as edge restraint for unit pavers.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Unit pavers.
2. Setting materials.
3. Edge restraints.

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 unit paver indicated.

C. Samples for Verification: Full-size units of each type of unit paver indicated; in sets for each color, texture, and pattern specified, showing the full range of variations expected in these characteristics.

1. Include Samples of exposed edge restraints.

D. 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.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed unit paver installations 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 each type of unit paver, joint material, and setting material from one source with resources to provide materials and products of consistent quality in appearance and physical properties.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect unit pavers and aggregate during storage and construction against soiling or contamination from earth and other materials.
 - 1. Cover pavers with plastic or use other packaging materials that will prevent rust marks from steel strapping.
- B. Store liquids in tightly closed containers protected from freezing.

1.6 PROJECT CONDITIONS

- A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.
- B. Weather Limitations for Mortar and Grout:
 - 1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
 - 2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602. Provide artificial shade and windbreaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F (38 deg C) and higher.
 - a. When ambient temperature exceeds 100 deg F (38 deg C), or when wind velocity exceeds 8 mph (13 km/h) and ambient temperature exceeds 90 deg F (32 deg C), set pavers within 1 minute of spreading setting-bed mortar.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Concrete Unit Pavers: The following manufacturer was used as the basis for design. Product by other manufacturers providing equal products may be allowed:
 - 1. Hanover Architectural Products
 - 2. Pine Hall Brick Co.
 - 3. Endicott Clay Products Co.

2.2 COLORS AND TEXTURES

- A. Colors and Textures: Colors based off unit pavers as manufactured by Hanover Architectural Products. Standard colors Prest Pavers with Tudor finish.
 - 1. Type 1: "Natural"
 - 2. Type 2: "Tan"

2.3 UNIT PAVERS

- A. Unit Pavers: Pavers shall be 12-inch wide x 24-inch long x 2-inch tall unit pavers as manufactured by Hanover Architectural Products or approved equal complying with the quality specifications for solid concrete paving units as required by ASTM C936.

2.4 ACCESSORIES

- A. Aluminum Edge Restraints: Commercial medium duty aluminum paver edging with holes to receive stakes at 24 inches (610 mm) o.c., and 3/8 inch spiral steel stakes 10 inches (254 mm) long for each hole. Attach sections per manufacturer's recommendation. BrickBloc by Permaloc or approved equal. Size of edging is as follows:
 - 1. 0.75 inch (1.9 mm) thick by 1-3/4 inches (44.5 mm) high.
- B. Job-Built Concrete Edge Restraints: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mixed concrete with minimum 28-day compressive strength of 3000 psi (20 MPa).

2.5 AGGREGATE SETTING-BED MATERIALS

- A. Graded Aggregate for Subbase: Aggregate base course material.
- B. Geotextile: Woven or nonwoven geotextile manufactured from polyester or polypropylene fibers, with a permeability rating 10 times greater than that of soil on which paving is founded and an apparent opening size small enough to prevent passage of fines from leveling course into graded aggregate of base course below.
- C. Sand for Leveling Course: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements of ASTM C 33 for fine aggregate.
- D. Sand for Joints: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing No. 16 (1.18-mm) sieve and no more than 10 percent passing No. 200 (0.075-mm) sieve.

2.6 MORTAR SETTING-BED MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type II.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Sand: ASTM C 144.
- D. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed, and not containing a retarder.
- E. Thinset Mortar: Latex-modified portland cement mortar complying with ANSI A118.4.
- F. Water: Potable.

2.7 GROUT MATERIALS

- A. Sand-Portland Cement Grout: ANSI A108.10, composed of white or gray cement and white or colored aggregate as required to produce color indicated.
- B. Grout Colors: As selected by Architect from manufacturer's full range.
- C. Water: Potable.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas indicated to receive paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Where pavers are to be installed over waterproofing, examine waterproofing installation, with waterproofing Installer present, for protection from paving operations. Examine areas where waterproofing system is turned up or flashed against vertical surfaces and horizontal waterproofing. Proceed with installation only after protection is in place.

3.2 PREPARATION

- A. Vacuum clean concrete substrates to remove dirt, dust, debris, and loose particles.
- B. Remove substances, from concrete substrates, that could impair mortar bond, including curing and sealing compounds, form oil, and laitance.
- C. Proof-roll prepared subgrade surface to check for unstable areas and areas requiring additional compaction. Proceed with unit paver installation only after deficient subgrades have been corrected and are ready to receive subbase for unit pavers.

3.3 INSTALLATION, GENERAL

- A. Do not use unit pavers with chips, cracks, voids, discolorations, and other defects that might be visible or cause staining in finished work.
- B. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.
- C. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.
- D. Joint Pattern: See plans for pattern style.
- E. Tolerances: Do not exceed 1/32-inch (0.8-mm) unit-to-unit offset from flush (lippage) nor 1/8 inch in 10 feet (3 mm in 3 m) from level, or indicated slope, for finished surface of paving.
- F. Provide edge restraints as indicated. Install edge restraints before placing unit pavers.
 - 1. For metal edge restraints with top edge exposed, drive stakes at least 1 inch (25 mm) below top edge.
 - 2. Install job-built concrete edge restraints to comply with requirements in Division 3 Section "Cast-in-Place Concrete."
 - 3. Where pavers embedded in concrete are indicated as edge restraints for pavers set in aggregate setting bed, install pavers embedded in concrete and allow concrete to cure before placing aggregate setting bed and remainder of pavers. Hold top of concrete below aggregate setting bed.

3.4 AGGREGATE SETTING-BED PAVER APPLICATIONS

- A. Compact soil subgrade uniformly to at least 95 percent of ASTM D 1557 laboratory density.

- B. Place geotextile over prepared subgrade, overlapping ends and edges at least 12 inches (300 mm).
- C. Place aggregate subbase and base in thickness indicated. Compact by tamping with plate vibrator and screed to depth required to allow setting of pavers.
- D. Place leveling course and screed to a thickness of 1 to 1-1/2 inches (25 to 38 mm), taking care that moisture content remains constant and density is loose and constant until pavers are set and compacted.
- E. Treat leveling base with soil sterilizer to inhibit growth of grass and weeds.
- F. Set pavers with a minimum joint width of 1/16 inch (1.6 mm) and a maximum of 1/8 inch (3 mm), being careful not to disturb leveling base. If pavers have spacer bars, place pavers hand tight against spacer bars. Use string lines to keep straight lines. Fill gaps between units that exceed 3/8 inch (10 mm) with pieces cut to fit from full-size unit pavers.
 - 1. When installation is performed with mechanical equipment, use only unit pavers with spacer bars on sides of each unit.
- G. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a 3500- to 5000-lbf (16- to 22-kN) compaction force at 80 to 90 Hz. Perform at least three passes across paving with vibrator. Vibrate under the following conditions:
 - 1. After edge pavers are installed and there is a completed surface or before surface is exposed to rain.
 - 2. Before ending each day's work, fully compact installed concrete pavers to within 36 inches (900 mm) of the laying face. Cover open layers with non-staining plastic sheets overlapped 48 inches (1200 mm) on each side of the laying face to protect it from rain.
- H. Spread dry sand and fill joints immediately after vibrating pavers into leveling course. Vibrate pavers and add sand until joints are completely filled, then remove excess sand. Leave a slight surplus of sand on the surface for joint filling.
- I. Do not allow traffic on installed pavers until sand has been vibrated into joints.
- J. Repeat joint-filling process 30 days later.

3.5 MORTAR SETTING-BED APPLICATIONS

- A. Saturate concrete sub-base with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.
- B. Apply mortar-bed bond coat over surface of concrete sub-base about 15 minutes before placing mortar bed. Limit area of bond coat to avoid its drying out before placing setting bed. Do not exceed 1/16-inch (1.6-mm) thickness for bond coat.
- C. Apply mortar bed over bond coat; spread and screed mortar bed to uniform thickness at subgrade elevations required for accurate setting of pavers to finished grades indicated.
- D. Mix and place only that amount of mortar bed that can be covered with pavers before initial set. Before placing pavers, cut back, bevel edge, and remove and discard setting-bed material that has reached initial set.
- E. Wet brick pavers before laying if the initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested according to ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

- F. Place pavers before initial set of cement occurs. Immediately before placing pavers on mortar bed, apply uniform 1/16-inch- (1.5-mm-) thick bond coat to mortar bed or to back of each paver with a flat trowel.
- G. Tamp or beat pavers with a wooden block or rubber mallet to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances. Set each paver in a single operation before initial set of mortar; do not return to areas already set or disturb pavers for purposes of realigning finished surfaces or adjusting joints.
- G. Spaced Joint Widths: Provide 3/8-inch (10-mm) nominal joint width with variations not exceeding plus or minus 1/8 inch (3 mm).
- I. Grouted Joints: Grout paver joints complying with ANSI A108.10.
- J. Grout joints as soon as possible after initial set of setting bed.
 - 1. Force grout into joints, taking care not to smear grout on adjoining surfaces.
 - 2. Clean pavers as grouting progresses by dry brushing or rubbing with dry burlap to remove smears before tooling joints.
 - 3. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
 - 4. If tooling squeezes grout from joints, remove excess grout and smears by dry brushing or rubbing with dry burlap and tool joints again to produce a uniform appearance.
- K. Cure grout by maintaining in a damp condition for seven days unless otherwise recommended by grout or liquid-latex manufacturer.

3.05 REPAIR, CLEANING, AND PROTECTION

- A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units as intended. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

END OF SECTION 321400

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.
 - 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 be a registered "Landscape Contractor" as defined by the NC General Statute 89D (www.ncclcb.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 (on-site, imported or both); (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. Landscape installation 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 to prove a hardship or confirm reason(s) for substitution.

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 burlapped 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 burlapped 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 insure 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 Substantial Completion dates of grassed areas of the site.
- B. Definitions:
 - 1. Substantially 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 substantial completion.
 - 2. Substantially Complete sodded grass: An installed and rolled healthy sod, free of weeds and dead spots. Required topdressing for play fields may be applied following substantial completion.
- C. Complete Site: A substantially 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) Substantial Completion: As established in the 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: Installer 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, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.
 - b. Structural failures including plantings falling or blowing over.
 - 2. Warranty Periods from Date of Substantial Completion:
 - a. Trees, Shrubs, and Ornamental Grasses: 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 substantial completion.

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: 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 remulch 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 Substantial 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.
- F. Athletic, Practice and Play Field Topdressing: Apply sterile sand or sterile sand/soil mix to established turf surface and work-in by matting, raking, and/or irrigating to produce a consistent and smooth playing surface. Repeat as needed until a proper surface with healthy turf is established.

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 burlapped 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 burlapped trees unless noted otherwise on the drawings. Plants designated "B&B" in the plant list shall be balled and burlapped. 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 burlapped coniferous evergreens.
 - 1. Container-grown coniferous evergreens will be acceptable in lieu of balled and burlapped coniferous evergreens subject to meeting ANSI Z60.1 limitations for container stock and provided they are equal in quality and size to balled and burlapped 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 burlapped broadleaf evergreens.
 - 1. Container-grown broadleaf evergreens will be acceptable in lieu of balled and burlapped broadleaf evergreens subject to meeting ANSI Z60.1 limitations for container stock and provided they are equal in quality and size to balled and burlapped 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 Bermuda Tifway-419. Provide machine cut, strongly rooted, certified turf grass sod, not less than two years old, not grown in netting, 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 1/8", 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.

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, unleached stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.
- H. Herbicides: EPA registered and approved, of type recommended by manufacturer.
- I. Water: Potable.
- J. Mycorrhizae: Applied to planting hole backfill or planting bed soil. 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 Arbortape or equivalent 3/4" 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. Antidesiccant: 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.
- B. Play / Athletic Field Topdressing: Sterile sand or sand/soil mix applied to growing turf to produce a consistent and smooth playing surface.

2.15 TACKIFIER

- A. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.
- B. Asphalt Emulsion: ASTM D 977, Grade SS-1; nontoxic and free of plant-growth or germination inhibitors. (9 gals/1,000 SF).

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, sprig or sod 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/SOD/SPRIG 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 per soil report, 2 inches of compost 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 burlapped 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 rootball 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. Any tree wrapping shall be removed and disposed of properly upon tree installation.

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 Arbortape or equivalent $\frac{3}{4}$ " 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.

1. Thickness: 3 inches (after compaction). Refer to Landscape Plan for greater thicknesses in areas where excess mulch can be spread.

NOTE: Mulch shall NOT be from on-site chipping operations.

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 substantial 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 (Horizontal:Vertical) 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 nonasphaltic 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.
- I. Topdress athletic fields as needed to establish a consistent and smooth playing surface.

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.
- 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 antidesiccant 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 antidesiccant at nursery before moving and again 2 weeks after planting.

3.16 INSPECTION AND ACCEPTANCE

- A. When landscape work is completed, including maintenance, Landscape 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 reinspected by Landscape Architect and found to be acceptable. Remove rejected plants and materials promptly from project site.

3.17 CLEANUP AND PROTECTION

- A. During landscape installation, 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

SECTION 331000- WATER SYSTEMS
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.
 - 3. Section 02660 - Cape Fear Public Utility Authority (CFPUA) Technical Specification sections.
 - a. **When project Water Systems specifications conflict with the above listed Cape Fear Public Utility Authority (CFPUA) specifications, the Cape Fear Public Utility Authority (CFPUA) specifications will take precedence, with the exception of the hydrant and valve openings that need to follow National Standards and open left.**

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 psi.

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. Meter boxes.
 - 2. Backflow preventers.
 - 3. Valves and boxes.
 - 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. Wiring diagrams for alarm devices, if applicable.

- F. Coordination drawings showing pipe sizes and valves, meter and specialty locations and elevations, if applicable. Include details of underground structures, connections, anchors, and reaction backing. Show other piping in same trench and clearances from water system piping. Indicate interface and spatial relationship between piping and proximate structures.
- G. Record drawings at Project closeout of installed water system piping and products according to Division 1.
- H. Test reports specified in "Field Quality Control" Article in Part 3.

1.5 QUALITY ASSURANCE

- A. All materials, construction methods and testing shall comply with the requirements of the Cape Fear Public Utility Authority (CFPUA) standard specifications and details. Payment of all fees and permits shall be included in the base bid.
- 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 and the Cape Fear Public Utility Authority (CFPUA). The burden of proof of equality and approval by the Cape Fear Public Utility Authority (CFPUA) of products is on the Contractor. Refer to Division 1 sections.
- 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 / Record drawings at Project closeout of installed water system piping and products meeting all requirements of the Cape Fear Public Utility Authority (CFPUA) Water & Sewer District As-Built Checklist. As-built survey shall be signed and seal by a NC Professional Land Surveyor and shall include the following:
 - 1. Name of project and owners, date, north arrow, scale.
 - 2. Surveyor's seal.
 - 3. As-built plans shall be provided on mylar sheets. A CD disk (DXF format or Auto Cad 2000 equivalent) must be provided to the County. All lettering shall be at least 0.10 inches in height. All drawings shall become the property of New Hanover County.
 - 4. All fire hydrant water valve sizes and locations with no less than two primary reference dimensions from permanent above grade features.
 - 5. Locations of bacteriological sampling points.
 - 6. Pipe materials and sizes.

7. Other water system components such as meters, backflow preventers, etc.
8. Location of air release valves, gate valves and fittings along water main.
9. Sheet numbers and number of total sheets.
10. Accurate location map and index planning map at a scale of 1 inch = 200 feet.
11. Clearly indexed cover sheet with location of plan - profile sheets on cover sheet, by sheet number.
12. C/O shown open circle, water meters open box.
13. Total linear feet on cover sheet: Water lines____, Gravity sewer____, Forcemain ____.
14. Water & sewer layers to be bolder line type than drainage, streets, etc.
15. Make contour lines very light or turnoff.

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. Obtain all necessary permits for pavement cuts, line taps, etc. from the authorities having jurisdiction. Payment of all fees and permits shall be included in the base bid.
- 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 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work are specified herein. Products by other manufacturers having equal performance characteristics may be considered, however approval must be acquired by the Contractor from the Cape Fear Public Utility Authority (CFPUA).

2.2 PIPES AND TUBES

- A. Refer to Cape Fear Public Utility Authority (CFPUA) Specifications.

2.3 PIPE AND TUBE FITTINGS

- A. Refer to Cape Fear Public Utility Authority (CFPUA) Specifications.

2.4 VALVES

- A. Refer to Cape Fear Public Utility Authority (CFPUA) Specifications.

2.5 BACKFLOW PREVENTERS

- A. General: As approved by the Underwriters Laboratories and/or the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California and the Cape Fear Public Utility Authority (CFPUA). Lead free.

2.6 IDENTIFICATION

- A. Metallic-Lined Plastic Underground Warning Tapes: Polyethylene plastic tape with metallic core, 6 inches wide by 4 mils thick, solid blue in color with continuously printed caption in black letters "CAUTION - WATER LINE BURIED BELOW."

2.7 WATER METERS

- A. Meters shall be set by Cape Fear Public Utility Authority (CFPUA). The Contractor shall coordinate installation directly with the Cape Fear Public Utility Authority (CFPUA). Contractor is responsible for all meter permits and installation fees.
- B. Meter Boxes: 18-in meter box to CFPUA standards. Meter boxes susceptible to traffic shall conform to ASTM A48, Class 30B and AASHTO H20 load rating standards.

2.8 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 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.

PART 3 - EXECUTION

3.1 GENERAL

- A. All construction shall conform to the Standard Specifications and Details of the Cape Fear Public Utility Authority (CFPUA) and the NCDOT as applicable in addition to the requirements state herein.
- B. Install pipe in strict conformance with AWWA C600. Minimum depth of bury above the top of pipe shall be 36 inches. Maximum joint deflection shall meet requirements of AWWA C600 or AWWA Manual of Practice M23.

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 at 5-feet outside face of the building wall in locations and pipe sizes indicated.
 - 1. Terminate water system piping at 5-feet outside building wall until building water systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building water systems when those systems are installed.

3.4 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.
- H. Lateral Separation of Sewers and Water Mains: Water mains shall be laid at least 10 feet laterally from existing or proposed sewers, unless local conditions or barriers prevent a 10 foot separation. In which case:
 - 1. The water main is laid in a separate trench, with the elevation of the bottom of the water main at least 18 inches above the top of the sewer; or.
 - 2. The water main is laid in the same trench as the sewer with the water main located at one side on a bench of undisturbed earth, and with the elevation of the bottom of the water main at least 18 inches above the top of the sewer.
- I. Crossing a Water Main Over a Sewer: Wherever it is necessary for a water main to cross over a sewer, the water main shall be laid at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer, unless local conditions or barriers prevent an 18 inch separation, in which case both the water main and the sewer shall be constructed of ferrous materials and with joints that are equivalent to water main standards for a distance of 10 feet on each side of the point of crossing.
- J. Crossing a Water Main Under a Sewer: Wherever it is necessary for a water main to cross under a sewer, both the water main and the sewer shall be constructed of ferrous materials and with joints equivalent to water main standards for a distance of 10 feet on each side of the point of crossing. A section of water pipe shall be centered at the point of crossing.

3.5 PIPING INSTALLATION

- A. Water Main Connection: Tap water main with size and in location as indicated according to requirements of water utility.
 - 1. Install service clamps and corporation stops in size, quantity, and arrangement required by utility company standards and according to manufacturer's installation instructions.
 - 2. Install service clamps on pipe to be tapped. Position outlet for corporation stop.
 - 3. Install corporation stops into service clamps. Install valve with stem pointing up and with cast-iron valve box.
 - 4. Install curb stop in service piping with head pointing up and with cast-iron service box.
 - 5. Install manifold for multiple taps in water main.

6. Use drilling machine compatible with service clamp and corporate stop. Drill hole in main. Remove drilling machine and connect water service piping.
- B. Install copper tube and wrought-copper fittings according to CDA No. 404/0 "Copper Tube Handbook."
- C. Bury piping at minimum depth of 3 feet below finished subgrade and not less than 18 inches below average local frost depth.
- D. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.
- E. Shoring or bracing of pits, trenches and other excavations shall be in accordance with the requirements of NCDOT and OSHA.
- F. 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.
- G. 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.
- H. 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.

3.6 ROUGHING-IN FOR WATER METERS

- A. Install roughing-in piping and specialties for water meter installation as indicated on the Drawings and according to Cape Fear Public Utility Authority (CFPUA) requirements.

3.7 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.

3.8 IDENTIFICATION INSTALLATION

- A. Install continuous plastic underground warning tape during back-filling of trench for underground water service piping. Locate 6 inches to 8 inches below finished grade, directly over piping.

3.9 FIELD QUALITY CONTROL

- A. General: All materials shall be inspected by the Cape Fear Public Utility Authority (CFPUA) inspector prior to installation. The Contractor shall furnish all materials, labor and equipment to perform all testing and inspections.

- B. Where any section of a water line is provided with concrete thrust blocking, the hydrostatic test shall not be made until at least 5 days after installation of the concrete thrust blocking unless otherwise approved. The method proposed for disposal of wastewater from hydrostatic tests and disinfection shall be submitted to the Owner's representative prior to performing hydrostatic tests. Use clean potable water for all testing of lines.
- C. Pressure Test: Pressure test in strict conformance with AWWA C600, Section 4.1. For purposes of testing, working pressure shall be 100 psi and test pressure shall be 150 psi.
- D. Leakage Test: Test for leakage concurrent with the pressure test and in strict conformance with AWWA C600, Section 4.2, Table 6 Allowable Leakage per 1000 ft (305 m) of Pipeline. Remedy all visible leaks and locate and repair leakage in lines which exceed the specified amounts..
 - 1. Failure of the water main to comply with the above acceptable leakage rate, shall require the contractor to replace any defective materials to insure a watertight installation. After any inadequacies have been corrected, the leakage rate shall again be tested. The test shall be repeated until that portion of the main is brought into compliance with the permissible leakage rate. All visible leaks shall be repaired regardless of amount of leakage.
- E. Disinfection: Hydrostatic tests and disinfection may be conducted concurrently, using the water treated for disinfection to test the lines. If water is lost during the test procedure and air is admitted to the pipeline, or if any repair procedure results in contamination of the unit, disinfection shall be reaccomplished. Disinfection procedures shall be in strict conformance with AWWA C601, or latest revision, except as specified herein
 - 1. Take extra care to prevent contamination during installation, as specified in AWWA C601, Section 4 or latest revision.
 - 2. Thoroughly flush each segment of the system with clean, potable water, obtaining a minimum velocity of 2.5 fps for a period of 10 minutes, or until the line is free of particulates.
 - 3. Chlorination: Introduce chlorinated water into the main in such volume and concentration as to achieve a chlorine concentration of 50 ppm throughout the system. Operate all valves. Perform a chlorine residual test at each blow-off or sample tap to verify concentration. Allow the chlorinated water to sit for 24 hours, then flush the mains to achieve a chlorine concentration of not more than 2.0 ppm.
 - 4. Testing: Upon completion of disinfection procedures, a sample will be taken at each blow-off or test point in the system, and sent to an approved laboratory for bacteriological testing. Samples will be taken in the presence of the Owner's Representative and tests shall be paid for the Contractor. Should the tests indicate the presence of bacteria, the system or affected segment shall be flushed, chlorinated, and retested as specified at no cost to the Owner.
- F. Flushing:
 - 1. Flushing of lines may only proceed after 24 hours of disinfection contact time and as directed by Town staff, provided the free residual chlorine analysis is satisfactory.
 - 2. At the completion of disinfection, chlorinated water flushed from the water main shall be disposed of in conformance with all Federal, State and local regulations.
 - 3. In accordance with all applicable regulations, a neutralizing chemical shall be applied to minimize chlorine residual in the flushing water before discharging from the water main, unless an alternate plan is submitted in writing and approved by the Town.
 - 4. Water used for disinfection shall be flushed from the water main until the chlorine residual concentration is below 5-ppm before initiating sampling.

G. Bacteriological and Turbidity Sampling

1. Refer to Cape Fear Public Utility Authority (CFPUA) Specifications.

H. Backflow Prevention Device Certification

1. All new or relocated backflow prevention devices shall be tested and certified by a licensed inspector 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.

I. 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 00- SANITARY SEWERAGE

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 31 Section "Cast-in-Place Concrete" for cast-in-place concrete structures.
 - 2. Section 02731 - Cape Fear Public Utility Authority (CFPUA) Technical Specification sections:
 - a. When project Sanitary Sewerage specifications conflict with the above listed Cape Fear Public Utility Authority (CFPUA) specifications, the Cape Fear Public Utility Authority (CFPUA) specifications will take precedence.

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.

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 Appurtenances.
- C. 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 Cape Fear Public Utility Authority (CFPUA) standard specifications and details. Payment of all fees and permits shall be included in the base bid.
- B. Utility Compliance: Comply with regulations pertaining to sanitary sewerage systems. Include standards of water and other utilities where appropriate.

- 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 "Product Substitutions."
- 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.
- E. As-Built Survey / Record drawings at Project closeout of installed sewer system piping and products meeting all requirements of the Cape Fear Public Utility Authority (CFPUA). As-built survey shall be signed and seal by a NC Professional Land Surveyor and shall include the following:
 - 1. Name of subdivision and owners, date, north arrow, scale.
 - 2. All inverts into and out of manholes shall be field verified to 1/100 ft.
 - 3. Surveyor's seal.
 - 4. Plans shall show stubs for individual services. Cleanouts (C.O.'s) shall be located by measuring from each manhole along the sewer main up stream to a point which lies on a line that is perpendicular to the sewer main and connects said point and C.O. – zero point shall be the immediate downstream manhole, i.e., 127/14R. No stations shall be used.
 - 5. Show approximate vertical and horizontal separations of sewer mains to proposed or existing utilities and structures.
 - 6. For each sewer reach, show pipe diameter, length, type, slope, existing surface elevations and proposed finish grades. Show station or distance to beginning and end of change in pipe material.
 - 7. Show all water supply wells within 50' & community wells within 100' of sewer main.
 - 8. Show manhole top elevation & flood elevation or surface water flow levels @ each MH.
 - 9. Elevations shall be tied to mean sea level. Indicate any benchmarks within project area.
 - 10. As-built plans shall be provided on mylar sheets. A CD disk (DXF format or Auto Cad 2000 equivalent) must be provided to the County. All lettering shall be at least 0.10 inches in height. All drawings shall become the property of New Hanover County.
 - 12. Lot numbers, lot lines and street names.
 - 13. Sheet numbers and number of total sheets.
 - 14. Indicate size of services greater than 4".
 - 15. Indicate manhole service taps, service casing &/or material transition.
 - 16. Manhole sewer monuments, if manhole is buried.
 - 17. Accurate location map and index planning map at a scale of 1 inch = 200 feet.
 - 18. Clearly indexed cover sheet with location of plan - profile sheets on cover sheet, by sheet number.
 - 19. Reference ties into existing sewer systems by title and page of as-built drawing for existing system. County will assist with obtaining this information, (i.e. existing manhole-number C.72.A, Howes Creeks, Phase II, Contract H, Page 36 or 65). Show information on plan-profile sheet and cover sheet.
 - 20. County note on all plan & profile sheets.
 - 21. C/O shown open circle, water meters open box.
 - 22. Total linear feet on cover sheet: Water lines____, Gravity sewer_____, Forcemain_____
 - 23. Water & sewer layers to be bolder line type than drainage, streets, etc.
 - 24. Make contour lines very light or turnoff.

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 utility company's sanitary sewer. Obtain all necessary permits for pavement cuts, line taps, etc. from the authorities having jurisdiction.
- B. Coordinate force main connection to existing force main with Owner.
- C. Coordinate with interior building drainage systems.
- D. Coordinate with other utility work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work are specified herein. Products by other manufacturers having equal performance characteristics may be considered, however approval must be acquired by the Contractor from the Cape Fear Public Utility Authority (CFPUA).

2.2 PIPES AND FITTINGS

- A. Refer to Cape Fear Public Utility Authority (CFPUA) Specifications.

2.4 CLEANOUTS

- A. Refer to Cape Fear Public Utility Authority (CFPUA) Specifications.

2.5 MANHOLES

- A. Refer to Cape Fear Public Utility Authority (CFPUA) Specifications.

PART 3 - EXECUTION

3.1 GENERAL

- A. All construction shall conform to the Standard Specifications and Details of the Cape Fear Public Utility Authority (CFPUA) 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 2 Section "Earthwork." 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.

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 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. 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.
- E. Extend gravity sewerage piping and connect to building's sanitary drains, of sizes and in locations indicated. Terminate piping as indicated.
- F. Install gravity sewerage piping pitched down in direction of flow, at minimum and cover as indicated.

- G. 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. PVC Gravity Sewer Pipe and Fittings: Join pipe and gasketed fittings with gaskets according to ASTM D2321 and manufacturer's written instructions.

3.7 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 with tops 1 inch above surrounding earth grade.
- C. Set cleanout frames and covers in concrete paving with tops flush with surface of paving.
- D. Set cleanout box on 4-inches of washed stone.

3.8 MANHOLE INSTALLATION

- A. General: Manholes shall be constructed of precast concrete rings in accordance with the Drawings. The precast concrete base shall be placed on a six inch (minimum) stone bedding foundation which shall extend up around the pipes to at least 3 inches above the top line of the pipes. The stone bedding shall be considered as incidental to the unit price bid for the installed manhole. Pipes entering the precast sections of the manhole shall be inserted into the adaptor couplings provided. All precast manhole components shall be lifted and moved by use of suitable lifting slings and plugs that will not damage the precast manhole lip. All damage to precast sections shall be thoroughly repaired in the presence of the Engineer. Repair and patching of minor breaks shall be done by chipping and scarifying the defective area before application of grout. Precast sections shall be subject to rejection on account of failure to conform to any of the specification requirements. In addition, individual sections of manhole sections may be rejected because of fractures or cracks passing through the wall, except for a single end crack that does not exceed the depth of the joint; defects that indicate imperfect proportioning, mixing, and molding; surface defects indicating honey-combed or open texture; damaged or cracked end, where such damage would prevent making a satisfactory joint; and/or any continuous crack having a surface which width of 0.01 inches or more and extending for a length of 12 inches or more, regardless of position in the section wall.
- B. The Contractor is responsible for getting the manhole tops to proper grade. Profiles on the plans are for cost estimates only. The top of the precast manhole may be brought to proper grade for receiving manhole frames by using brick with a maximum adjustment of 12 inches from precast cone to the cast iron ring. Masonry construction shall be preformed by experienced and qualified workmen. All

work shall be laid plumb, straight, level, square, and true. The Contractor shall set and bond the manhole frame in a full bed of mortar. All manhole steps and miscellaneous items shall be properly bedded. The masonry walls shall be parged on the inside and outside with a ½-inch coat of Type S mortar.

1. Wedging or the placing of the shims to secure proper level will not be used in setting of manhole sections. Manholes located in unpaved roads shall be constructed with top of lid located 8 inches below road surface and a concrete reference marker shall be placed at the adjacent right of way line.
- C. Invert Channels: The invert channels shall be 3/4 the depth of the largest pipe and shall be smooth and semicircular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of channels shall be made gradually and evenly. The invert channels shall be formed directly in the concrete of the manhole base or shall be built up with solid brick and Type S mortar.
1. All upstream pipes (including services) shall have sloped invert channel slides that provide smooth transitions to the downstream invert channel. Invert channel slides shall be the diameter of the entering pipe and be formed as a channel that is at least 3/4 pipe deep. Upstream pipes that enter at the shelf shall have their invert channel slides smoothly cast into the shelf with a sloping transition to the downstream pipe invert.
 2. The floor of the manhole outside the channels, or slides, shall be smooth and shall slope toward the channels not less than 1 inch per foot nor more than 2 inches per foot. No laser bowl invert manholes shall be permitted.
- D. Grade Rings: Manhole castings shall be installed to grade using 24 inch inside diameter precast concrete grade rings, or brick grouted in place, for a maximum adjustment of 12 inches. Manhole sections shall be used for greater adjustment, unless approved otherwise. Flat top manholes shall not be adjusted by more than one course of brick.
- E. Drop Manholes: Inside drop only with minimum 5' diameter. Where sewer lines enter on a grade 30 inches or more above the invert of the discharge line, a drop manhole shall be constructed as directed by the Engineer. The drop or drops, shall be constructed in accordance with the Standard Detail, as shown on the plans, of 316 stainless steel or better excluding pipe with intermediate supports on 30-inch spacing as required.

3.9 IDENTIFICATION INSTALLATION

- A. Install continuous plastic underground warning tape during back-filling of trench for underground water service piping. Locate 6 inches to 24 inches below finished grade, directly over piping.

3.10 FIELD QUALITY CONTROL – GRAVITY SEWER

- A. General: The Contractor shall be responsible for providing all equipment necessary for tests of displacement, deflection, and leakage. Tests for deflection and leakage shall be performed by the Contractor and observed by the Owner's representative. Each segment of line shall be tested after 30 days prior to final acceptance of the project if required and in any event, all segments of main and all services shall be cameraed in the presence of the District's representative at no cost to the District. The camera inspection must be performed upon completing of cleaning and potable water introduced into the system to be tested. All defects in the pipeline and appurtenances shall be remedied by the Contractor at no additional expense to the District or New Hanover County and will be reinspected as

outlined above. Acceptance of any deviation from these requirements is at the sole discretion of the District.

- B. Test for Displacement of Sewers: Sewer mains will be checked by the Owner's representative to determine whether any displacement of the pipe has occurred. The test will be as follows: A light will be flashed between manholes, by means of a flashlight or by reflecting sunlight with a mirror. If the illuminated interior of the pipeline shows poor alignment, displaced pipe, or any other defects, the defects shall be remedied by the Contractor. Water will be introduced into the pipe to aid in detection of defects. The owner may choose to re-inspect the pipe at its discretion, using all appropriate tests including inspecting the pipes by using a closed-circuit television camera. Any observed leakage shall be repaired, regardless of leakage rate. Acceptance of any deviation from these requirements is at the sole discretion of the District.
- C. Test for Deflection: Deflection tests may be performed on all sections of flexible pipe.
 - 1. Maximum allowable deflection shall be 5 percent at any point.
 - 2. Deflection shall be measured with a pin-type mandrel "Go/No Go" gauge. The gauge shall be pulled through the pipe by means of a strong cord or cable.
 - 3. Any section of pipe not meeting the 5 percent maximum deflective requirement shall be excavated, backfilled, recompacted and retested.
- D. Test for Leakage: All segments of completed line may be tested for leakage by low pressure air test, except that the infiltration test may be used as approved by the Owner's representative. The County may choose to camera the pipe. Acceptance of any deviation from these requirements is at the sole discretion of the District.
 - 1. The Contractor shall remedy all visible leaks in pipes, manholes, and appurtenances.
 - 2. Maximum allowable leakage for the system shall be 0 gallons per inch pipe diameter per linear mile of pipe per 24 hours, including manhole infiltration. No single segment of line (manhole to manhole) shall exceed this requirement.
 - 3. Air Testing: Air testing shall be required if, in the sole opinion of the Cape Fear Public Utility Authority (CFPUA), conditions are such that infiltration measurements may be inconclusive. The test shall be conducted in the presence of the County Engineer and shall conform to the following requirements:
 - a. Test pressure shall be 3.5 psi increased by the ground water pressure above the top of the sewer.
 - b. Pressure loss from 3.5 psi shall not exceed 0.5 psi during the required testing time.
 - c. Testing time in minutes shall be calculated as $0.625 \times \text{nominal pipe size (inches)}$.
- E. Test Results: Certified copies of all test results shall be furnished to the Owner and the Owner's representative within 1 week after the test.
- F. Repairs: Make all necessary repairs to bring new sewer into compliance with test requirements.

END OF SECTION 33 30 00

SECTION 333200 – 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.
 - 5. Force main piping.
- B. Related Sections: The following Sections contain requirements that relate to this Section.
 - 1. Division 16 Sections for electrical work including backup generator.
 - 2. Division 31 Section “Earth Moving” for excavation and backfill.
 - 3. Division 33 Section “Sanitary Sewerage Utilities” for sewer pipes and appurtenances.
 - 4. Section 02732 Section 02732 – Cape Fear Public Utility Authority (CFPUA) Technical Specification sections.

When project Sanitary Sewerage specifications conflict with the above listed Cape Fear Public Utility Authority (CFPUA) specifications, the Cape Fear Public Utility Authority (CFPUA) specifications will take precedence.

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. Discharge pipe and fittings.
 - c. Control panel and alarm.
 - d. Wet well, tanks and vaults.
 - e. Hatches and castings.
 - f. Valves.
 - g. Control panels.
 - h. Alarms.
 - i. Telemetry system.
 - j. Lift out rail system.
 - k. Level control system.
 - l. Force main piping, fittings, valves and appurtenances.
 - m. Other items specified in this section.
- 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. Documents shall include the following:
1. Cover Sheet listing the following: Pump manufacturer; source of repair parts, complete with address and phone number; operating conditions - rated capacity and TDH of each pump; model number, serial number, impeller diameter of each pump; all data plate information from each pump motor; data on all other equipment included as components in the pump station;
 2. Pump Performance Design Curve with operating conditions indicated on it; also manufacturer's Certified Pump Curve for each pump.
 3. Detailed dimensional drawings of the pump and pump base elbow;
 4. Detailed dimensional drawings of the pump and pump motor;
 5. A wiring diagram and logic diagram for each control panel;
 6. Pump and Motor Installation and Service Manual;
 7. Detailed information related to other components of the pump station, including but not limited to, generator, automatic transfer switch, and hoist system;
 8. Warranty letter;
 9. Copy of vendor reports for the start-up testing of their equipment;
 10. Warranties: In addition to the Town's required standard one year workmanship and materials warranty, the following shall apply: The Contractor shall warrant all pump station equipment for one year from the date of beginning of one year warranty of the pump station, as identified in the Letter of Acceptance for the pump station. The Town reserves the right to make necessary emergency repairs and/or perform work necessary in emergency situations within this warranty period. The Contractor shall be responsible for reimbursement costs associated with any such work. If a non-emergency repair or other work becomes necessary within the warranty period, the Town shall provide written notice to the Contractor of need for such work. If the work is not completed within the time frame specified in the written notice, the Town shall undertake the work and the Contractor shall be responsible for reimbursing those costs.

1.6 QUALITY ASSURANCE

- A. All materials, construction methods and testing shall comply with the requirements of the Cape Fear Public Utility Authority (CFPUA) Standards and Details. The Contractor is required to obtain a copy of the Standards for reference during construction and advise the Architect if conflicts with the Contract Documents are discovered. For bidding purposes, the more stringent specification shall apply.
- B. 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. Pumps and motors shall be manufactured by ISO-9001 certified companies only.
- C. 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.
- D. All products and construction associated with pump station shall be warrantied against defects in material and workmanship for at least one year from date of final acceptance.
- E. 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.
- F. Perform As-Built Survey of installed force main piping and products. As-built survey shall be signed and seal by a NC Professional Land Surveyor and shall include the following:
1. Pipe locations, materials and sizes.
 2. Air release valves.
 3. Tie-in manholes and inverts.
 4. Pump station wet well and valve vault.
- G. No connection shall be made to the existing sewer system unless and until the Contractor has obtained all necessary approvals from the Cape Fear Public Utility Authority (CFPUA).
- H. Connections shall be made by approved methods and in accordance with the Cape Fear Public Utility Authority (CFPUA) Standards and Details.
- I. No pipe shall be opened until the new system is complete, tested and approved in accordance with the Cape Fear Public Utility Authority (CFPUA) Standards and Details.
- 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 PIPES AND FITTINGS

- A. Refer to Cape Fear Public Utility Authority (CFPUA) Specifications.

2.2 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 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

2.3 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.

2.4 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.

2.5 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.

2.6 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".

2.7 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.

2.8 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.
- Q. Panel Mounting Rack: The control panel, auto-transfer switch and main disconnect shall be mounted on a steel rack with aluminum rain shield. The rack shall be constructed of galvanized steel posts and struts of sufficient size and strength to accommodate the weight of the panels and rain shield.

2.9 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 analog phone line from the adjacent building. 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).
- B. Telephone Service: Contractor shall schedule, coordinate and pay all costs associated with installation of a new telephone service and RJ-11C jack at the pump station site by the local phone utility provider to serve the alarm dialer. All cost associated with establishment of service and installation of line from the street to the pump station, other than regular monthly phone charges, shall be paid by the Contractor and included in the Base Bid.

2.10 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.

2.11 WET WELL

- A. Pump station shall be provided as a package unit within a 48" diameter fiberglass basin. The wetwell shall 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 and check 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.

2.12 IDENTIFICATION

- A. Metallic-Lined Plastic Underground Warning Tapes: Polyethylene plastic tape with metallic core, 6 inches wide by 4 mils thick, solid blue in color with continuously printed caption in black letters "SEWER FORCE MAIN."
- B. Tracer Wire: Tracer Wire: Continuous and uninterrupted, 10-gauge insulated wire blue in color with Rhino Tri-View Markers to provide access to tracer wire.

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.
4. Results of all tests shall be documented and submitted to the Engineer.

END OF SECTION 33 32 00

SECTION 33 40 00 - 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 01 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 "Erosion Controls."
 - 3. Division 03 Section "Cast-In-Place Concrete."
 - 4. Division 22 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 01 Specification Sections.
- B. As-Built Survey / Record drawings at Project closeout of installed drainage system piping and basins. As-built survey shall be signed and seal by a NC Professional Land Surveyor and shall include the following:
 - 1. All basin 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.

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 01 Section "Products."

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.

- E. High Density Polyethylene (HDPE) Pipe and Fittings: AASHTO M252, M294, MP6, or MP7. Smooth interior and corrugated exterior. All sizes shall conform to the AASHTO classification Type S or D. N-12 or N-12HC by ADS or approved equal.
 - 1. Standard Joints: Silt-tight, rubber gasket, ASTM F477, bell and spigot.
 - 2. Watertight Joints: Watertight per ASTM D3212, AASHTO M294, MP6 or MP7, bell and spigot, rubber gasket, ASTM F477.
 - 3. 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 slotted 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 fabric composed of high-quality polypropylene filaments and designed for filtration applications with an Apparent Opening Size of no smaller than #40 US std. sieve size (ASTM D-4751).

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 manufactured 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. 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.
 - 4. Grout for Pond/Wetland/BMP Installations: ASTM C1107, non-shrink, hydraulic cement grout.
- 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. Floor Drains: 12-inch diameter 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.

2.4 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.

2.5 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.

2.6 FOUNDATION DRAIN PIPING

- A. Foundation and Under Slab Drain Pipe and Fittings: ASTM D-1785, SCH 40 PVC with slotted perforations located in bottom half of pipe. Minimum 4-inch diameter unless otherwise indicated on the drawings.

- 1. Filter Fabric: Non-woven geotextile drainage fabric per Division 31, Section "Earth Moving."

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. Light Duty: In earth or grass, foot-traffic areas.
 - 2. Medium Duty: In paved, foot-traffic areas.
 - 3. Heavy Duty: In vehicle-traffic service areas.
 - 4. Extra Heavy Duty: In roads.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Division 31, Section "Earth Moving."

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 materials, 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.
- 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 irregardless of pipe location.
 - 3. Excessive groundwater necessitates dewatering. Pipe will float in standing water, requiring immediate haunching and initial backfill to hold line and grade.
 - 4. 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 INSTALLATION

- A. Construct catch basins 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 31, Section "Earth Moving."

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